


BMJ Open Integrated patient-centred care for type 2 diabetes in Singapore Primary Care Networks: a mixed-methods study

Lay Hoon Goh ,¹ Chiew Jiat Rosalind Siah,² Anna Szücs,¹ E Shyong Tai,¹ Jose M Valderas,¹ Doris Young¹

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¹Medicine, National University of Singapore Yong Loo Lin School of Medicine, Singapore

²National University of Singapore Yong Loo Lin School of Medicine, Singapore

Correspondence to
Dr Lay Hoon Goh;
mdcglh@nus.edu.sg

ABSTRACT

Objective Patients with type 2 diabetes require patient-centred care as guided by the Chronic Care Model (CCM). Many diabetes patients in Singapore are managed by the Primary Care Networks (PCNs) which organised healthcare professionals (HCPs) comprising general practitioners, nurses and care coordinators into teams to provide diabetes care. Little is known about how the PCNs deliver care to people with type 2 diabetes. This study evaluated the consistency of diabetes care delivery in the PCNs with the CCM.

Design This was a mixed-method study. The Assessment of Chronic Illness Care (ACIC version 3.5) survey was self-administered by the HCPs in the quantitative study (ACIC scores range 0–11, the latter indicating care delivery most consistent with CCM). Descriptive statistics were obtained, and linear mixed-effects regression model was used to test for association between independent variables and ACIC total scores. The qualitative study comprised semi-structured focus group discussions and used thematic analysis.

Setting The study was conducted on virtual platforms involving the PCNs.

Participants 179 HCPs for quantitative study and 65 HCPs for qualitative study.

Results Integrated analysis of quantitative and qualitative results found that there was support for diabetes care consistent with the CCM in the PCNs. The mean ACIC total score was 5.62 (SD 1.93). The mean element scores ranged from 6.69 (SD 2.18) (Health System Organisation) to 4.91 (SD 2.37) (Community Linkages). The qualitative themes described how the PCNs provided much needed diabetes services, their characteristics such as continuity of care, patient-centred care; collaborating with community partners, financial aspects of care, enablers for and challenges in performing care, and areas for enhancement.

Conclusion This mixed-methods study informs that diabetes care delivery in the Singapore PCNs is consistent with the CCM. Future research should consider using independent observers in the quantitative study and collecting objective data such as patient outcomes.

BACKGROUND

Consistent with worldwide trends, Singapore is rapidly ageing with one in four Singaporeans becoming 65 years and older in 2030.¹

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ Cross-sectional design limits the ability to evaluate causality in the associations between Primary Care Networks (PCNs) healthcare professionals' (HCPs') characteristics and perceived integrated care in the quantitative study data.
- ⇒ Convenience sampling of the HCPs may limit the generalisability of the findings but recruitment across the PCNs ensured fair representation of the entire population.
- ⇒ First mixed-method study in Singapore to investigate diabetes care delivery across all PCNs using the Chronic Care Model, a relevant and validated integrated patient-centred care delivery model.
- ⇒ The mixed-methods findings give a more comprehensive understanding of the study topic that can inform enhancements to the care delivery in the PCNs.

Likewise, the prevalence of diabetes is projected to double by 2050, reaching 15%.² The most common chronic conditions seen in the Singapore primary care are type 2 diabetes, hypertension and hyperlipidaemia.³ Primary care in Singapore comprises public-funded polyclinics and private general practitioner (GP) clinics. Polyclinics are primary healthcare centres that provide a wide range of government subsidised medical and laboratory services to Singapore citizens.⁴ In 2014, polyclinics saw 40% of all chronic visits in primary care.⁵ People with chronic conditions are over-crowding the polyclinics leading to longer waiting time and over-straining of the subsidised resources.^{6–8} Contrastingly, there are 1800 private GP clinics in Singapore.⁴ Majority of GP clinics are single provider or small group practices with two to three doctors; the remaining are medium or large corporate groups with more doctors.⁵ Most GP clinics are situated within the community and accessible on foot. The clinics have in-house dispensaries while laboratory and imaging needs are provided by external



vendors. Additionally, GP clinics are staffed by administrative clinic assistants who are not clinically trained; the clinics do not have nurses or other allied health support. In 2014, only 29% of GP clinics fully adopted electronic medical records for their patients' clinical information.⁵ Despite the large numbers of private GP clinics, chronic care comprised only 20% of their workload.⁵ Thus, the private GPs remained a resource to help manage chronic diseases in Singapore. Patients who see GPs paid the full amount directly for medical consultations, investigations and medications for their chronic conditions without receiving subsidies from the government, unlike patients in the polyclinics.⁹

In 2018, the Primary Care Networks (PCNs) were established by organising GPs into teams with nurses and care coordinators to provide integrated and coordinated care to people with chronic conditions.¹⁰ The nurses provide ancillary and support services for people with chronic conditions such as diabetic retinal photography, diabetic foot screening and health education, while the care coordinators established the Chronic Disease Registry to track care processes and patient outcomes and assist with care coordination.¹⁰ To encourage patients with chronic diseases to see the PCNs for care, patients can use Community Health Assist Scheme, a means-tested subsidy to reduce out-of-pocket payments in the PCNs.¹¹ Additionally, the Singapore Ministry of Health and other government agencies provide PCNs with manpower and administration support.^{12 13}

In total, 10 PCNs were formed based on three organisational types¹⁰: (1) GP-led PCN, formed and coordinated by single provider GPs, (2) group PCN, led by two GP corporate groups and (3) cluster PCN, formed between GPs and three Regional Health System clusters. Each PCN has a headquarters comprising a clinical leader who oversees the development and clinical governance and an administrative leader who manages funding and resources in the PCNs. Majority of GP clinics in PCNs are single GP provider clinics including those clinics in the group and cluster PCNs. The GP clinics from the group and cluster type PCNs may have received more administrative and IT support from their headquarters than those from the GP-led PCNs. Nevertheless, funding for PCNs and access to subsidised services for patients from the Ministry of Health is the same for all PCNs.

Although support is provided for diabetes care in the PCNs, their effectiveness of care integration has not been evaluated and may be suboptimal, as it was not explicitly based on any evidence-based framework upon its creation. Contrastingly, the polyclinics have redesigned their chronic care delivery processes using the Chronic Care Model (CCM),¹⁴ which is an effective framework with six healthcare elements that influence chronic care delivery.^{15–17} To date, evidence is lacking about whether diabetes care delivery in the PCNs applies the CCM.

Previous PCN studies obtained perspectives of GPs,¹⁸ PCN representatives¹⁹ and type 2 diabetes patients²⁰ on care delivery for chronic conditions. To capture differing

perspectives of the healthcare professionals (HCPs) on diabetes care delivery in the PCNs,²¹ this study involved the GPs, nurses and care coordinators across all 10 PCNs. Additionally, we used a mixed-methods design to integrate findings from qualitative and quantitative studies and derive a more comprehensive understanding of the diabetes care delivery.²² Thus, the study aims to evaluate the consistency of diabetes care delivery in the PCNs in relation to the CCM. The research questions are: In relation to the CCM, (1) what is the consistency of support for diabetes care delivery for the PCN HCPs? and (2) what are the HCPs' perspectives on the role of the PCNs in diabetes care delivery?

METHODS

Design and sample

We used a cross-sectional convergent mixed-methods approach to evaluate: (1) diabetes care support in the PCNs using the Assessment of Chronic Illness Care (ACIC) version 3.5 as perceived by the HCPs and (2) HCPs' perspectives through focus group discussions. The leaders from the 10 PCNs invited their GPs, nurses and care coordinators to participate in the quantitative and qualitative studies using their routine email correspondence. The numbers of each HCP type in each PCN were not known. However, the HCPs in the study were recruited from all 10 PCNs to show fair representation from each PCN (online supplemental table 1). All participants gave written consent before participating in the studies. Participants in the quantitative study indicated their written consent using the electronic consent-taking mechanism on the online survey while participants in the qualitative study gave written consent using a soft copy consent form. The studies were conducted between January 2020 and February 2022. All HCPs were reimbursed SGD20 for their participation in each study.

Across all PCNs, HCPs (GPs, nurses and care coordinators) were recruited by email to participate in the quantitative study using an anonymous online survey. There were 1030 PCN HCPs in 2021, comprising 889 GPs, 18 nurses and 123 care coordinators (source: Singapore Ministry of Health, December 2021). With a margin of error of 0.25, 95% CI and a population variance of 2.89,^{23–25} the sample size for the quantitative study was calculated to be 152. The response rate from the HCPs for the quantitative study was 14.7% (131 out of 889) for GPs, 100% (18 out of 18) for nurses and 24.4% (30 out of 123) for care coordinators. For the qualitative study, the HCPs were purposefully recruited based on their job type (GP, nurse or care coordinator), age, gender and their PCN type (GP-led, group or cluster).

Patient and public involvement

None.

Data collection

Quantitative study

The ACIC version 3.5 with 34 items was used to rate what best described the support for diabetes care in the

PCNs²⁶ (online supplemental table 2). The ACIC version 3.5 provides subscale scores corresponding to six CCM elements with the seventh element evaluating integration of CCM components. The HCPs chose from a 0–11 scale, with 0–2 indicating ‘little support for chronic illness care’, 3–5 indicating ‘basic support’, 6–8 indicating ‘good support’ and 9–11 indicating ‘full support’. Item means for each subscale were obtained by the average of the item scores within the subscale. The ACIC total score was derived by summing the average scores of each subscale and dividing by seven. The ACIC version 3.5 was validated by content and face validation by a panel of seven experts comprising five primary care doctors, a nurse and a care coordinator. The validation resulted in minor adaptations such as changing the phrasing and examples of the items (online supplemental table 3). The Cronbach’s alpha for the total score in the adapted ACIC was 0.95 in the study sample. The following HCPs’ characteristics were collected in this study: (1) age, gender, ethnicity, years of education, HCP role (sociodemographics), (2) duration of working in the PCN, number of hours spent per week in the clinic and number of patients with type 2 diabetes (practice characteristics) and (3) PCN type.

Qualitative study

Two authors LHG, a family physician and CJRS, a nurse, conducted the focus group discussions of three to seven HCPs using a semi-structured interview guide, structured following the CCM (online supplemental material 4). The focus groups lasted about an hour and were audiotaped and transcribed verbatim. The interviews were stopped on reaching data saturation when no new information was generated from the qualitative findings.²⁷

Data analysis

Quantitative analysis

We calculated descriptive statistics on the quantitative data using the SPSS (V.28, IBM, Armonk, NY, USA). Continuous data were presented as mean and SD or as median, IQR and range. Frequency and percentage were used to describe categorical variables. The ACIC total score was presented in continuous values (mean and SD). Two-tailed tests were conducted, with a predetermined alpha level of 0.05 for statistical significance. Bivariate analyses were conducted to test associations between ACIC total scores and HCP-related and practice-related characteristics, and between PCN types and HCP-related and practice-related characteristics. This analysis used Pearson or Spearman’s correlation for continuous variables, χ^2 test for categorical variables and t-tests, one-way analysis of variance and Kruskal-Wallis tests for associations between continuous and categorical variables. Variables significant in the bivariate analyses (age, ethnicity, HCP type and numbers of diabetes patients) with $p < 0.05$ (online supplemental tables 5 and 6) were entered in a linear mixed-effects regression model, while PCN type was considered as random effect. Education level was strongly correlated with HCP type and was omitted from

the model. Missing data were excluded from the analysis using complete case analysis.

Qualitative analysis

Qualitative interviews were transcribed verbatim. Each transcript was independently coded by two researchers (LHG and CJRS) who identified and organised the codes into codebooks. Coding for the transcripts followed the codebooks. The thematic analysis approach by Braun *et al* was used in this study²⁷ that consisted of data familiarisation, identifying codes and themes, coding data and organising codes and themes. Field notes were used to capture additional notes of non-verbal communication that occurred during the interviews and the interviewers’ impressions of the interviews. The study used grounded theory techniques involving open-ended questions, line-by-line coding, iterative coding and constant comparison of codes throughout the analysis process.²⁸ Codes with similar meanings were collapsed under subthemes. Through this iterative process, emergent themes were developed to arrive at the final themes. Team discussions were held regularly to agree on the final list of codes, subthemes and themes. A preliminary analysis of the qualitative findings was performed after 12 participants to assess for saturation.²⁹ Saturation was assessed to be achieved during analysis when no new information was obtained from the findings.²⁷ Participants’ quotes were selected to illustrate themes and subthemes. Codes were analysed using NVivo V.R1 (2020) software.

Integrated analysis

Quantitative and qualitative results were analysed and interpreted separately before integration using a joint comparison table.²² Themes or subthemes that described the same or common meaning or concept as the subscale were compared by putting them on the same rows of the table. For example, quantitative and qualitative results describing leadership in the PCNs were placed in the same row. Based on interpretation of the quantitative and qualitative results (ie, ‘integrated analysis’), each row was then summarised into an overarching idea (ie, a ‘key concept’) that answered the research question. The integrated analysis was classified as confirming if the quantitative and qualitative results converged or agreed with each other,²² disconfirming if the quantitative and qualitative results diverged or contradicted each other, and expanded if the quantitative and qualitative results enhanced or provided a deeper understanding of each other. Additionally, the key concepts derived from the integrated analysis were guided by the CCM.²⁶ Thus, these key concepts tracked closely to the CCM but were not identical. This alignment reflected the dual interest in being able to: (1) map to the CCM as it was the overarching theoretical framing of the study and (2) highlight the strengths and areas for enhancement regarding diabetes care delivery in the PCNs based on the CCM.

Here is an example of how the integrated analysis was performed: The quantitative ACIC items 1–5 were



compared with the qualitative theme 5 ‘enablers provided for performing PCN care’ in the same row in the joint table (online supplemental table 7). This was because both quantitative and qualitative results contained common concepts of leadership and policies that facilitated diabetes care delivery in the PCNs. ACIC items 1–5 contained scores indicating good support for diabetes care, while three subthemes from theme 5 described good support for diabetes care. Since both quantitative and qualitative results agreed with each other, the integration was categorised as confirming. Contrastingly, ACIC item 6 ‘benefits’ was compared with theme 4 ‘financial aspects of PCN care’ and theme 6 ‘challenges faced in performing PCN care’ in the same row in the joint table. This was because both quantitative and qualitative results referred to the common concept of financial and organisational processes in performing diabetes care in the PCNs. Whereas ACIC item 6 had a score indicating basic to good support for diabetes care, four subthemes under theme 4 and theme 6 described financial and organisational obstacles faced in performing diabetes care in the PCNs. Since both quantitative and qualitative results diverged, the integration was categorised as disconfirming. During the integrated analysis, common concepts (leadership, policies and processes for diabetes care delivery) were thus identified in both quantitative and qualitative data. These concepts are also components within the CCM element of ‘Organisation of Healthcare Delivery System’.²⁶ Hence, the key concept ‘Organisation of Healthcare Delivery System has good support’ was derived. Besides tracking closely to the CCM as the

theoretical framework of the study, the key concept also highlighted the PCNs’ strength in this aspect of diabetes care delivery.

RESULTS

Quantitative results

Overall, 179 HCPs (17.4% of 1030 PCN HCPs) comprising 131 GPs, 18 nurses and 30 care coordinators, participated in the quantitative study (table 1). Their mean age was 45.20 years (SD 11.02, range 23–76). They have worked for a mean of 2.89 years (SD 1.15) in the PCNs and each managed about 50 patients (IQR 20–100) (table 2). There was missing data from three variables from 19 HCPs, comprising 1.2% of all data: (1) duration of working (from five GPs), (2) number of working hours per week (from two GPs) and (3) number of diabetes patients (from eight GPs and four nurses).

ACIC in the PCNs

The mean ACIC total score for the PCNs was 5.62 out of 11 (SD 1.93). The mean elements’ scores ranged from 4.91 (SD 2.37) (Community Linkages) to 6.69 (SD 2.18) (Organisation of Healthcare Delivery System) (table 2, online supplemental table 8). Results showed that being a care coordinator as compared with a GP and managing more diabetes patients were associated with higher ACIC total scores (table 3).

Qualitative results

A total of 65 HCPs comprising 38 GPs, 12 nurses and 15 care coordinators were interviewed. There were 30

Table 1 Healthcare professionals’ characteristics across Primary Care Networks types

	All (N=179)	GP-led type (N=76)	Group type (N=45)	Cluster type (N=58)	Effect size estimate (95% CI)*	P value
Age, years, mean (SD)	45.20 (11.02)	46.22 (10.75)	42.47 (9.03)	45.97 (12.50)	$\eta^2=0.02$ (0.00 to 0.07)	0.157
Gender, count (%)					Cramer’s V=0.17	0.087
Female	85 (47.5)	39 (51.3)	15 (33.3)	31 (53.5)		
Male	94 (52.5)	37 (48.7)	30 (66.7)	27 (46.6)		
Ethnicity, count (%)					Cramer’s V=0.15	0.137
Chinese	154 (86.0)	66 (86.8)	35 (77.8)	53 (91.4)		
Non-Chinese	25 (14.0)	10 (13.2)	10 (22.2)	5 (8.6)		
Education, count (%)					Cramer’s V=0.11	0.386
Secondary or technical	37 (20.7)	21 (27.6)	6 (13.3)	10 (17.2)		
University (Bachelors)	42 (22.9)	16 (21.1)	11 (24.4)	14 (24.1)		
Postgraduate	101 (56.4)	39 (51.3)	28 (62.2)	34 (58.6)		
Healthcare professional type, count (%)					Cramer’s V=0.12	0.263
GP	131 (73.2)	51 (67.1)	37 (82.2)	43 (74.1)		
Nurse	18 (10.1)	8 (10.5)	5 (11.1)	5 (8.6)		
Care coordinator	30 (16.8)	17 (22.4)	3 (6.7)	10 (17.2)		

*Effect size reported to two decimal places.
GP, general practitioner; η^2 , eta-squared point estimate.

Table 2 Practice characteristics and Assessment of Chronic Illness Care (ACIC) scores across Primary Care Networks (PCNs) types

	All (N=179)	GP-led type (N=76)	Group type (N=45)	Cluster type (N=58)	Effect size estimate (95% CI)*	P value
Work in PCN, years, mean (SD), (n=174)	2.89 (1.15)	2.64 (1.18)	3.28 (1.10)	2.93 (1.06)	$\eta^2=0.05^\dagger$ (0.00 to 0.12)	0.011‡
Working hours per week, mean (SD), (n=177)	35.81 (13.0)	34.21 (12.26)	40.98 (8.68)	33.96 (15.63)	$\eta^2=0.05^\dagger$ (0.00 to 0.12)	0.009‡
Numbers of diabetes patients, median (IQR), (n=167)	50 (20–100)	50 (20–100)	50 (20–120)	50 (25–100)	$\eta^2=-0.01$	0.742
ACIC scores, mean (SD) [§]						
ACIC total score	5.62 (1.93)	5.82 (1.96)	5.68 (2.01)	5.31 (1.82)	$\eta^2=0.01$ (0.00 to 0.06)	0.306
Organisation of Healthcare Delivery System	6.69 (2.18)	6.87 (2.17)	7.03 (2.19)	6.18 (2.12)	$\eta^2=0.03$ (0.00 to 0.08)	0.088
Community Linkages	4.91 (2.37)	5.05 (2.39)	4.47 (2.36)	5.06 (2.34)	$\eta^2=0.01$ (0.00 to 0.05)	0.355
Self-Management Support	5.37 (2.34)	5.73 (2.39)	5.07 (2.62)	5.14 (1.99)	$\eta^2=0.02$ (0.00 to 0.07)	0.215
Decision Support	5.80 (2.04)	5.87 (2.08)	6.04 (2.24)	5.53 (1.83)	$\eta^2=0.01$ (0.00 to 0.03)	0.434
Delivery System Design	5.64 (2.35)	5.99 (2.29)	5.80 (2.54)	5.07 (2.18)	$\eta^2=0.03$ (0.00 to 0.09)	0.066
Clinical Information Systems	5.95 (2.45)	6.18 (2.56)	6.30 (2.38)	5.39 (2.30)	$\eta^2=0.03$ (0.00 to 0.08)	0.097
Integration of Chronic Care Model Components	4.97 (2.28)	5.04 (2.26)	5.09 (2.57)	4.79 (2.09)	$\eta^2=0.00$ (0.00 to 0.03)	0.761

*Effect size reported to two decimal places.

†Small effect.

‡p<0.05.

§Interpretation of ACIC scores: 0–2 indicating ‘little support for diabetes care’, 3–5 indicating ‘basic support for diabetes care’, 6–8 indicating ‘good support for diabetes care’ and 9–11 indicating ‘full support for diabetes care’.

GP, general practitioner; η^2 , eta-squared point estimate.

males and 35 females with a median age of 44 years (IQR 33.5–52.0, range 23–61). We identified seven themes about the HCPs’ perspectives about diabetes care delivery in the PCNs in relation to the CCM (table 4): (1) PCNs provided much needed diabetes services, (2) PCN characteristics in diabetes care delivery

(comprising continuity of care, convenient access, team-based care, patient-centred care, goal setting, patients empowered for self-care and building rapport with patients), (3) collaborating with community partners, (4) financial aspects of PCN care, (5) enablers provided for performing PCN care, (6) challenges

Table 3 Linear mixed-effects regression model testing associations with Assessment of Chronic Illness Care total scores for healthcare professionals

Parameter	Estimate	95% CI	P value
Age, years	–0.02	–0.05 to 0.01	0.127
Non-Chinese ethnicity vs Chinese	0.57	–0.26 to 1.31	0.185
General practitioner (GP) vs nurse	–1.08	–2.30 to 0.14	0.101
GP vs care coordinator	–1.48	–2.28 to 0.68	<0.001*
Nurse vs care coordinator	–0.40	–1.51 to 0.71	0.481
Number of diabetes patients, per 50 patients	0.11	0.01 to 0.21	0.038†

*p<0.001.

†p<0.05.

**Table 4** Healthcare professionals' themes and subthemes about diabetes care

Themes	Subthemes
Theme 1 PCNs provided much needed diabetes services	1.1 PCNs provided ancillary services 1.2 Nurses provided mobile services to clinics 1.3 Nurses used protocols and guidelines in diabetes management 1.4 Care coordinators helped with coordination and follow-up
Theme 2 PCN characteristics in diabetes care delivery	2.1 Patients received continuity of care 2.2 Convenient access to PCN care 2.3 PCNs provided team-based care 2.4 Patients received patient-centred care 2.5 Patients received goal setting for their diabetes 2.6 Patients empowered for self-care through patient education 2.7 Building rapport with patients
Theme 3 Collaborating with community partners	3.1 Working with polyclinics 3.2 Working with community partners
Theme 4 Financial aspects of PCN care	4.1 Financial gradient between PCN clinics and polyclinics 4.2 PCN fees affordable for diabetes care 4.3 PCN fees may be a barrier to care
Theme 5 Enablers provided for performing PCN care	5.1 Integrated care delivery in PCNs 5.2 Leadership provided to PCNs 5.3 Quality improvement process in patient care 5.4 Incentives provided to PCNs 5.5 Training provided for PCN staff 5.6 Support provided to PCNs to do their work 5.7 Use of patients' medical records 5.8 Team camaraderie, trust and relationship
Theme 6 Challenges faced in performing PCN care	6.1 Fragmented care delivery in PCNs 6.2 Heterogeneity and autonomy of PCN practices 6.3 Lack of physical space in PCN clinics 6.4 Evaluating the effectiveness of PCN care on patient outcomes 6.5 Administrative work and data collection 6.6 Lack of access to medical records to manage patients with complex needs 6.7 Mismatch perceptions about nurse counselling
Theme 7 Aspects of care for enhancement	7.1 Increase use of technology in diabetes care 7.2 Enhance nurses' role in PCNs 7.3 Increase access to subsidised allied health services 7.4 Reduce variation in work processes 7.5 Having GPs with special interests in PCNs

GPs, general practitioners; PCNs, Primary Care Networks.

faced in performing PCN care and (7) aspects of care for enhancement.

PCNs provided much needed diabetes services

The HCPs agreed that PCNs provided useful diabetes services comprising diabetic retinal photography, diabetic foot screening and nurse counselling or education for their patients: 'She's a nurse educator, she does counselling, and I find it very useful. When you're looking at the patients' parameters, they get better when they follow her advice' (GP-3).

PCN characteristics in diabetes care delivery

Team-based care previously absent in the single-handed PCN clinics, was perceived by the GPs as important in improving chronic care. 'My patient came down for foot screening. The nurse picked up that she has a

foot infection. She took a picture and messaged me. I prescribed the medication and reviewed the patient soon' (GP-13).

Collaborating with community partners

The GPs suggested that they tapped into the government subsidised medications that the polyclinics were receiving: 'Our diabetes medications are not cheap, and they (the patients) get such a huge subsidy from polyclinic. My suggestion would be that they see me and the polyclinics send them the medications at polyclinic price' (GP-28).

Financial aspects of PCN care

Although there were Community Health Assist Scheme subsidies available at the PCNs to make care affordable for patients, there were concerns that the subsidies were insufficient, and that the subsidy amount should be

increased: 'I think giving patients that choice and empowerment so increasing their Community Health Assist Scheme subsidies ... Inflation, cost of living is a big issue, and there's never enough to go around' (GP-22).

Enablers provided for performing PCN care

The HCPs perceived that PCNs provided integrated patient-centred care to their patients that was structured and considered patients' individual needs and preferences: 'For patients, their benefit is that the GPs spend more time giving the consultation and explain about the conditions and the management plan. We (the PCNs) provide all the services in under one roof for foot screening and eye screening instead of referring patient to specialist clinics or polyclinics' (Coordinator-1).

Participants mentioned the team camaraderie, support and friendships that arose from joining a PCN: 'There's a sense of camaraderie. There's a bridge between the solo doctors and the larger primary care group such as the polyclinics. Besides diabetes, the larger picture is that we have support and resource that I think would have not been possible if it's just GPs alone' (GP-27).

Challenges faced in performing PCN care

The HCPs felt that fragmented care occurred in the PCNs when patients moved between the PCNs and the polyclinics:

'They (the patients) will come in ... certain medicines they collect from us (the PCN clinics), certain medicines they collect from the polyclinic. We do their tests, we'll discuss with them their medical conditions, we tweak the management, or we write a memo to the (polyclinic) doctor. But that's not an official shared care' (GP-33).

Nurses did not have adequate access to the patients' medical records which impeded their effectiveness in tailoring their advice to patients during counselling:

'When I cannot assess the clinic's system, it's based on a lot of my being a detective, my observation, and a detailed assessment before I can work in partnership with the patients. If I can have this information, then I'll be able to provide customised education to the patient more confidently' (Nurse-3).

Aspects of care for enhancement

The HCPs advocated for the greater use of technology in facilitating diabetes care in the PCNs: 'For improving PCN is to harness technology using tele-support, tele-collaborations. Singapore is land scarce, right? Can technology overcome it with tele-team care? Then we don't need the physical primary space' (GP-9).

Some GPs proposed that the PCNs should have GPs with special interests to increase their scope of work within the PCNs instead of referring patients to the hospital specialists: 'We're (the doctors) not good at everything. If you have several GPs working together, they may have a GP

with a special interest in a certain area, and they can do an internal referral' (GP-28).

Integrated analysis results

The ACIC elements' scores were integrated with the themes and subthemes using a joint comparison table, resulting in eight key concepts for diabetes care delivery in the PCNs (table 5): (1) CCM-consistent diabetes care delivery has basic support, (2) Organisation of Healthcare Delivery System has good support, (3) Community Linkages has basic support, (4) Self-Management Support has basic support, (5) Decision Support has basic support, (6) Delivery System Design has basic support, (7) Clinical Information Systems has basic support and (8) Integration of Care has basic support. Overall, the qualitative findings supported the CCM-consistent diabetes care delivery in the PCNs, with 19 confirming subthemes, 15 disconfirming subthemes, two expanded subthemes and one subtheme that was not integrated with the quantitative findings (online supplemental table 7). Support provided to PCNs to do their work (subtheme 5.6) was both confirming and disconfirming for the key concept of Decision Support receiving basic support in the PCNs. Among the CCM elements, Organisation of Healthcare Delivery System, Self-Management Support, Decision Support, Delivery System Design and Clinical Information Systems were more supported than Community Linkages and Integration of Care.

DISCUSSION

The PCNs received support to provide CCM-consistent patient-centred diabetes care which differed according to the ACIC elements. The HCPs perceived that Organisation of Healthcare Delivery System, Self-Management Support, Decision Support, Delivery System Design and Clinical Information Systems in the PCNs were more supported than Community Linkages and Integration of Care.^{30 31}

CCM-consistent diabetes care delivery

Our study found that there was basic support for CCM-consistent diabetes care delivery in the PCNs. Although the PCNs attempted to deliver integrated under-one-roof diabetes care for patients, there was still fragmentation. For example, coordinating care with patients who moved between polyclinics and the PCN clinics and allowing access to patients' medical information for the nurses, could be better integrated.

Organisation of Healthcare Delivery System

Our finding of good support in the PCNs was congruent with other studies.^{32 33} Support from PCN leaders for high-quality chronic disease management, quality improvement in diabetes care and incentives encouraged the HCPs to provide high quality diabetes care. Contrastingly, the HCPs described how the financial gradient between PCNs and polyclinics influenced how patients perceived

**Table 5** Healthcare professionals' joint comparison table showing integrated analysis of quantitative and qualitative results

Integrated analysis		Quantitative results	Qualitative results
Key concepts for diabetes care	Classifying the integration	ACIC total or element score (mean score/SD, interpretation)*	Themet†
Chronic Care Model-consistent diabetes care delivery has basic support	Confirming	ACIC total score (5.62/1.93, basic support)	Enablers provided for performing PCN
	Disconfirming		Challenges faced in performing PCN care
Organisation of Healthcare Delivery System has good support	Confirming	Organisation of Healthcare Delivery System (6.69/2.18, good support)	Enablers provided for performing PCN care
	Disconfirming		Financial aspects of PCN care Challenges faced in performing PCN care
Community Linkages has basic support	Confirming	Community Linkages (4.91/2.37, basic support)	Financial aspects of PCN care
	Disconfirming		Collaborating with community partners
Self-Management Support has basic support	Confirming	Self-Management Support (5.37/2.34, basic support)	PCN characteristics in diabetes care delivery
	Disconfirming		Challenges faced in performing PCN care
Decision Support has basic support	Confirming	Decision Support (5.80/2.04, basic support)	PCNs provided much needed diabetes services Enablers provided for performing PCN care
	Disconfirming		Enablers provided for performing PCN care
Delivery System Design has basic support	Confirming	Delivery System Design (5.64/2.35, basic support)	PCNs provided much needed diabetes services PCN characteristics in diabetes care delivery
	Expanded		Aspects of care for enhancement
	Disconfirming		Challenges faced in performing PCN care Aspects of care for enhancement
Clinical Information Systems has basic support	Confirming	Clinical Information Systems (5.95/2.45, basic support)	Enablers provided for performing PCN care
	Disconfirming		Challenges faced in performing PCN care
Integration of Care has basic support	Confirming	Integration of Chronic Care Model Components (4.97/2.28, basic support)	PCNs provided diabetes services PCN characteristics in diabetes care delivery
	Disconfirming		Challenges faced in performing PCN care Collaborating with community partners
–	Integration not possible	–	Enablers provided for performing PCN care

*Interpretation of ACIC scores: 0–2 indicating 'little support for diabetes care', 3–5 indicating 'basic support for diabetes care', 6–8 indicating 'good support for diabetes care' and 9–11 indicating 'full support for diabetes care'.
†Qualitative themes from healthcare professionals.
ACIC, Assessment of Chronic Illness Care; PCNs, Primary Care Networks.

that polyclinics were more affordable than GP clinics despite financial enablers such as the Community Health Assist Scheme.

Community Linkages

This element received the least support for diabetes care in the PCNs, contrasting with literature.^{33 34} Although there were community providers in Singapore, the HCPs did not refer their patients to them due to challenges such as matching patients' needs to the resources, the

lack of clinical follow-up with the community providers and familiarity of referring patients to the polyclinics.

Self-Management Support

Effective Self-Management Support improved clinical indicators, health-related quality of life, self-efficacy,³⁵ disease knowledge³⁵ and reduced healthcare utilisation.³⁶ The HCPs integrated patient-centred Self-Management Support in the PCNs. They used structured education to empower and support patients in embedding self-care in

their lives. This education was coupled with follow-up, provision of self-help materials to improve their disease or treatment knowledge, help with psychological coping, and increasing their responsibility in medication adherence and making lifestyle choices.

Decision Support

The HCPs received good support for the use of evidence-based guidelines and protocols, training and administrative support for their work. However, the diabetes guidelines were not embedded within the clinic management system, thus limiting its effectiveness in providing clinical decision support for the HCPs.³⁷ Additionally, support from specialists in diabetes care in the PCNs was uncommon. To ensure a successful integration between the specialists and PCNs in providing diabetes care, joint planning, integrated information communication technology, shared clinical priorities, incentives and continuing professional development should be present.³⁸

Delivery System Design

There was evidence of continuity of care, convenient access, team-based care and provision of ancillary services in the PCNs.^{18 39} The HCPs demonstrated willingness to collaborate to deliver high-quality care, aligning with literature that suggested that strong networks and increased communication between providers facilitated CCM implementation.⁴⁰ The HCPs also opined that the nurses should play a greater role in the PCNs, a view congruent with studies advocating that nurses should be integrated into GP practices.⁴¹ Hence, the PCNs should address the nurses' scope of practice, funding and training to expand their role. Additionally, the HCPs called for increase access to subsidised allied health services such as dietitian, podiatry and physiotherapy. The allied health professionals could assist the PCNs in the assessment and treatment of diabetes patients⁴² and diabetes complications such as leg ulcers.⁴³

Furthermore, the HCPs advocated an increase in technology use in diabetes care to enhance patients' self-management and adherence and mitigate the lack of clinic space for patient care. While telehealth interventions have been shown to improve diabetes health outcomes, clinical monitoring and management,⁴⁴ supporting patients' self-management efforts,⁴⁵ and barriers such as lower socioeconomic status, limited language proficiency and access to technology, for example, internet, should be addressed before implementation.⁴⁶ Finally, there were mixed views from the PCNs GPs about having GPs with special interests in the PCNs through learning extra skills to manage chronic conditions beyond routine GP care. Potential advantages could be increased access to specialist investigations, increased job satisfaction and improved access for patients,⁴⁷ while disadvantages include fragmentation of care and de-skilling of GPs who did not have special interests. A 2019 systematic review called for greater workforce clarity and regulation of GPs with special interests.⁴⁸

Clinical Information Systems

The HCPs used shared patients' electronic medical records to follow-up on patients' treatment plans. The collaborative use of the Clinical Information Systems can improve patients' health outcomes by enhancing feedback to providers and improving their responses, for example, medication adjustment to clinical data¹⁵ and improving guideline adherence.⁴⁹ Additionally, the PCNs conducted quality improvement sessions for their teams to improve their performance in diabetes care using data from the medical records or the Chronic Disease Registry.⁵⁰ However, there were barriers to the care delivery such as the lack of access to medical records for the nurses to manage patients with complex needs and the Chronic Disease Registry not linked to guidelines or reminders.

Integration of Care

After joining the PCNs, the GP clinics were adapting their processes and workflows to do things differently. Within the PCN clinics, there were different stakeholders involved in the work processes. Many nurses and care coordinators were not employees of the GP clinics. Their work processes were determined by the PCN Headquarters and less likely to align to the processes determined by the GPs. For example, the nurses used health education materials that were different from what the GPs used. Another example was the challenge involved in the integration of the clinic management system to ensure continuity, coordination and follow-up of patients within the clinic, with community partners and with the national electronic health records. Hence, integration between different processes, workflows and CCM elements within the PCNs needed more engagement from key stakeholders in obtaining an understanding what was required, and the resources needed for integrating care.⁵¹

Team camaraderie, trust and relationship built through joining the PCNs was unexpected but welcoming to the HCPs. Trust among the PCN HCPs indicated their willingness to collaborate to deliver care, have informal peer sharing and learning, exchange of patients' information through electronic medical records, sharing of professional knowledge and balancing out members' differences in skills and contributions to the networks.⁵² The PCNs should continue to build on this core strength of team camaraderie to facilitate collaborations within and without their PCNs to enhance diabetes care delivery for their patients.

Associations of ACIC total score with HCPs' characteristics

In this study, the care coordinators as compared with GPs gave higher ACIC scores. The care coordinators have less clinical interaction with patients and might not have accurately evaluated the practice characteristics related to the CCM elements, as compared with the GPs. However, it was important to involve a mixture of clinicians and non-clinician HCPs to ensure a more balanced perspective on the care delivery in the PCNs.²⁵ Additionally, managing

more diabetes patients in the PCNs and thus having more frequent interactions with the clinics processes was associated with the perception of more CCM-consistent care.

Study limitations include the following: first, the observational cross-sectional design did not make possible to assess causality in the observed associations between participant and clinic features, and perceived quality of care in the quantitative study data. Additionally, the data was obtained by participants' self-reporting that could have recall bias and social desirability bias. Due to limitation of resources, neither objective measures nor external validation of the reported data were incorporated in this study. Second, convenience sampling was used for HCP recruitment, raising concerns about selection bias, thus affecting the generalisability of the findings. However, the HCPs in the study were recruited across all PCNs to ensure fair representation. Thus, the results obtained from this sample might accurately reflect the characteristics and behaviours of the entire population. Third, there was no information about the non-PCN GP clinics, and other non-participating HCPs to compare their characteristics with our participants. However, the inputs from HCPs across the 10 PCNs were sought in a rigorous way that might mitigate these limitations. Additionally, we used the CCM, a validated and relevant care model to evaluate the consistency of diabetes care delivery and to give recommendations for practical enhancements of the PCNs. Finally, the mixed-methods integrated the study findings to derive meaningful recommendations to enhance the care delivery in the PCNs. Future research should consider using independent observers in completing the quantitative component instead of the HCPs. Additionally, external validation using objective data such as resource allocation, patient outcomes or adherence to clinical guidelines within the PCNs can be performed. This approach will provide a more objective and comprehensive assessment of the support for diabetes care delivery.

CONCLUSION

This mixed-methods study found that there was support for diabetes care delivery consistent with the CCM in the Singapore PCNs. The PCNs HCPs perceived support for the elements of Organisation of Healthcare Delivery System, Self-Management Support, Decision Support, Delivery System Design and Clinical Information Systems for diabetes care delivery. However, Community Linkages and Integration of Care required enhancement.

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ORCID ID

Lay Hoon Goh <http://orcid.org/0000-0003-1536-3050>

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