

Managing Chronic Disease in Ontario Primary Care: The Impact of Organizational Factors

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ABSTRACT

PURPOSE New approaches to chronic disease management emphasize the need to improve the delivery of primary care services to meet the needs of chronically ill patients. This study (1) assessed whether chronic disease management differed among 4 models of primary health care delivery and (2) identified which practice organizational factors were independently associated with high-quality care.

METHODS We undertook a cross-sectional survey with nested qualitative case studies (2 practices per model) in 137 randomly selected primary care practices from 4 delivery models in Ontario Canada: fee for service, capitation, blended payment, and community health centers (CHCs). Practice and clinician surveys were based on the Primary Care Assessment Tool. A chart audit assessed evidence-based care delivery for patients with diabetes, congestive heart failure, and coronary artery disease. Intermediate outcomes were calculated for patients with diabetes and hypertension. Multiple linear regression identified those organizational factors independently associated with chronic disease management.

RESULTS Chronic disease management was superior in CHCs. Clinicians in CHCs found it easier than those in the other models to promote high-quality care through longer consultations and interprofessional collaboration. Across the whole sample and independent of model, high-quality chronic disease management was associated with the presence of a nurse-practitioner. It was also associated with lower patient-family physician ratios and when practices had 4 or fewer full-time-equivalent family physicians.

CONCLUSIONS The study adds to the literature supporting the value of nurse-practitioners within primary care teams and validates the contributions of Ontario's CHCs. Our observation that quality of care decreased in larger, busier practices suggests that moves toward larger practices and greater patient-physician ratios may have unanticipated negative effects on processes of care quality.

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INTRODUCTION

Chronic health conditions are a substantial challenge to global health.¹ By 2020 they will account for 73% of all deaths and 60% of the global burden of disease.²⁻⁵ Canada's experience matches that of much of the developed world, where in the next decade deaths caused by chronic diseases will increase by 15%.⁶ The growing burden of chronic diseases threatens the sustainability of health care systems.^{7,8} In the United States, for example, the annual economic effect on the US economy of the most common chronic diseases is more than \$1 trillion and could reach nearly \$6 trillion by the middle of the century.⁴ Canada stands to lose \$9 billion in the next decade from premature deaths caused by heart disease, stroke, and diabetes.⁶

Policy makers have become increasingly interested in the potential of high-quality primary care to help deal with the chronic disease challenge. Primary care is well positioned to have an important impact on outcomes of care for patients with chronic conditions.⁹ There are, however, important variations in the delivery of chronic disease management programs and services in primary care.^{10,11} Recent studies suggest that the way chronic disease management is delivered in general practice is highly influenced by organizational factors.^{12,13} Various studies have suggested that high-quality chronic disease management can be promoted by financial incentives, capitated payment structures, improved Internet technology infrastructure, and the wider use of nonmedical health care professionals.¹⁴⁻¹⁶

In Canada, several provinces are in the process of redesigning their primary care system with the clear purpose of improving chronic illness care.¹⁰ This report

originates from a mixed methods study, Comparison of Models of Primary Health Care in Ontario, funded by the Ontario Ministry of Health and Long Term Care. The study was designed to describe and compare the structure and process of care within 4 primary health care delivery models in Ontario, Canada: fee for service (FFS), family health networks (FHNs), health service organizations (HSOs), and community health centers (CHCs).¹¹ From 2004 through 2006 practices operating within these 4 models were responsible for delivering primary care to most of the Ontario population. Table 1 displays these models, as well as the family health groups (FHGs) to which most practices in the FFS group eventually transitioned, and their essential characteristics.¹⁷⁻¹⁹

In this article we address 2 questions: (1) does chronic disease management differ between the 4 models of primary health care delivery in Ontario, and

Table 1. Comparing the Features of the Models in 2005-2006

Characteristic	Community Health Center (CHC)	Fee for Service (FFS)	Family Health Groups (FHG) ^a	Family Health Network (FHN)	Health Service Organization (HSO)
Year introduced	1970s	–	2004	2001	1970s
Group size	Group practice, size unspecified	1 Physician	Minimum 3	Minimum 3	Minimum 3
Physician remuneration	Salary	FFS	FFS and incentives	Capitation ^b with a 10% FFS component, and incentives	Capitation ^b and incentives
Patient enrollment	Required No roster size limit	Not required	Required No roster size limit	Required Disincentive to enroll >2,400 ^c	Required Disincentive to enroll >2,400 ^c
Access	No specified requirements	No specified requirements	THAS Extended hours ^e	THAS Extended hours ^d Access bonus ^e	THAS Extended hours ^d Access negation ^f
Multidisciplinarity ^g	Extensive	None	None	Some	Some
Assistance for information technology	Some	None	None	Yes	None
Objectives/priorities	Responsiveness to population needs, multidisciplinary, prevention, focus on underserved, community governed ¹⁸	–	Accessibility ¹⁹	Accessibility, comprehensiveness, doctor-nurse collaboration, use of technology	Responsiveness to population needs, multidisciplinary, health promotion, cost effectiveness ²⁰

Adapted from <https://www.oma.org/PC/PCRComparisonJan0807.pdf> (PCRComparisonJan0807.pdf).

THAS = Telephone Health Advisory Service, a patient telephone advisory system for which physicians are required to provide on-call services 24 hours a day, 7 days a week.

^a Late in 2004, the Ontario Ministry of Health (MOH) created a new model of care, the FHG, to which FFS practices could transition. A family health group (FHG) is a collaborative comprehensive primary care delivery model involving 3 or more physicians practicing together. These physicians need not be located in the same physical office space, but must be within reasonable distance of each other. FFS practices converted to this new model quickly, so that by early 2006 most FFS practices had become FHGs, and it became evident that the great majority would transition by the year end.

^b Under capitation remuneration, family physicians received a fixed monthly fee per patient enrolled, independent of the number of visits made to the practice by that patient. The capitation fee is based on the enrolled patient sex and age. FHN physicians receive an additional 10% of the FFS structure for each visit. The latter is intended to allow better monitoring of services delivered. In 2008 all HSO were converted to family health organizations. Under that model, the practices today also receive 10% of the FFS structure for each visit.

^c The base capitation rate is reduced to 50% for patients enrolled to a clinician with a practice size exceeding 2,400.

^d Each physician is required to provide at least 1, 3-hour session outside regular hours (evening/weekend) per week (up to 5 sessions per group/network/organization).

^e An incentive bonus reduced in relation to number of visits patients make to nonspecialists outside the FHN.

^f A penalty incurred from the capitation fee for visits patients make to nonspecialists outside the FHN. Today, HSO practices are eligible for the access bonus are not subject to negation.

^g Multidisciplinarity refers to the presence of allied health professionals (eg, physiotherapist, social worker, and pharmacist), excluding nursing staff, but including nurse-practitioners.

(2) what practice-based organizational factors are associated with high-quality chronic disease management.

METHODS

Design

Ours was a cross-sectional study with a concurrent nested qualitative component. The study was set in primary care practices in Ontario between October 2005 and June 2006. Data were gathered from primary care practices, clinicians (family physicians and nurse-practitioners), and patients (surveys and chart abstractions) receiving care at these practices. The study was approved by the Ottawa Hospital Research Ethics Board.

Sample

We aimed to recruit 35 practices of each model from a sampling frame that included all known and eligible FHNs (94), CHCs (51), and HSOs (65) in the province. The FFS sampling base comprised 155 randomly selected practices from a list of 1,884 practices. Eligible practices were required to have offered comprehensive primary care services for adults, have belonged to their respective model for at least 1 year, and have at least 50% of their primary care clinicians consent to the study.

The patient sample for chart review was obtained from a random sample of 30 charts in each practice. We included charts of patients aged 17 years or older

who had been a patient of the practice for more than 2 years and had visited the practice in the year before the chart review. For the qualitative case study, we purposefully selected 2 typical practices per model. In each practice, we conducted semi-structured interviews with between 1 and 4 family physicians in each practice. In the 2 CHCs and HSOs we also interviewed nurse-practitioners. Finally, 6 of the 50 randomly selected patients who completed a patient questionnaire at each site were also interviewed.

Instruments

Three instruments comprised the data sources for this study. A clinician questionnaire (appropriate for family physicians and nurse-practitioners) and a practice questionnaire were modified from the clinician survey tool of the Primary Care Assessment Tool (PCAT)-Adult edition, original and abridged versions.²⁰ These questionnaires contained items eliciting sociodemographic information about the clinicians and descriptive information about the practice environment (including the team structure, setting, hours of operation, availability of medical and social services in the surroundings, and use of information technology). A chart abstraction tool comprised patient demographic data (age, sex, and insurance status) with a series of items assessing evidence-based care delivery for diabetes, congestive heart failure, and coronary artery disease, as well as intermediate outcomes for diabetes and hypertension.

Evidence-based indicators were based on the most

recent guidelines for the management of these conditions and are shown in Table 2.²¹⁻²⁷ Disease-specific composite scores were calculated for each patient with a diagnosis of diabetes, coronary artery disease, or congestive heart failure as the sum of each indicator value divided by the number of indicators evaluated for that condition. An overall chronic disease management score was computed as the average of individual disease-specific composite scores for each patient. This score constituted the primary outcome measure for the study. Two secondary outcome measures represented intermediate clinical outcomes relating R clinical targets for diabetes (HbA_{1c}) and hypertension.

Sample size calculation for the larger study was based on

Table 2. Indicators Individually Reported

Maneuvers	Diabetes ^{21,22}	CAD ^{23,24}	CHF ^{25,26}	Hypertension ²⁷
Foot examination in previous 2 years	X ^a			
Eye examination in previous 2 years	X ^a			
ACEI/ARB in previous 2 years	X ^a		X ^a	
2 HbA _{1c} tests in the previous 1 year	X ^a			
Target blood pressure in past 6 months ^b				X
Average blood pressure in past 6 months				X
Aspirin in previous 2 years		X ^a		
β Blocker in previous 2 years		X ^a	X ^a	
Statin in previous 2 years		X ^a		
Target HbA _{1c} (<7.0%)	X			
Average HbA _{1c}	X			

ACEI/ARB = angiotensin-converting enzyme inhibitor/angiotensin receptor blockers; HbA_{1c} = hemoglobin A_{1c}.

^a Used to calculate disease score. Scoring method: the chronic disease management score is calculated for patients suffering from at least 1 of the chronic diseases listed above. Each eligible condition's maneuvers are assigned a 1 if the maneuver was followed (or 0.5 if HbA_{1c} test in the previous year was done only once rather than twice) or a 0 if it was not. For each condition the ratio of maneuvers followed is estimated. Finally, a simple (not weighted) average of the applicable condition scores is calculated to obtain the patient's chronic disease management score.

^b Target blood pressure for patients with diabetes is set at 130/80 mm Hg and 140/90 mm Hg for other patients.

the ability to detect a difference in another outcome measure: disease prevention. The study was powered to detect a difference of 0.5 standard deviation in the disease prevention score, with an intraclass correlation of 0.2, an α value of .05, and a β value of 0.20. Power analysis was performed for the overall chronic disease management.

The chronic disease management score was computed through use of the G-power program (a free statistical program developed by Franz Faul, Uni Kiel, Germany: <http://www.psych.uni-duesseldorf.de/abteilungen/aap/gpower3/>). We calculated the difference between models that could be detected with an 80% power to be 12%.

Data Analysis

Data were analyzed using SPSS-PC version 15.0 (SPSS Inc, Chicago, Illinois). The unit of analysis was the model for the first question (comparing the models) and the practice for the second question (ascertaining organizational factors associated with better chronic disease management.)

Description of the Models

Descriptive profiles of the models' characteristics assessed intermodel variability. Patient, clinician, and practice factor associations with the chronic disease management score were evaluated individually using linear regression analyses. Linearity of continuous variables was verified.

Comparison of Models

Differences in the models' chronic disease management scores were first assessed through analyses of variance. Linear and logistic regressions were used to examine individual indicators and secondary clinical outcomes. To adjust for the influence of patient and clinician characteristics on the models' differences in score, 2 separate multiple linear regressions were performed (each controlled for patient characteristics and rurality; the second added a control for clinician characteristics).

Organizational Factors

Organizational factors (clinician and practice characteristics) associated with performance of chronic disease management were identified by applying multiple linear regression analysis with forward selection (entry of $P = .10$ and exit of $P = .15$) while controlling for patient characteristics. To evaluate the transferability of associations across models, the findings were applied to each model individually.

For the qualitative analysis, interviews were tape-recorded, transcribed verbatim, then coded and analyzed with the support of N6 software.²⁸ We used a

coding tree informed by the literature on primary care organizations, which was then refined through an iterative process using an open coding strategy.²⁹ Subsequent analysis involved axial and selected coding to explore interconnections between existing categories and sub-categories.³⁰ Finally, we used an immersion/crystallization approach³¹ to identify and articulate the themes and patterns emerging from the empirical dataset.

RESULTS

Practice and patient survey response rates ranged between 23% to 69% and 74% to 85%, respectively. Secondary analysis of province-wide health administrative databases showed that the physicians from each model participating in the study were similar to all physicians practicing in that model in Ontario. Four practice patterns could also be evaluated in FFS and FHN practices. These patterns were found to differ by less 25% in 7 of 8 comparisons (results not shown).

Descriptive and Bivariate Analyses

Data were collected from 137 practices and 363 health clinicians. We interviewed 46 clinicians and 22 patients. Among the 4,108 patients included in the chart abstractions, 514 (12.5%) had at least 1 chronic condition and are included in the chronic disease management score. A further 899 charts were included from patients with hypertension.

Table 3 displays the models in terms of patient, clinician, and practice characteristics and indicates bivariate association with the chronic disease management score. Adherence to recommended care was 6% higher in men. Performance increased with age until approximately 65 to 70 years, after which it dropped (data not shown).

Comparison of Models

After we adjusted the regression analysis for potential confounding factors, CHCs had higher overall performance of chronic disease management (by 10% to 15%), a result largely explained by their better performance in evidence-based processes associated with diabetic care (Table 4). No differences between models were detected for the clinical intermediate outcomes except for diastolic blood pressure readings, which were significantly lower in HSO patients.

Organizational Factors Associated With Chronic Disease Management Performance

Table 5 shows the organizational factors independently associated with chronic disease management scores after adjusting for significant patient factors. The presence of a nurse-practitioner was associated with a

10% absolute increase in disease management scores, whereas larger practices (with more than 4 full-time-equivalent family physicians) had a 7% lower score than smaller practices. Higher patient load per physician (number of patients per family physician) was also associated with lower scores. The relationship was linear, with each additional 1,000 patients being associated with a 3% drop in the score. The multivariate model accounted for 9% ($R^2 = .09$) of score variability. In this multivariate equation, the addition of the model variables did not add significant explanatory value, suggesting that much of the impact of the model variable was captured in the 3 predictive factors.

Table 6 shows a stratified analysis by model. The results indicate that, with the exception of the patient

load variable, which appears to be driven by its effect within FFS and HSO practices, the independent variables associated with performance of chronic disease management were consistent across models. Larger practices were associated with lower levels of care in CHC, FFS, and HSO practices, but not in FHNs. The presence of a nurse-practitioner in a practice was associated with approximately 6% better performance.

The qualitative findings shed light on some of the care processes that facilitate effective chronic disease management. First, there was a general consensus among clinicians that longer consultations translate into better care for chronically ill patients. CHC physicians and nurse-practitioners seemed less likely than those working in other models to feel time-challenged.

Table 3. Patient, Clinician, and Practice Characteristics by Care Model

Characteristic	Practice Model				Association With CDM ^a	
	CHC	FFS	FHN	HSO	β	P Value
Patients included in CDM score	120	115	138	141	–	–
Diabetes, n	82	69	80	82	–	–
Coronary artery disease, n	50	57	72	84	–	–
Congestive heart failure, n	8	15	15	19	–	–
Hypertension, n	201	221	257	236	–	–
Chronic diseases, average, n ^b	1.8	1.8	1.9	2.0	0.043	.019
Age, y ^c	59.6	62.6	63.8	65.1	0.0022	.016
Sex, male, %	39	49	49	50	0.057	.027
Practice profile n (% response)	35 (69)	35 (23)	35 (37)	32 (49)		
Solo practices, %	0	26	37	38	0.0041	.87
Practice size >4 family physicians, %	17	14	40	3	–0.044	.188
Practice full-time equivalent, n						
Family physicians	3.0	2.4	3.6	1.7	–0.0039	.50
Nurse-practitioners	2.5	0.1	0.3	0.2	0.035	.001
Nurses ^d	2.7	0.6	1.9	1.0	0.012	.19
Presence of nurse-practitioner, %	100	8.6	31.4	18.8	0.097	<.001
No. of patients per family physician, $\times 1,000$	1.3	1.8	1.5	2.0	–0.032	.033
Booking time for routine visit, min	25	13	14	14	0.0063	.004
Setting						
Hospital within 10 km	71	85	94	84	–0.031	.35
Rurality index	14.2	12.6	16.2	8.0	–0.0010	.16
Length of practice operation, y	18.3	16.4	24.4	26.7	0.00029	.80
Information technologies, %						
Electronic patient records	29	14	57	44	–0.021	.44
Electronic reminder system	26	14	46	28	0.036	.19
Clinician profile, n	182	58	81	42		
Years since graduation, n	19	22	23	29	0.0021	.15
Female clinician, %	58	45	41	26	–0.023	.47
Foreign-trained clinician, %	9	17	3	14	–0.0065	.90
Clinicians with CFPC degree, %	79	85	78	68	–0.0017	.96

CDM = chronic disease management; CFPC = The College of Family Physicians of Canada; CHC = community health center; FFS = fee for service; FHN = family health network; HSO = health service organization.

^a Result of unadjusted regression analysis between CDM score and each variable separately.

^b Includes all charts in sample meeting criteria for diabetes, coronary artery disease, congestive heart failure, and hypertension.

^c The relationship between CDM and age is best represented by the following second-order equation: $\text{age } \beta = 0.027 + \text{age}^2$. $\beta = 0.00019$.

^d Includes registered practical nurses, nurses, and nursing assistants.

...for diabetics to do the teaching that takes time, the amount of time you need to spend with those people is significant...here you have the fee structure set up where you are able to take that time...it is not a factory. It is not an assembly line. It's good health care (Nurse-practitioner, CHC).

Additionally, many CHC participants suggested that participation in a collaborative team forces more

comprehensive and accurate charting. One CHC physician with a long experience in FFS settings noted:

...in a private practice you are the only person who sees the file, so nobody else has to be able to interpret what you have written...while here the charts are much more comprehensive. I am not saying that it is a better system than in a private practice, I just know that the files are not as complete maybe as they would be in a place like this (Family physician, CHC).

Table 4. Chronic Disease Management Measures Across Models

Measures	CHC	FFS	FHN	HSO	P Value
Process measures					
Diabetes, %					
Foot examination documented in previous 2 y	63	29	39	39	<.001 ^a
Eye examination in previous 2 y	61	44	38	37	.005 ^a
ACEI/ARB in previous 2 y	71	64	65	73	.536 ^a
2 HbA _{1c} tests in previous 1 y	73	57	54	48	.007 ^a
Overall diabetes score	69	52	53	54	<.001 ^b
Coronary artery disease, %					
Aspirin documented in previous 2 y	80	75	72	75	.81 ^a
β-Blocker documented in previous 2 y	80	67	62	73	.18 ^a
Statin documented in previous 2 y	76	81	64	76	.14 ^a
Overall coronary artery disease score	79	74	66	75	.11 ^b
Congestive heart failure, %					
ACEI/ARB in previous 2 y	63	93	93	84	.17 ^a
β-Blocker in previous 2 y	50	47	47	68	.51 ^a
Overall congestive heart failure score	56	70	70	76	.56 ^b
Overall chronic disease management score, %					
Total score, mean	72	61	60	64	.003 ^b
Unadjusted difference in score ^c	Ref	-11 ^d	-12 ^e	-8 ^f	
Adjusted difference in score ^g	Ref	-13 ^e	-15 ^e	-10 ^d	
Outcome measures: intermediate clinical outcome					
Diabetes					
Target HbA _{1c} , % ^h	56	54	61	55	.83 ^a
Last HbA _{1c} level, mean %	7.3	7.1	6.8	7.2	.23 ^b
Hypertension					
Target blood pressure, % ⁱ	38	40	39	44	.65 ^a
Systolic blood pressure, mean, mm Hg	138 ^j	135.2	137	135.3	.055 ^b
Diastolic blood pressure, mean, mm Hg	81.2 ^j	80.4 ^k	80.1 ^k	76.7	.007 ^b

ACEI/ARB = antiotensin-converting enzyme inhibitors/antiotensin receptor blockers; CHC = community health center; FFS = fee for service; FHN = family health network; HbA_{1c} = hemoglobin A1c; HSO = health service organization.

Note: Values, unless otherwise stated, are expressed as percentage of charts on which the individual manoeuvre was noted.

^a Generated from contingency table using Pearson χ^2 statistic.

^b Generated with analysis of variance.

^c Result of regression analysis with only model dummy variables.

^d $P < .01$ compared with CHC as reference.

^e $P < .001$ compared with CHC as reference.

^f $P < .05$ compared with CHC as a reference.

^g Result of regression analysis with model dummy variables and adjusted for patient age and sex.

^h Percentage of patients with HbA_{1c} ≤ 7.0

ⁱ Percentage of patients with average target blood pressure in previous 6 months. Target blood pressure was 130/80 mm Hg for patients with diabetes and 140/90 mm Hg for all others.

^j $P < .05$ compared to HSO as reference.

^k $P < .001$ compared to HSO as reference.

Of importance, CHCs had a degree of organizational readiness for changes aimed at improving diabetes care, particularly in their use of diabetes education and care teams. Nurse-practitioners were an important part of many of these teams, with their activities ranging from consultation-based primary care to the organization of chronic disease clinics. The contributions of diabetes nurse specialists, dietitians, and chiropodists are also valued by CHC physicians:

...because of the way the organization is set up, it can almost be set up so that the diabetes is managed with directives by the physician and all of that by the diabetes nurse. So she can increase their medication, she can advise them on what to do with their diabetes, so that helps a lot because then...that is one major chronic disease that can be cared for that I don't have to deal with. I can deal with whatever else, or I can deal with the more complicated issues of the diabetes.... We have a diet counselor who can help with patients with problems with weight, obesity, and the like. What else do we have? A chiropodist, so that helps with the foot problems. All of those help with the most complex patients, you can kind of help each other out on that. (Family physician, CHC).

Physicians practicing in other models reported that they are only slowly starting to take advantage of system change related to diabetes care:

There is a special code that I can use for seeing diabetics...(since I began to use the code). I am starting to

Table 5. Organizational Factors Independently Associated With Chronic Disease Management

Practice Profile Predictors	β	P Value	Confidence Interval
Presence of nurse-practitioner	0.101	<.001	0.051 to 0.152
Large practices ^a	-0.067	.040	-0.13 to -0.003
Patient load ^b	-0.032	.028	-0.060 to -0.004

Note: Results of regression model showing the impact of each factor on chronic disease management performance. The model is adjusted for patient age and sex.

^a Practices hosting more than 4 family physicians.

^b No. of patients per family physician ($\times 1,000$).

Table 6. Organizational Factors Independently Associated With Chronic Disease Management Across Models (β Represented Only)

Practice Profile Predictors	Overall	CHC	FFS	FHN	HSO
Presence of nurse-practitioner	0.101	— ^a	0.062	0.054	0.060
Large practices ^b	-0.067	-0.125	-0.076	0.0042	-0.087
Patient load ^c	-0.032	0.021	-0.069	-0.0037	-0.026

CHC = Community Health Center; FFS = fee for service; FHN = family health network; HSO = health service organization.

Note: Results of regression model showing the impact of each factor on chronic disease management performance. The model is adjusted for patient age and sex.

^a All participating CHCs hosted nurse-practitioners.

^b Practices hosting more than 4 family physicians.

^c No. of patients per family physician $\times 1,000$.

book longer visits for my diabetic patients in order to do those assessments, which is actually what we should have been doing, I wasn't really aware that there was such a comprehensive assessment doable. I guess I was aware but I just wasn't organized enough to do it (Family physician, FHN).

DISCUSSION

This study adds to the sparse literature comparing chronic disease management between differing models of primary care. It also offers insight into the organizational features within a primary care practice associated with high-quality care of chronic health conditions.

There are 2 key findings. First, we found evidence-based processes associated with high-quality chronic disease care to be most common in Ontario's CHCs. Second, across the whole sample, high-quality chronic care delivery was more likely with the presence of a nurse-practitioner. Quality of care decreased with patient load and in those practices with more than 4 full-time-equivalent family physicians. These factors outweighed any independent influence of model of care delivery.

Ontario's CHCs were established in the 1970s and were part of a broader Canadian initiative to respond to perceived problems in health service delivery. Unlike

other models within our study, CHCs operate under community governance, pay physicians by salary, and combine clinical services with a range of integrated community programs. Several have implemented specific diabetes care programs. We found that measures of diabetic processes of care were higher in CHCs, but that blood glucose control was not. With the exception of HbA_{1c} assessments, the processes measured in diabetes were related to the detection and prevention of end-organ damage rather than blood glucose control. Still, if the processes measures used to evaluate performance were an indicator of overall care, one may have expected improved intermediate outcomes in that population. Failure to observe a difference may relate to the gap between recommended care and patient compliance or response to such care.

CHCs based in the United States have been found to deliver a higher standard of care when compared with hospital outpatient clinics, and physician's offices.^{32,33} Patients rate them highly in service coordination, comprehensiveness, and community orientation.³⁴ In our study, 2 of 3 organizational characteristics independently associated with quality chronic disease management processes (the presence of a nurse-practitioner and smaller patient-physician ratios) were characteristic of CHC practices.

Our findings add to the literature suggesting that nurse-practitioners have a positive effect on a number of aspects of primary care delivery.^{35,36} The presence of other clinical disciplines did not have a positive association with chronic disease management. Although there is evolving understanding of the benefits of, and processes associated with, nurse-practitioner-physician collaboration,³⁷⁻³⁹ the reasons underlying improved outcomes associated with nurse-practitioner involvement in primary care teams are unclear. There are several possibilities. First, a nurse-practitioner may help ease physician workload through taking over some duties usually performed by physicians. Second, nurse-practitioners may affect performance through their involvement in delivering care through organized care management activities, such as diabetes clinics. Finally, it is feasible that the incorporation of a nurse-practitioner, particularly in the non-CHC practices, is a marker of practice-based organizational approaches toward changing the status quo.

Professional organizations have been increasingly preoccupied with the impact of workforce shortages of primary care clinicians, in particular family physicians and nurses. Our data suggested that practices with smaller numbers of patients per clinician were more likely to provide higher care quality, principally in FFS, the model serving the largest population of Ontarians.

We found better chronic disease management in practices containing 4 or fewer family physicians—a finding consistent across each of the models. Although several US-based studies have found a modest direct correlation between the number of physicians and the quality of chronic care processes,⁴⁰⁻⁴² recent British studies have found practice size to be only modestly,⁴³ if at all, predictive of quality of care processes.⁴⁴

Again, our cross-sectional design makes it difficult to be certain about the reasons behind the association between smaller practices and better chronic disease management. The finding, however, may be associated with unique features of Ontario primary care. Unlike overseas, physicians' assistants are unknown in Ontario, reducing the likelihood of the delegation of activities often found in larger practices. With the province only beginning the process of primary care reform, it may be that larger practices are yet to perceive sufficient incentives to initiate high-quality care processes. Accordingly, it may be that the potential economies of scale of larger practices may be outweighed by easier practice decision making in smaller practice sites.

Unlike others,^{32,40,45,46} we found no evidence that a practice's use of electronic medical records influenced the chronic disease management score. Similar findings in studies comparing chronic disease management in paper-based and electronic practices in the United States,⁴⁷ and Quebec⁴⁸ suggest that although practice information systems can assist chronic disease management, using such systems is no guarantee of effective chronic disease care.

This cross-sectional study has a number of limitations. Our practice sample excluded practices in the far north of the province and was limited by a low response rate in FFS practices (23%). Nevertheless, our FFS sample had a similar demographic profile to grouped data on all FFS practices within Ontario. Our assessment of chronic disease care excluded the consideration of chronic disease management in children and was restricted to the consideration of 3 conditions. Our outcome measures were ascertained by chart abstractions, well known to underestimate care processes through their inability to capture processes of care that are delivered, but not documented. This approach can also lead to a biased model comparison if differential charting practices exist across models, a parameter we did not measure. Even so, differences in

the quality of care observed between models were not exclusively found in processes that are less likely to be documented. They were also found, for example, in the frequency of hemoglobin A_{1c} evaluation, suggesting that document bias alone could not explain the differences in the performance measured. Finally, whereas our assessment of practice factors potentially influencing quality of care was large, it was not comprehensive. For example, we did not collect data on the clinician's experience of, as well as characteristics of, the relationships with their patients or within team members.

Implications for Policy and Practice

Our data allowed us to evaluate chronic care outcomes in a province undergoing considerable primary care reform. The study adds to the evidence suggesting that the organization and makeup of the primary care team influences the delivery of care quality. Our findings add to the literature supporting the value of nurse-practitioners within primary care teams and validate the contributions of Ontario's CHCs. Further work should examine whether current moves toward larger practices and greater patient physician ratios may have unanticipated negative impacts on processes of quality care.

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