Editor's key points

- Best practices for primary care clinics vary owing to the diversity of populations served, operational structures, and program delivery across the country. One community-based family medicine clinic in rural southern Alberta (reference clinic [RC]) adapted its service model to address the specific needs of the patient population, which included a substantial number of Aboriginal patients and a high rate of diabetes. This study aimed to assess outcomes for patients with diabetes in the RC over a 4-year period relative to other clinics in the region.
- The changes implemented at the RC included the introduction of formal patient panels, creation of an in-house interdisciplinary health team, increased autonomy for allied health professionals, and the ability of physicians, patients, and allied health care providers to initiate referrals to the interdisciplinary team.
- Patients with diabetes attending the RC were more likely to have hypertension and other comorbid conditions, and they started with a higher average body mass index and higher diastolic blood pressure. Although the results were mixed, the RC was associated with a significant ($P<.001$) improvement in a clinically relevant outcome for diabetes care (lower blood pressure) and achieved generally similar outcomes to the comparison clinics, despite serving what is likely a more medically and socially complex population.

Team-based comanagement of diabetes in rural primary care

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Abstract

Objective To explore clinical indicators among patients with diabetes in southern Alberta and assess changes over time, and to compare patients with diabetes attending a reference clinic (RC), which had adapted its service model to address the specific needs of the patient population, with patients with diabetes attending comparison clinics (CCs) in the same region.

Design Analysis of longitudinal data from the Canadian Primary Care Sentinel Surveillance Network (CPCSSN).

Setting Rural southern Alberta.

Participants A community-based family medicine clinic and the 6 other CPCSSN clinics in the same region at the time of the study.

Main outcome measures A range of data elements from patients with diabetes within the RC, as well as from patients with diabetes from the CCs, were analyzed by CPCSSN to compare rates of comorbidity and mean body mass index, hemoglobin A_{1c} levels, and blood pressure, as well as service use and measurement frequency. Rate of change per year was modeled longitudinally for each of the outcomes.

Results The RC had higher proportions of patients with comorbid conditions and a consistently higher mean body mass index. Mean HbA_{1c} levels varied minimally between the RC and CCs, with both sets worsening slightly. However, the rate of worsening among patients with diabetes in the RC was found to be significantly greater ($P<.05$) than for those in the CCs. Blood pressure also varied minimally between the RC and the CCs, with both sets improving; however, the RC had a significantly greater ($P<.001$) rate of improvement than the CCs did. Finally, a greater proportion of patients in the RC had complete data for these 3 outcome measures, and RC patients made a greater number of clinic visits compared with the CC patients ($P<.001$).

Conclusion This study describes a team-based comanagement organizational model and might provide useful commentary about organizational effectiveness in primary care. Although improvement in health outcomes cannot be directly attributed to any specific change in clinic organization, some statistically and likely clinically significant benefit was found associated with the service model of the RC in a relatively medically and socially challenged patient population and in a conservative evaluative design.

Prise en charge du diabète par une équipe de soins primaires en région rurale

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Résumé

Objectif Déterminer les indicateurs cliniques de patients diabétiques du sud de l'Alberta, vérifier comment ces indicateurs évoluent dans le temps et comparer les diabétiques traités dans une clinique de référence (CR) qui a adopté un type particulier de services pour répondre aux besoins spécifiques de la population locale à ceux de cliniques comparables (CC) de la même région.

Type d'étud Une analyse de l'évolution dans le temps de données du Réseau canadien de surveillance sentinelle en soins primaires (RCSSSP).

Contexte Une région rurale du sud de l'Alberta.

Participants Une clinique communautaire de médecine familiale et 6 autres cliniques du RCSSSP opérant dans la même région au moment de l'étude.

Principaux paramètres à l'étude Certaines composantes des données des diabétiques traités à la CR, mais aussi de ceux traités dans les CC, ont été analysées par le RCSSSP pour comparer les taux de comorbidité et les indices de masse corporelle (IMC), les niveaux moyens de l'hémoglobine A_{1c} et la tension artérielle, de même que le recours aux services offerts et la fréquence des mesures. Le taux annuel de changement était illustré de façon longitudinale pour chacune des issues.

Résultats Un plus forte proportion des patients de la CR présentait de la comorbidité et un IMC plus élevé. Les niveaux moyens d'hémoglobine A_{1c} étaient sensiblement les mêmes dans la CR et dans les CC, avec une légère aggravation dans les deux types de clinique. Toutefois, l'aggravation chez les diabétiques de la CR était significativement plus rapide ($P < .05$) que chez ceux des CC. De même, la tension artérielle était pratiquement la même dans les deux groupes, avec une tendance à l'amélioration : le taux d'amélioration était toutefois significativement plus important ($P < .001$) chez les diabétiques du CR que chez ceux des CC. Enfin, une proportion plus grande des patients de la CR présentait des données complètes pour la mesure de ces trois derniers paramètres; ces patients avaient aussi visité leur clinique plus souvent que ceux des CC ($P < .001$).

Conclusion Cette étude présente une forme de traitement en équipe qui pourrait susciter des discussions à propos de l'efficacité organisationnelle dans la prestation des soins primaires. Même s'il n'est pas possible de déterminer si l'amélioration de certains problèmes de santé résulte directement d'un changement dans l'organisation des soins, nos travaux ont montré qu'il y avait des avantages statistiquement et probablement cliniquement significatifs à utiliser le type de services offerts par la CR pour une population de patients présentant certains problèmes d'ordre social et médical, et ce, en utilisant un mode d'évaluation conventionnel.

Points de repère du rédacteur

- Dans les établissements de soins primaires, les meilleures pratiques cliniques varient en fonction des populations desservies, des structures opérationnelles en place et des programmes disponibles localement. Une clinique communautaire de médecine familiale d'une région rurale du sud de l'Alberta (une clinique de référence [CR]) a changé la façon de dispenser ses services de manière à répondre aux besoins particuliers de la population locale, qui comporte une importante proportion d'autochtones et de diabétiques. Cette étude voulait évaluer les résultats obtenus par les diabétiques suivis pendant 4 ans à cette clinique, et ce, par rapport à ceux d'autres cliniques de la même région.
- Les modifications apportées dans cette clinique comprenaient : la création de groupes de discussion entre patients; la mise sur pieds d'une équipe interdisciplinaire de soignants; une augmentation de l'autonomie des professionnels de la santé associés; et la possibilité pour les médecins, les patients et les professionnels de la santé associés de déclencher le processus de référence à l'équipe interdisciplinaire.
- Les diabétiques de cette CR étaient plus susceptibles de souffrir d'hypertension et de maladies concomitantes et présentaient au départ un indice de masse corporelle (IMC) et une tension artérielle diastolique moyens plus élevés. Malgré des résultats variables, les diabétiques de la CR montraient une amélioration significative (P < .001) des résultats pour des issues cliniquement importantes pour le diabète (diminution de la tension artérielle) et obtenaient des résultats généralement semblables à ceux des autres cliniques, et ce, malgré la plus grande complexité médicale et sociale de la population desservie.

Variation in the organization and provision of services between individual primary care clinics derives to a large extent from their pursuit of best practices according to the characteristics of their patient populations; however, this also means that much diversity exists in operations and program delivery across the country. Natural experiments comparing the effects of real-world innovation with contemporary organizational characteristics or clinical practices might be one method for demonstrating effect on patient outcomes.[1,2]

One community-based family medicine clinic in rural southern Alberta made a number of specific changes to their service model in an effort to enhance chronic disease prevention and management, particularly among their large populations of Aboriginal patients and patients with diabetes. The prevalence of diabetes is currently 2 to 5 times higher among Aboriginal adults than in the general Canadian adult population, and this is expected to rise owing to poor health among Aboriginal youth.[3] The implemented changes included strategies to improve the integration of care and chronic disease management, such as the following:

- the introduction of formal, patient-verified patient panels;
- the authority for the clinic to select its own in-house interdisciplinary health team (IHT), which was created in 2003 and has remained relatively unchanged since 2009;
- the ability for the clinic to choose members of the IHT to best serve the clinic's patient population instead of receiving personnel selected by the local primary care network (in addition to family physicians, this consisted of a full-time registered nurse, a full-time registered social worker, a part-time pharmacist, a part-time registered dietitian, 2 part-time respiratory technicians, and a part-time data manager who was hired to create a patient database for screening and identifying clinical outcomes within the clinic);
- more autonomy for allied health care professionals, who are embedded and integrated within the clinic; and
- the ability for physicians, patients, and allied health care providers (including home care) to initiate referrals to the IHT when the patient is attached to a physician's panel at the clinic.

The integrated nature of this team resulting from colocation is unusual in both the autonomy given to its nonphysician providers and the opportunity for regular contact and patient updates that occur between physicians and other team members. When a physician initiates a referral to the team, all members have full access to the patient's electronic medical record (EMR) and all members are able to complete their charting notes, medication adjustments, and updates to the medical summary on the same system. Referrals made to the team are not limited by age, diagnostic, or severity-of-illness barriers, in contrast to other models of team-based primary care in which referrals might only be accepted for a more narrowly defined population of patients. In addition, automatic referrals to the team might be triggered based on specific admitting diagnoses at the local hospital. For example, an admitting diagnosis for a patient of congestive heart failure automatically generates an initial in-hospital contact and subsequent follow-up visits after discharge with the multidisciplinary team. Last, the team has the authority to adjust a patient's clinical care under the indirect supervision of the physician, eliminating unnecessary direct physician-to-patient contact. The physician effectively "quarterbacks" the team without needing to be on the field for every play. Team development, such as adding a team member or "sharing care," multidisciplinary organization, and expanding or revising professional roles, has been shown to improve glycemic control in patients with diabetes in a large systematic review and meta-analysis.[4]

In relation to diabetes management in particular, the clinic had implemented a 2-fold process for monitoring hemoglobin A_{1c} (HbA_{1c}): a monthly list system for follow-up and recall (which was monitored by licensed practical nurses who contacted patients who were due for HbA_{1c} laboratory work) and standing orders supporting self-management. Additionally, patients were contacted by telephone or at the clinic for insulin titration, with insulin adjustments provided in written form as part of self-management teaching that was undertaken by all team members including physicians. The "worst controlled" patients were brought into the clinic as frequently as they were able and willing to come. Supporting these patients was often challenging.

In order to explore evidence for the effectiveness of these organizational and service delivery innovations, we developed a study which sought to compare the outcomes of patients with diabetes from the reference clinic (RC) with those of patients with diabetes aggregated from all other clinics participating in the southern Alberta network of the Canadian Primary Care Sentinel Surveillance Network (CPCSSN) over the same period of time. To observe potential differences between the clinics, we examined 3 well-known indicators of quality in diabetes management: body mass index (BMI), HbA_{1c} levels, and blood pressure. In so doing, we attempted to maximize the organizational and service delivery heterogeneity of the comparison clinics (CCs) such that beneficial differences in outcomes associated with the RC would be harder to attribute to its characteristics, especially in the context of its challenging patient population, contributing to more conservative interpretations of effectiveness.

The objectives of this study were to use longitudinal CPCSSN data to explore clinical indicators among patients with diabetes in southern Alberta and assess changes over time, and to compare patients with diabetes attending the RC with patients with diabetes attending the 6 other CPCSSN clinics in the same region at the time of the study.

Methods

Data source

The data for the study came from CPCSSN, a national collaboration of primary care research networks contributing anonymized patient data from the EMRs of primary care clinics.[5] Participants in CPCSSN are family physicians and nurse practitioners who consent to allow the extraction of de-identified EMR data, which are cleaned, coded, and standardized by CPCSSN processing algorithms. In addition to Canada-wide epidemiology and surveillance, these data have become useful for clinical quality improvement and decision support at the level of an individual patient, as well as for answering research questions deriving directly from practice.

The database used in this analysis included all 7 participating CPCSSN clinics belonging to the Southern Alberta Primary Care Research Network in 2012, which consisted of data from more than 50 000 patients extracted up to September 30, 2012. The data are broadly representative of Albertan citizens, providers, and primary care practices and are derived from a mix of academic and community-based practices in both rural and urban locations.

Sample definition

The sample consisted of adult patients (18 years and older) with diabetes, as indexed by the validated CPCSSN case definition,[6] who had had at least 1 clinic visit during each of the 4 study years (2009 to 2012). The time period was selected because 2009 was the year in which the components of the RC's health team were firmly established, representing a baseline time period.

Variables and data analysis

Three main outcomes were used in this study based on commonly used clinical indicators for the evaluation of the quality of diabetes care: annual mean BMI, blood pressure (systolic [SBP] and diastolic [DBP]), and HbA_{1c}.[7] Covariates used for adjustment were age, sex, chronic comorbid conditions (hypertension, osteoarthritis, depression, chronic obstructive pulmonary disease, dementia, epilepsy, and parkinsonism), and the number of measurements of the associated outcome variable throughout the entire follow-up period (2009 to 2012).

For each outcome, the rate of change per year was modeled longitudinally using the means of each of the 4 annual periods, creating a slope coefficient for each patient. Change (non-zero slope) versus no change (zero slope) was tested using *t* tests evaluated at an α of .05, with linear regression used for covariate adjustments. Analysis of each outcome was performed independently, and only those patients with at least 1 observation in each of the 4 study years were included in each analysis.

Results

Select patient characteristics from the RC and CCs are summarized in **Table 1**.[6]

Comorbidity

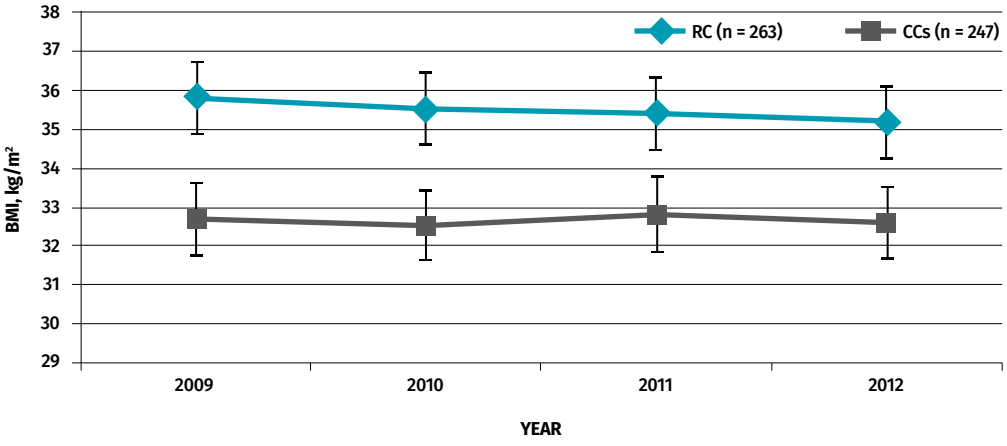
Patients attending the RC were generally in poorer health than control patients were. Patients from the RC with diabetes had a higher proportion of comorbid hypertension (70.25% vs 64.62%), had a greater proportion of multiple comorbidities (54.67% had 2 or more comorbid conditions compared with 43.13% of patients in the CCs), and started with higher BMI values (35.8 vs 32.7 kg/m^2) and DBP (78.1 vs 76.6 mm Hg) in 2009. Overall, a slightly greater proportion of RC patients with diabetes had a comorbid chronic condition relative to CC patients (85.49% vs 80.60%, $P = .005$) and had consistently higher BMI measurements across study years (**Figure 1**).

Table 1. Patient characteristics for the study sample from 7 clinics in southern Alberta

CHARACTERISTIC	RC (n = 689), % (95% CI)	CCs (n = 1778), % (95% CI)	TOTAL (n = 2467), % (95% CI)
Female sex	48.47 (44.74-52.22)	45.28 (42.96-47.59)	46.17 (44.20-48.14)
Age ≥ 60 years	54.14 (50.41-57.86)	58.16 (55.86-60.45)	57.03 (55.08-58.99)
≥ 4 encounters each year (from 2009 to 2012)*	58.49 (54.81-62.17)	42.18 (39.88-44.48)	46.74 (44.77-48.71)
Comorbid chronic condition†‡	85.49 (82.85-88.12)	80.60 (78.76-82.43)	81.96 (80.44-83.48)
Hypertension†§	70.25 (66.83-73.66)	64.62 (62.40-66.85)	66.19 (64.33-68.06)
≥ 2 comorbid conditions*	54.67 (50.64-58.70)	43.13 (40.56-45.69)	46.49 (44.31-48.66)

CC—comparison clinic, CPCSSN—Canadian Primary Care Sentinel Surveillance Network, RC—reference clinic.
*Comparison between RC and CCs (χ^2 test), $P < .001$.
†Comparison between RC and CCs (χ^2 test), $P < .01$.
‡Extracted using CPCSSN case definition algorithms for hypertension, osteoarthritis, chronic obstructive pulmonary disease, depression, dementia, epilepsy, and parkinsonism, which have been validated with adequate to good specificity, sensitivity, and predictive value.[6]
§Extracted using the CPCSSN case definition algorithm (sensitivity of 84.9%, specificity of 93.5%, positive predictive value of 92.9%, and negative predictive value of 86.0%).[6]

Figure 1. Mean BMI from 2009 to 2012



BMI—body mass index, CC—comparison clinic, RC—reference clinic.

Body mass index

Overall, 38.17% of RC patients with diabetes had a BMI measurement in each of the study years, and only 13.89% of CC patients with diabetes also met this criterion ($P<.001$). Those with complete BMI data were slightly older (62.7 vs 61.0 years, $P<.05$), and a greater proportion was female ($P<.001$). Mean annual BMI for both the RC and the CCs can be found in **Table 2** and **Figure 1**. In general, RC patients with diabetes had a higher average BMI than patients with diabetes in the CCs across all study years. Patients with diabetes in the RC were found to have a slight decrease in BMI across the study period, with a rate of change per year of -0.18 kg/m^2 ($t=-2.81$, $P<.05$). Conversely, no evidence of BMI change was found from 2009 to 2012 among patients in the CCs ($t=-0.038$, $P=.97$). However, the rate of change between patients from the RC compared with patients from the CCs (-0.2 vs -0.003 kg/m^2, respectively) was not statistically significant ($t=1.62$, $P=.11$). This result was consistent after adjustment for sex, age, chronic conditions, and frequency of BMI measurement ($t=0.89$, $P=.37$). Additionally, 53.73% (n=274) of those with BMI measurements in each of the study years were found to have had a decrease in BMI (rate of change <0; 55.5% for the RC and 51.8% in the CCs); however, the proportion that had a decrease did not differ between patients in the RC and the CCs ($P=.46$).

Hemoglobin A_{1c}

Overall, 65.02% of patients with diabetes from the RC and 49.49% of patients with diabetes in the CCs were found to have an HbA_{1c} measurement in each of the study years ($P<.001$). Mean HbA_{1c} levels for both the RC and the CCs can be found in **Table 3**. Those with complete data were slightly older (63.1 vs 59.4 years, $P<.001$) and were more likely to have a comorbid chronic condition ($P<.001$). In general, HbA_{1c} level varied minimally between RC and CC patients across study years (**Table 3** and **Figure 2**). The rate of change in HbA_{1c} levels was found to be 0.13% ($t=5.57$, $P<.001$) for RC patients with diabetes and 0.07% ($t=5.34$, $P<.001$) for CC patients with diabetes; the rate of change among RC patients with diabetes was significantly greater ($t=2.67$, $P<.05$). Frequency of HbA_{1c} measurement was adjusted for when comparing the rate of change between RC and CC patients. This result was consistent after adjustment for sex, age, chronic conditions, and frequency of HbA_{1c} measurements ($t=-2.31$, $P<.05$).

Table 2. Mean BMI from 2009 to 2012

	MEAN (95% CI) BMI, kg/m²			
CLINIC	2009	2010	2011	2012
RC (n = 263)	35.8 (34.8-36.7)	35.5 (34.6-36.5)	35.4 (34.5-36.4)	35.2 (34.3-36.1)
CCs (n = 247)	32.7 (31.8-33.6)	32.5 (31.6-33.5)	32.8 (31.8-33.8)	32.6 (31.7-33.6)

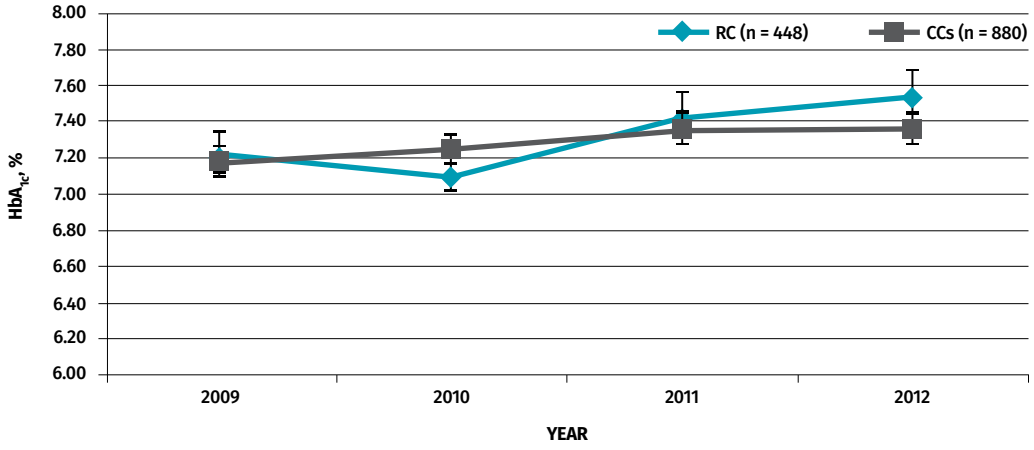
BMI—body mass index, CC—comparison clinic, RC—reference clinic.

Table 3. Mean HbA_{1c} levels from 2009 to 2012

	MEAN (95% CI) HbA_{1c} LEVEL, %			
CLINIC	2009	2010	2011	2012
RC (n = 448)	7.20 (7.06-7.35)	7.10 (6.97-7.23)	7.42 (7.27-7.57)	7.53 (7.38-7.69)
CCs (n = 880)	7.18 (7.10-7.27)	7.25 (7.17-7.33)	7.36 (7.28-7.45)	7.36 (7.28-7.45)

CC—comparison clinic, HbA_{1c}—hemoglobin A_{1c}, RC—reference clinic.

Figure 2. Mean HbA_{1c} levels from 2009 to 2012



CC—comparison clinic, HbA_{1c}—hemoglobin A_{1c}, RC—reference clinic.

Additionally, 37.4% (n=497) of those with HbA_{1c} measurements in each of the study years were found to have a decrease in HbA_{1c} level (rate of change <0; 34.6% for RC and 38.9% in CC), and the proportion that had a decrease was significantly higher among patients in the CCs relative to those in the RC ($P<.05$).

Blood pressure

Overall, 91.14% of patients with diabetes from the RC had a blood pressure measurement in each of the study years, as did 72.89% from the CCs ($P<.001$). Mean SBP and DBP for both the RC and the CCs can be found in **Table 4** and **Figure 3**. Patients with complete data were slightly older (62.9 vs 57.3 years, $P<.001$) and were more likely to have a comorbid chronic condition ($\chi^2=59.54$, $P<.001$). In general, blood pressure varied minimally between RC and CC patients with diabetes across the study years.

The rates of change in SBP for RC and CC patients with diabetes were found to be -1.39 mm Hg ($t=-8.43$, $P<.001$) and -0.30 mm Hg ($t=-2.22$, $P<.05$), respectively. The rates of change in DBP were found to be -0.91 mm Hg ($t=-8.87$, $P<.001$) and -0.38 mm Hg ($t=-6.38$, $P<.001$) for RC and CC patients, respectively. The rate of change among RC patients with diabetes was found to be significantly greater than that for CC patients with diabetes for both SBP ($t=-4.87$, $P<.001$) and DBP ($t=-3.30$, $P<.05$). This result remained significant after adjustment for sex, age, chronic conditions, and frequency of blood pressure measurements for both SBP ($P<.001$) and DBP ($P<.001$).

Additionally, 43.61% (n=839) of patients with a blood pressure measurement in each of the study years were found to have had a decrease in both SBP and DBP (rate of change <0; 51.1% for the RC and 40.0% in the CCs), and consistent with the rate-of-change analysis, the proportion that had a decrease was significantly higher among patients in the RC relative to those in the CCs ($\chi^2=21.37$, $P<.001$).

Service use and measurement frequency

A greater proportion of RC patients with diabetes had complete data for all 3 outcome measures in each of the 4 study years, in addition to a greater number of clinic visits relative to CC patients with diabetes (nonparametric rank sum test, $z=10.23$; $P<.001$), with a median total visits from 2009 to 2012 of 34 for RC and 25 for CC patients.

Discussion

This study of clinical indicators for diabetes among patients was aimed at exploring the effects of the organizational changes one clinic had implemented, particularly concerning their IHT, compared with "the rest." We considered these organizational changes to be appreciably different from strategies being employed by the CCs. For example, the clinic-directed selection and in-house location of its health care professionals, as well as the presence of a data manager, were thought to be unique to the RC among participating study sites. Owing to the funding structure of primary care networks in Alberta,[8] the 6 CCs were considered to be generally homogeneous in their operational infrastructure, with most likely to be operating with some form of multidisciplinary health team.[1]

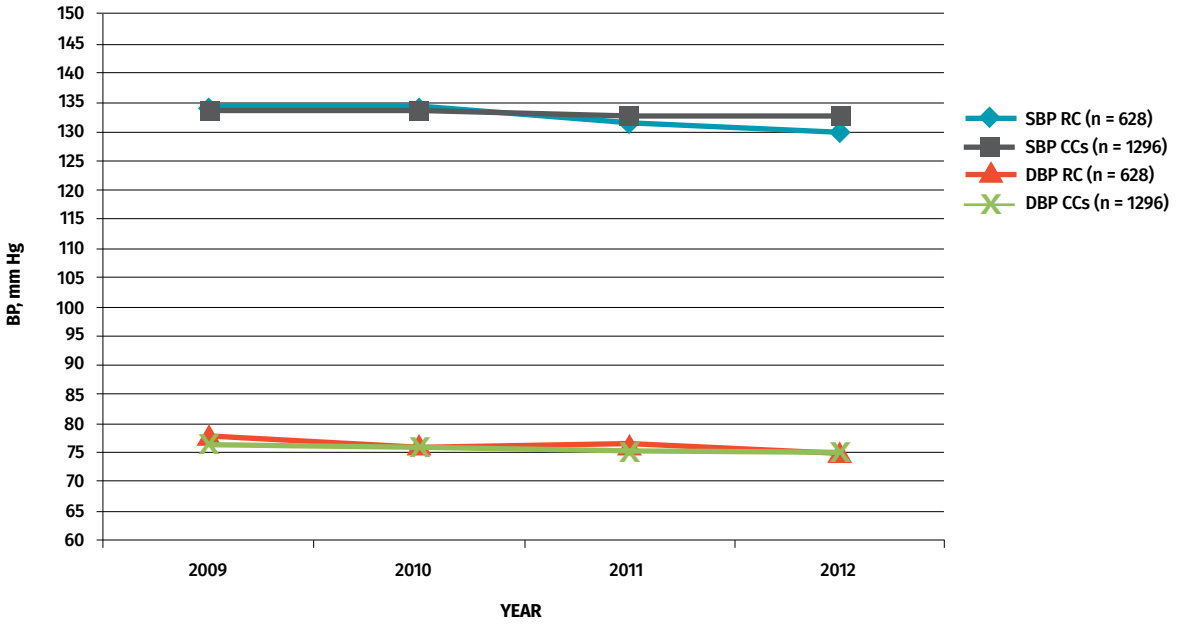
Through time, the results were mixed. Patients with diabetes in the RC saw a larger improvement in the average rate of change for SBP and DBP than CC patients with diabetes did. Conversely, RC patients with diabetes were found to have worsening levels of glycated

Table 4. Mean BP 2009 to 2012

	MEAN (95% CI) BP, mm Hg			
CLINIC	2009	2010	2011	2012
Systolic BP				
• RC (n = 628)	133.8 (132.9-134.7)	134.0 (133.2-134.8)	131.8 (130.9-132.7)	129.9 (129.0-130.8)
• CCs (n = 1296)	133.6 (132.8-134.4)	133.4 (132.6-134.2)	132.8 (132.1-133.6)	132.8 (132.0-133.6)
Diastolic BP				
• RC (n = 628)	78.1 (77.4-78.8)	76.5 (75.9-77.1)	76.4 (75.7-77.1)	75.1 (74.4-75.7)
• CCs (n = 1296)	76.6 (76.1-77.1)	75.7 (75.2-76.2)	75.2 (74.7-75.7)	75.1 (74.6-75.7)

BP—blood pressure, CC—comparison clinic, RC—reference clinic.

Figure 3. Mean BP from 2009 to 2012



BP—blood pressure, CC—comparison clinic, DBP—diastolic BP, RC—reference clinic, SBP—systolic BP.

hemoglobin, with an average rate of change of increasing HbA_{1c} levels across study years greater than that for CC patients with diabetes. Despite the worsening levels of HbA_{1c}, the improvement in blood pressure is an important indicator for improved diabetes care.[7]

Measurable effects on glycemic control among people with diabetes have been previously observed, associated with organizational changes, particularly team changes and case management (including the ability of clinical staff to make medication changes without waiting for physician approval); however, the complexity of organizational interventions and many confounding factors make it difficult to attribute actual clinical outcomes solely to such practice changes.[9]

Our findings have to be considered in light of the social and health contexts of the patient populations of the participating clinics, which suggest that RC patients were more complex, clinically as well as socially, and that managing their diabetes might therefore have been comparatively challenging.

We identified more visits by patients in the RC clinic, with little evidence for differences in the burden of morbidity, possibly indicating greater service use by RC patients associated with relative ease of access. Together with improved documentation and recording in the EMR, these findings are suggestive of improved continuity, patient health literacy, and perhaps satisfaction. Future work might further examine the effects of clinic-based initiatives and organizational characteristics on clinical outcomes, such as those demonstrated by the Dorval Medical Group (who have employed methods adapted from the work of Starfield).[10]

When considering the burden to the health care system, our study demonstrated that the comanagement model incorporated in the RC was associated with a clinically relevant outcome for diabetes care (lowered blood pressure[11]) and achieved generally similar outcomes to clinics with a more traditional physician-directed approach, despite servicing what is likely a more clinically complex population relative to the aggregated CC patient population.

Limitations

We acknowledge a number of limitations in our study design, mostly deriving from the relatively small, clustered sample; missing data; and the non-randomized, observational design. We identified patients with diabetes in participating clinics but did not analyze within-patient changes. Completer bias and confounding by severity are possible, as participants whose health was worse might have tended to be lost to follow-up. This might have disproportionately affected the CCs, significantly fewer of which had complete data. Comorbidity was explored using only those variables for which CPCSSN has developed robust and valid case definitions.[6] Important determinants of health such as socioeconomic status and ethnicity were not included in the analysis because they are poorly recorded in primary care EMR data. We were unable to examine the organizational characteristics of individual clinics to identify possible confounders related to work flow, task attribution, team structures, and other factors; hence, it is difficult to attribute differences between the RC and the CCs to specific and identifiable factors. We did not address economic effects directly, but further study might show that a system of graduated delegation of authority to team members who operate on a salary rather than in a fee-for-service model is cost-effective.

Conclusion

Our study describes a team-based comanagement organizational model designed to improve patient outcomes and might provide useful commentary about organizational effectiveness in primary care, as well as the prospects for routine evaluation and reporting in this sector. While we cannot attribute improvement in health outcomes, or lack thereof, to any specific cause associated with clinic organization, we report some statistically and likely clinically significant benefit associated with the RC compared with the comparators, in a relatively medically and socially challenged patient population and in a conservative evaluative design. Further research could now be targeted to a specific and detailed assessment of the determinants of organizational effectiveness and efficiency associated with this benefit.

Numerous organizations, including the College of Family Physicians of Canada, advocate for the Patient's Medical Home model in which most health services accessed by patients in primary care are found within the same group of providers and ideally in the same geographic location or linked virtually.[12] The RC comanagement model could be seen as an archetype of a modern, integrated, multidisciplinary primary care team that continues to evolve to meet the health care needs of the community it serves and for which it ultimately strives to improve patient health outcomes.

Mr Reyes was a research assistant in the Department of Family Medicine at the University of Calgary in Alberta at the time of the study. **Dr Parker** is Clinical Assistant Professor in the Cumming School of Medicine at the University of Calgary and a family physician at the Associate Clinic in Pincher Creek, Alta. **Ms Garies** is Assistant Network Director for the Canadian Primary Care Sentinel Surveillance Network in southern Alberta in the Department of Family Medicine at the University of Calgary. **Ms Dolan** is a registered nurse and Clinical Care Coordinator at the Associate Clinic. **Ms Gerber** is a registered social worker and Mental Health and Wellness Coordinator at the Associate Clinic. **Drs Beverly Burton** and **Tracy Burton** are family physicians and **Mr Brockmann** is Executive Director, all at the Associate Clinic. **Ms Miyagishima** is a research assistant in the Department of Family Medicine at the University of Alberta in Edmonton. **Dr Drummond** is Professor and holds the Capital Health Chair in Primary Care Research in the Department of Family Medicine at the University of Alberta.

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Contributors

All of the authors contributed to study design, interpretation of findings, manuscript revisions, and final approval. **Mr Reyes** also completed the analysis and drafted the initial manuscript.

Competing interests

None declared

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