Implementation of Chronic Care Model for Diabetes Self-Management: A Quantitative Analysis

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Abstract: Objective: The main aim of this study was to implement the Chronic Care Model (CCM) for the self-management of type 2 diabetes in primary health care settings of rural areas of Pakistan and identify its effectiveness and develop strategies for overcoming its challenges. The two core elements of the Chronic Care Model: patient Self-Management Support (SMS) and Delivery System Design (DSD), were implemented to improve the quality of life and risk behaviour of type 2 diabetes patients in the middle-aged population of rural Pakistan. Methods: Thirty patients with type 2 diabetes and 20 healthcare professionals were included in this study consisting of 10 general practitioners and 10 nurses recruited from various clinics (medical centres) of Al-Rehman Hospital in Abbottabad, Pakistan. The quantitative content analysis method was used to identify the frequency of the most recurring statements. A *t*-test was performed to see the mean difference of HbA1c at baseline after 3-months and 6-months follow-up between male and female patients with diabetes. The hypothesis was tested to identify that diabetes self-management has a gendered dimension in rural areas of Pakistan. Results: The quantitative analysis demonstrated that diabetes self-management has a gendered dimension in the rural areas of Pakistan as the mean difference of HbA1c after a 6-month intervention of the two components of the chronic care model between male and female patients of diabetes was 0.83 ($p = 0.039$) with 95% CI (-0.05; -1.61). The mean difference in BMI after the intervention of 6 months between males and females was significant ($p < 0.05$). The mean difference was 4.97 kg/m^2, $p = 0.040$ with 95% CI (-0.24; -9.69). The results have shown that the two components of CCM were effective and improved clinical outcomes for diabetes patients of the rural areas of Pakistan. Conclusions: The application of the two Chronic Care Model's components provided a viable structure for diabetes self-management education and assistance. As a result, developing systems that incorporate long-term diabetes self-management education has an effect on the health care system's outcomes.

Keywords: Chronic Care Model; self-management of type 2 diabetes; chronic disease; healthcare system of Pakistan; patients' quality of life

1. Introduction

Diabetes is one of the most prevalent metabolic illnesses worldwide, resulting in a high rate of morbidity and mortality in Pakistan (WHO, 2003 [1]; Jafar et al., 2006 [2]; Akhtar et al., 2019 [3]). According to data, Pakistan is one of the top ten countries in the world for people with diabetes aged 20 to 79 years (Whiting et al., 2011 [4]). As a result, type 2 diabetes mellitus is a serious health concern in Pakistan. Adnan and Aasim (2020 [5]) conducted a pooled analysis (meta-analysis) of the prevalence of Type 2 diabetes in the adult population of Pakistan and reported a higher pool estimate of diabetes in males than in females (13.1% vs. 12.4%).

The Chronic Care Model (CCM) was created with the primary objective of enhancing the healthcare system and facilitating individual and population health interventions. The Chronic Care Model's applications helped to emphasize patient-centred care and an interdisciplinary approach (AGDHA, 2006 [6]; Anderson et al., 1986 [7]). This study discusses the CCM, providing evidence of its efficacy and describing in detail the two key elements of the model that are used to address self-management of type 2 diabetes in the middle-aged population of the rural areas of Pakistan.

The knowledge and skills in diabetes self-management are critical to effective diabetes management and self-care (Burke et al., 2014 [8]). The Chronic Care Models emphasize patient-centred care, patient empowerment, and support for self-management. There is evidence that therapies based on these principles enhance health status in chronic disorders (Bojadzievski and Gabbay, 2011 [9]; Stellefson et al., 2013 [10]).

Diabetes educators and healthcare professionals employ evidence-based healthcare delivery models such as the Chronic Care Model to improve outcomes for persons with diabetes. It was revealed from the literature reviews that out of 12 studies, six studies showed evidence of the effectiveness of the CCM for type 2 diabetes self-management in primary care settings as well as significant improvements in clinical outcomes (Piatt et al., 2006 [11]; Hiss et al., 2007 [12]; Piatt et al., 2010 [13]; Carter et al., 2011 [14]; Foy et al., 2011 [15]; Lee et al., 2011 [16]).

This study examines two critical components of the Chronic Care Model: patient self-management support (SMS) and delivery system design (DSD) for middle-aged patients with type 2 diabetes in rural Pakistan. It evaluates the effectiveness of these CCM components in improving patients' diabetes self-management approach, quality of life, risk behaviour, knowledge and awareness of diabetes and its complications, and treatment adherence.

The International Diabetes Federation estimates that 463 million people had diabetes in 2019 and 700 million by 2040. Thus, diabetes mellitus is clearly one of the most rapidly evolving health concerns of the twenty-first century. Type 2 diabetes accounts for approximately 90% of all diabetes cases worldwide. Type 2 diabetes is anticipated to cost the global economy USD 760 billion in 2019 and USD 845 billion by 2045 [17] (IDF, 2019).

The incidence rate of diabetes in Pakistan is expected to increase to 15% (13.8 million people) by 2030. (WHO, 2003 [1], WHO, 2014 [18]). As a result, Pakistan is rated seventh in terms of diabetes prevalence (Jafar et al., 2006 [2]). This increases the risk of developing type 2 diabetes in the community (Jafar et al., 2005 [2]; Ansari, 2009 [19]; Whiting et al., 2011 [4]).

The CCM is the most often utilized care model (Wagner, 1996 [20]). The model is composed of six components (Figure 1): delivery system design (DSD), self-management support (SMS), decision support, clinical information systems (all implemented at the practice level), and at the community level, there are two components such as community resources and health care organizations (Bodenheimer et al., 2002 [21]; Wagner, 1996 [20]).

The two important components of CCM were studied in this article and applied to primary health care to see how effective the two elements of the CCM, patient "Self-Management Support" (SMS) and "Delivery System Design" (DSD), were in improving the quality of life and risk behaviour of Type 2 diabetes patients.

The literature review revealed that attempts had been made to examine the efficacy of the CCM on chronic illness outcomes and the extent to which the CCM's components have benefited primary health care (Bodenheimer et al., 2002 [22]; Tsai et al., 2005 [23]). The findings indicated that including one or more CCM elements resulted in improved patient or process outcomes for a number of chronic conditions (Wagner et al., 1996 [20]). Diabetes (lower HbA1c levels), heart failure, asthma, and depression all had the strongest evidence (Tsai et al., 2005 [23]).
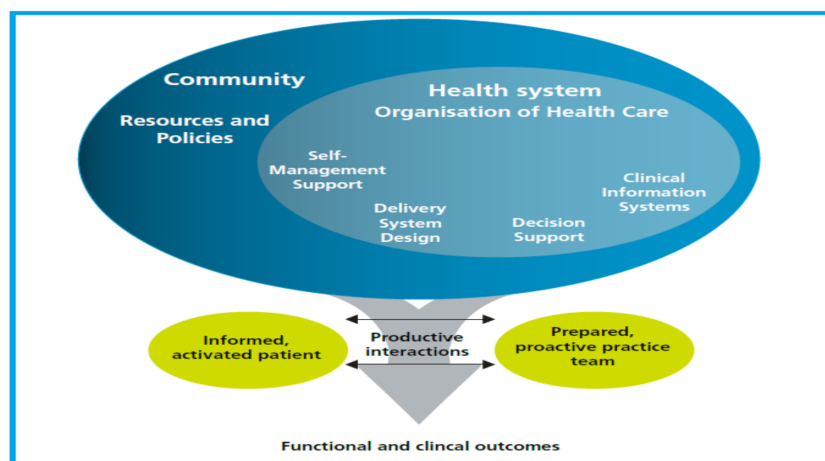
Figure 1. The Wagner Chronic Care Model with its elements: Source: Wagner et al. (1996) [20].

A study was conducted by Zwar et al. (2006) [24] aimed at examining the efficacy of the components of CCM on chronic illness outcomes and the extent to which the CCMs components have benefited primary healthcare. The usefulness of the four elements of CCM was identified by Zwar et al. (2006) [24] following the results of 23 systematic reviews.

In addition, there were six reviews on type 2 diabetes (Deakin et al., 2005 [25]; Norris et al., 2001 [26]; Norris et al., 2002 [27]; Fass et al., 1997 [28]; Loveman et al., 2003 [29]; Van Dam et al., 2003 [30]), two reviews on asthma (Powell and Gibson, 2002 [31]; Toelle and Ram, 2004 [32]), one on chronic obstructive pulmonary disease (Turnock et al., 2005 [33]), one on hypertension (Boulware et al., 2001 [34]) and one on arthritis (Stellefson et al., 2013 [10]).

It has been reported that out of six reviews on diabetes, only four reviews showed that patients with diabetes were in a position to understand the importance of diabetes self-management (Deakin et al., 2005 [25]; Norris et al., 2001 [26]; Norris et al., 2002 [27]; Loveman et al., 2003 [29]). The other two reviews established a link between increased knowledge and improved patient outcomes for diabetes group training (Deakin et al., 2005 [25]) and for self-management education in community meeting places (Norris et al., 2002 [27]).

2. Application of Chronic Care Model in Pakistan

In Pakistan, there is no teamwork approach to self-management support, and delivery system design does not have an adequate structure (Rafique and Shaikh, 2000 [35]) as recommended by the American Diabetes Association (ADA, 2016 [36]). There is no evidence in Pakistan for implementing the Chronic Care Model in the primary health care system besides the fact that diabetes is the main priority in the country (Hakeem and Fawwad, 2010 [37]; Ansari et al., 2016 [38]).

2.1. Self-Management Support (SMS)

The Chronic Care Model's self-management support component was included in this study for diabetics in rural Pakistan. The research shows that self-management support improves patient-level outcomes such as physiological disease markers, quality of life, health status, and satisfaction (Zwar et al., 2016 [24]). Overall, patient self-management support (SMS) was the most commonly used intervention, followed by clinician decision support (Page et al., 2005 [39]) and delivery system design (Turnock et al., 2005 [33]).

These results support a previous analysis of the elements of the CCM by Tsai et al. (2005) [23] and further analysis of patient and provider interventions by Weingarten et al. (2002) [40]. The effectiveness of the CCM for type 2 diabetes self-management in primary care settings, as well as significant improvements in clinical outcomes, was also identified by Baptista et al. (2016) [41] in their systematic review. The systematic review conducted

by Reynolds et al. (2018) [42] confirmed that self-management support is the most frequent Chronic Care Model intervention, and it is associated with statistically significant improvement, predominantly for diabetes. Despite the benefits associated with self-management of diabetes, most patients in the middle-aged population of Pakistan do not adhere to self-management recommendations (IDF, 2014 [43]; Jafar et al., 2006 [2]).

Following the recommendations and barriers are both troublesome for lifestyle behaviours such as food habits and physical exercise, rather than modifying adherence (WHO, 2003 [1]; Narayan, 2005 [44]; Jafar et al., 2006 [2]; Ansari, 2009 [19]). This is evident in the culture, history, and lifestyle behaviour of rural Pakistanis, whose dietary habits and physical activity present significant challenges for the middle-aged population in managing type 2 diabetes (Hasan et al., 2000 [45]; Rafique and Shaikh, 2000 [35]).

2.2. Delivery System Design (DSD)

Delivery system design (DSD) entails collaboration among diverse groups of health professionals. Interventions that addressed delivery system design improved adherence to guidelines, patient service utilization, and disease-related physiological measures (Zwar et al., 2006 [24]). Numerous scholars have argued in favour of modifying the design of the delivery system in order to improve patient health care services (Coleman et al., 1998 [46]; Norris et al., 2002 [27]; Rich et al., 1995 [47]; Shojania et al., 2006 [48]).

Among delivery models, case management has frequently been highlighted as an effective strategy (Rich et al., 1995 [47]). Coleman et al. (1998) [46] asserted that case management is successful at mitigating the negative consequences of lower resources. Case management is positively associated with the improvement of patients' healthcare services (Norris et al., 2002 [27]).

3. Material and Methods

3.1. Study Design

The quantitative content analysis method was used to specifically identify the frequency of the most frequent responses or statements. The findings of qualitative thematic analysis based on the interviews and its analysis provided useful information for this study to carry out the quantitative analysis (Ansari et al., 2021 [49]).

In the literature, there was no evidence of similar types of previous studies (qualitative or quantitative) with the same idea and sample composition exploring different perspectives of diabetes patients and healthcare professionals as described in this study. This is a retrospective study that uses the same database which was used in our previous publication related to qualitative studies (Ansari et al., 2021 [49]). The study was approved by the ethics committee of the University of New South Wales, Australia (ref: HC16882), and by Ayub Medical Institutions, Abbottabad, Pakistan, from the office of the Chairman Medical Ethics Committee. Moreover, written consent to participate in this study was obtained from the participants using the UNSW participant information statement and consent form.

3.2. Research Participants

Thirty people with type 2 diabetes were chosen from the total group of participants. Male and female involvement was kept equal (50 percent each). The individuals' mean age was 52 years (range 40–65 years, SD = 6.83), and the mean time from diagnosis was 8.5 years (range 3–12 years, SD = 2.7). The HbA1c levels for both men and women patients were 9.26 (range from 7 to 13 percent, SD = 1.80) in the hospital's medical records. The BMI was 28 kg/m^2 (range: 17.8–46.1, SD = 7.18).

The other group of volunteers included 20 healthcare professionals, including 10 nurses and 10 doctors. Males and females were evenly represented. The same authors described the recruitment process, study teams, and qualitative analysis (Ansari et al., 2019 [19]). The study was conducted in rural Abbottabad. Abbottabad had 1.1719 million residents in 2010. (NIPS, 2013). The city is 110 km north of Islamabad (the capital city). Around 80% of the

population lives in rural areas with 19 basic healthcare clinics, five of which are affiliated with the hospital where the study was done (UNDP, 2013; NIPS, 2013).

3.3. Statistical Analysis

The statistical analysis was performed using STATA 15 software (StataCorp. 2015. Stata Statistical Software: Release 15. College Station, TX: StataCorp LP). A *p*-value < 0.05 was considered as the criterion for statistical significance. In order to assess the demographic characteristics and clinical measurements between the variables, a *t*-test was performed and used to evaluate the predictors and their association with glycaemic control. The hypothesis was tested to identify that diabetes self-management has a gendered dimension in rural areas of Pakistan.

3.4. Data Collection

Face-to-face interviews with 30 type 2 diabetes patients and 20 healthcare workers (10 general practitioners and 10 nurses) were done in the Urdu language in a clinical environment at several Al-Rehman hospital medical facilities in Pakistan.

The primary author and an auxiliary nurse from the medical centre participated in semi-structured interviews. The interviewees were moderated by the primary author, who encouraged individuals to express their perspectives. Participants were urged to offer their perspectives on the issues raised. Each interview lasted between 30 and 40 min. The interviews, which were semi-structured, were transcribed and translated from the Urdu language. Following an initial check to confirm that data collection was complete, all participant identifying information was erased, and objective identifiers were put on the transcripts to ensure participant anonymity. The questionnaire utilized in this study was aligned with the Chronic Care Model's components, and the questions were identical for patients and healthcare providers.

4. Results

The two major themes of CCM at the practice level (Table 1) have been discussed in detail below for patients with diabetes in the middle-aged population of rural areas of Pakistan. These are the themes of self-management support (SMS) and delivery systems (DSD) design. These themes were discussed in detail by the same authors (Ansari et al., 2021 [49]) as part of qualitative analysis. The statements provided by participants throughout the interviews were categorized into subthemes according to the Chronic Care Model's components. The examination of data from 30 patients and 20 healthcare professionals yielded 340 statements from all 50 participants (*n* = 50), which were classified into six major Chronic Care Model themes. Male and female patients with Type 2 diabetes made a total of 226 statements, as indicated in Table 1. A total of 114 statements were made by healthcare professionals.

Table 1. The number of factors affecting the self-management of type 2 diabetes outcome (*n* = 50) (Ansari et al., 2021 [49]).

Themes (CCM)	Type 2 Diabetes Patients (Statements)		Health Professionals (Statements)	Total (Statements)
Practice Level	**Male**	**Female**		**N (%)**
Delivery System (DSD)	20	10	30	60 (18)
Self-management (SMS)	22	25	21	68 (20)
Decision Support	19	10	20	49 (14)
Clinical Information	20	19	11	50 (15)
Community and System Level				
Community Resources	20	40	20	80 (23)
Health Care System	10	11	12	33 (10)
Total Statements	111	115	114	340 (100)

4.1. Quantitative Analysis

The quantitative analysis was carried out considering the two important components of CCM and applied to the primary health care system with an objective to study how effective the two components of the CCM (Self-Management Support and Delivery System Design) were in improving the self-management approach and risk behaviour of patients with type 2 diabetes in the middle-aged population of rural Pakistan.

The American Diabetes Association (ADA) recommended a collaborative approach to self-management assistance and delivery system design (Rafique and Shaikh, 2000 [35,36]; ADA, 2016). However, there was a gap in recommended evidence-based diabetes care and practice in the rural areas of Pakistan (Rafique and Shaikh, 2000 [35,36]; ADA, 2016), and hence, quality improvement strategies and key performance indicators used to measure the improvement of the quality of diabetes care delivered were misaligned.

This quantitative research aimed at addressing the above-mentioned gap through the application of the two main components of the CCM model, which allowed for better measurement of care outcomes against quality improvement strategies.

The specific question related to this research was:

Do the components of the Chronic Care Model improve clinical outcomes for patients with type 2 diabetes in the rural areas of Pakistan?

This study identified that diabetes self-management has a gendered dimension in rural areas of Pakistan, and this research gap was addressed in this study by using the two components of CCM.

We hypothesized that the mean difference of HbA1c (%) between males and females at the follow-up after 6-months would be equal in the two groups of participants.

The two subthemes of the self-management support (SMS), patients' central role in managing type 2 diabetes and effective self-management support strategies, were implemented based on the various statements made by the patients during qualitative analysis (Ansari et al., 2021 [49]). There was a lack of knowledge about diabetes, and patients did not view themselves as actively managing their disease. The other important aspect was the patients' desire to attend the educational/information classes on diabetes self-management in the local language.

The educational classes were arranged for the patients providing information about the diabetes self-management approach and explaining the complications of diabetes in case the disease is not controlled. Nurses played an important role and prompted great interest among the patients in attending the classes regularly. The nurses conducted the educational classes for six months, 3 days a week, and one hour with each group of 15 patients with diabetes.

The overall impact of the lectures was evident as the patients reported going to the walk regularly, being more careful with their eating habits and selecting healthy food to eat, and showing more interest in monitoring blood glucose. The patients were using their prescribed medications as usual.

The self-management support (SMS) component was most effective, which allowed for better measurement of care outcomes, that is, improved and better management and control of blood sugar. However, the implementation of the other core element of the Chronic Care Model, "Delivery System Design", helped to influence the self-management activities of the middle-aged population of rural areas.

This core element of CCM facilitated routine, proactive scheduled visits of general practitioners incorporating the patients' goals and assisting individuals in maintaining optimal health and enabled the health system to manage its resources more effectively.

The database of the patients participating in this research was updated in the electronic system of the primary health clinic. The baseline medical record was already available before the start of the research work. The results of metabolic indicators tests were recorded in the electronic system after 3 months and 6 months intervals of implementation of the two components of the Chronic Care Model.

4.2. Application of the Two Components of CCM

4.2.1. Baseline Analysis of HbA1c

The *t*-test in Table 2 shows that the mean difference of HbA1c at baseline analysis between male and female patients with diabetes is 0.43 and that difference is statistically non-significant (*p* = 0.519) with 95% CI (0.92; 1.79). Figure 2 shows the scatter plot of HbA1c and age variables by sex at baseline analysis while Figure 3 shows the histograms of the distribution of data for male and female patients. The histogram in Figure 3 for females is right-skewed, that is, the mode (7.0) is less than the median (9.0), and the median is less than the mean (9.2). The histogram for males is approximately normal. The following Figure 4 shows these statistics on the histograms.
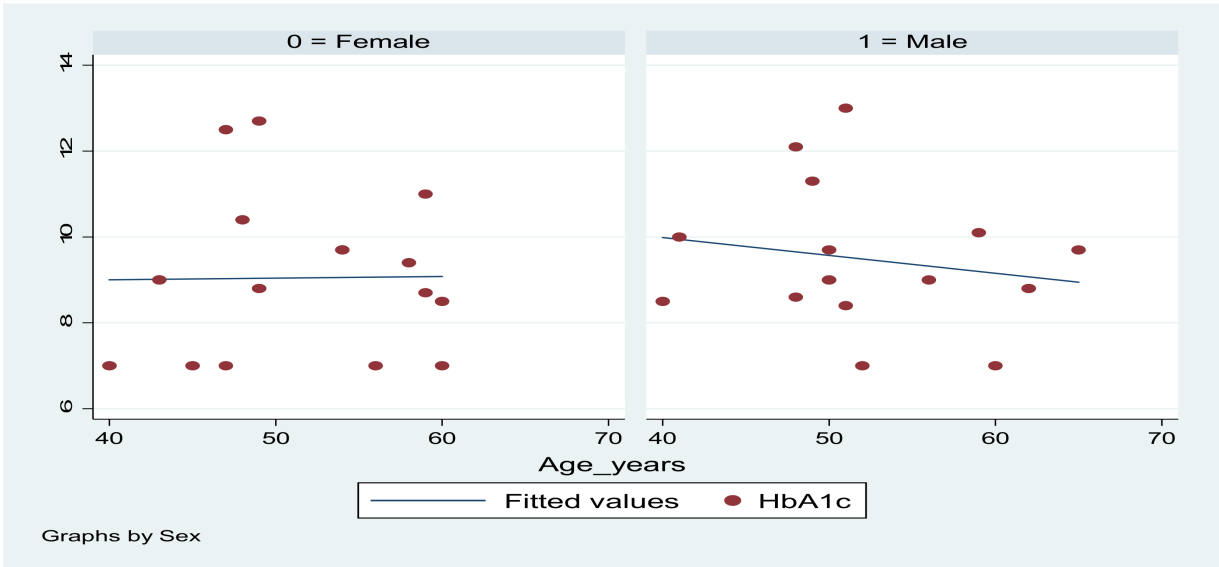

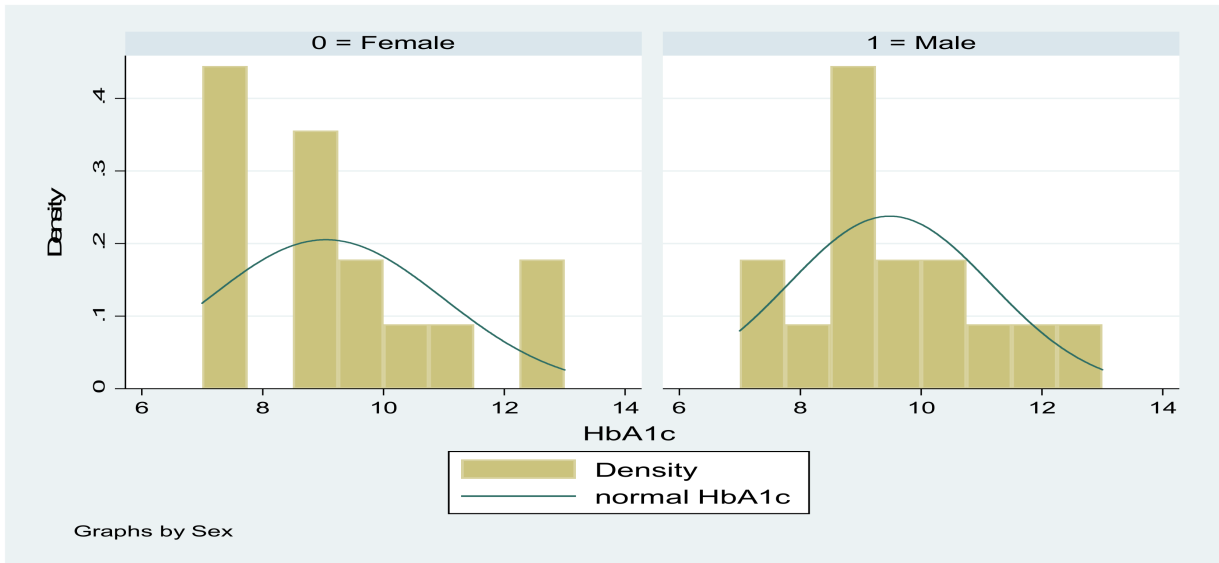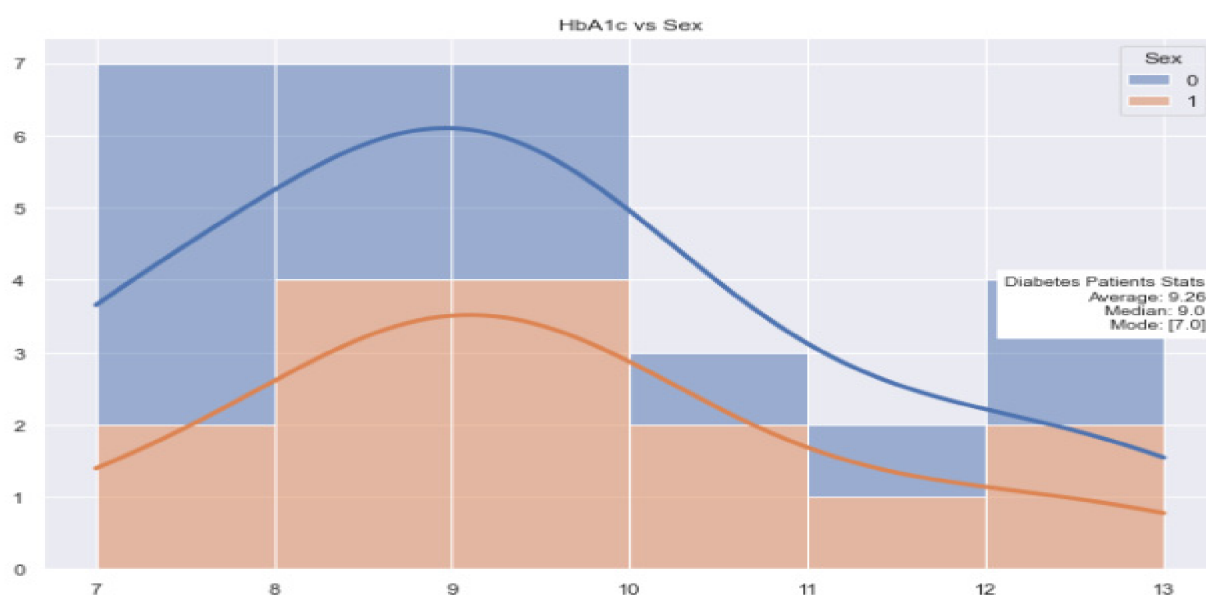**Figure 2.** Scatter plots of HbA1c and age variables by sex at baseline analysis.

Figure 3. The histograms of HbA1c variable by sex at baseline analysis.

Table 2. Summary statistics of two-sample *t*-test of HbA1c by sex in the sample of the population at baseline analysis.

Sex	N	Mean (HbA1c %)	SD (HbA1c)	Confidence Interval (CI)	
Male	15	9.48	1.68	8.55–10.41	
Female	15	9.05	1.94	7.97–10.12	
Combined	30	9.26	1.80	8.59–9.93	
Difference		Mean	*t*-value	CI	*p*-value
(Male-Female)		0.43	−0.654	0.92–1.79	0.519

Figure 4. The histograms of HbA1c by sex show statistics at baseline analysis.

4.2.2. After the 3-months intervention of CCM components

The *t*-test in Table 3 shows that the mean difference of HbA1c after a 3-month intervention of the two components of the Chronic Care Model in the sample population between male and female patients with diabetes is 1.06, and that difference is statistically significant ($p = 0.041$) with 95% CI ($-0.05; -2.09$). Figure 5 shows plots of HbA1c and age variables by sex after 3 months.

Table 3. Summary statistics of two-sample *t*-test of HbA1c by sex in the sample. of population after 3-months follow-up.

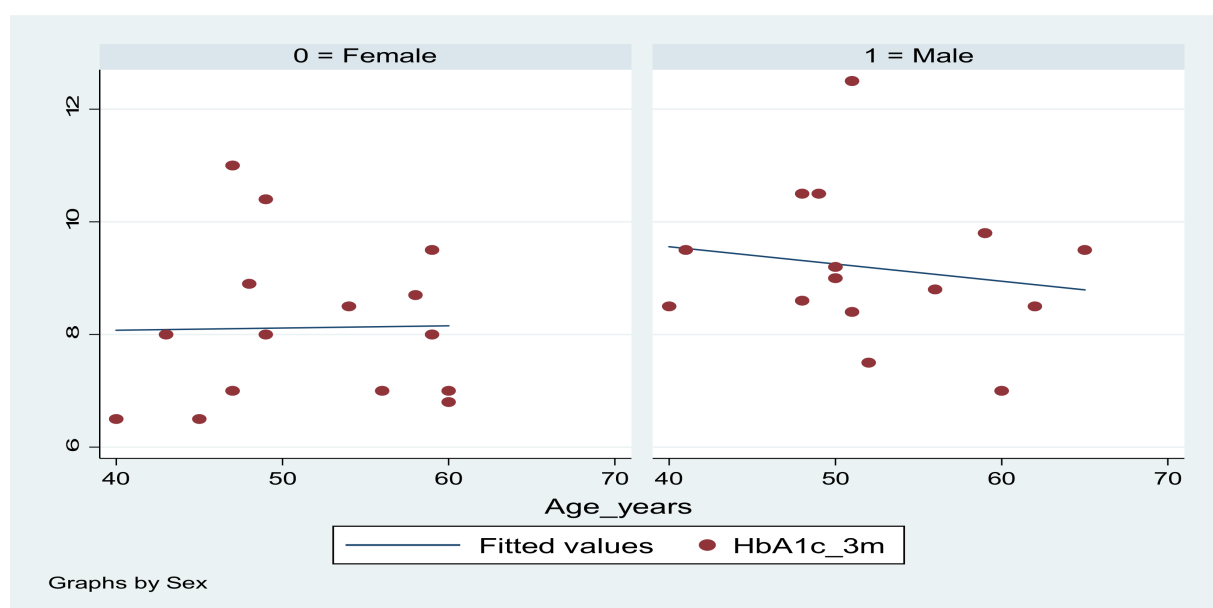| Sex	N	Mean (HbA1c %)	SD	Confidence Interval (CI)	
Male	15	9.19	1.33	8.45–9.92	
Female	15	8.12	1.40	7.35–8.89	
Combined	30	8.65	1.44	8.11–9.19	
Difference		Mean	*t*-value	CI	*p*-value
(Male-Female)		1.06	−2.144	−0.05−−2.09	0.041

Figure 5. Scatter plots of HbA1c and age variables by sex after 3 months.

The histogram in Figure 6 for female patients is right-skewed, that is, the median (8.55) is less than the mean (8.65). The histogram for male patients in Figure 6 is approximately normal. Figure 7 shows these statistics on the histograms.
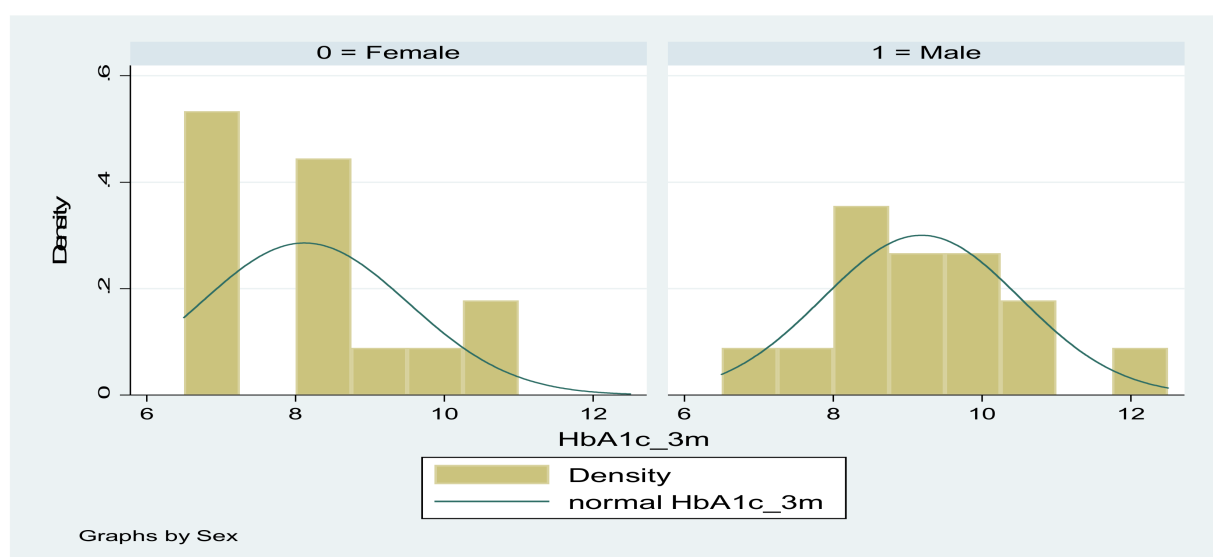

Figure 6. The histograms of HbA1c variable by sex after 3-months intervention.

4.2.3. After the 6-Month Intervention of CCM Components

The *t*-test in Table 4 showed that the mean difference of HbA1c after a 6-month intervention of the two components of the Chronic Care Model in the sample of the population between male and female patients with diabetes is 0.83. It was observed from the hypothesis test (that the two-sided *p*-value was 0.039 ($p < 0.05$). We rejected the null hypothesis and concluded that the mean difference of HbA1c (%) between males and females was not equal. The statistics *t*-value = −2.168, df = 28 and with 95% CI (−0.046; −1.61).
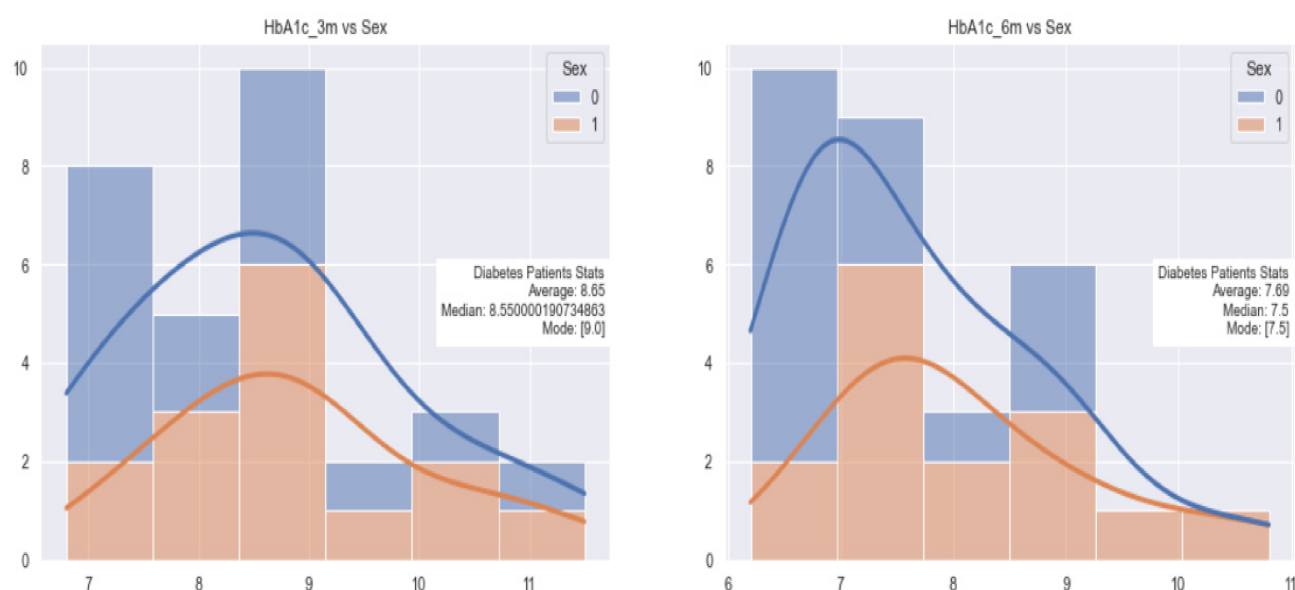
Figure 7. The histograms of HbA1c by sex show statistics after 3-months and 6-months intervention.

Table 4. Summary statistics of two-sample *t*-test of HbA1c by sex in the sample population after 6-months follow-up.

Sex	N	Mean (HbA1c %)	SD	Confidence Interval (CI)	
Male	15	8.11	1.16	7.46–8.75	
Female	15	7.28	0.91	6.77–7.79	
Combined	30	7.69	1.11	7.28–8.11	
Difference		Mean	*t*-value	CI	*p*-value
(Male-Female)		0.83	−2.168	−0.04−−1.61	0.039

Figure 8 shows the scatter plots of HbA1c and age variables by sex after 6 months. The histogram for female patients in Figure 9 is right-skewed and for male patients is approximately normal with a symmetrical distribution (mode = median = 7.5). Figure 7 shows these statistics on the histograms.

The overall results of the quantitative analysis showed that the variable HbA1c was reduced from 9.48% from the baseline analysis to 8.11% after a 6-months intervention of the two components of the Chronic Care Model; for male patients with type 2 diabetes and for female patients, the results were more promising as HbA1C was reduced from 9.05% to 7.28% after a six-months follow-up. Table 5 gives the summary statistics of a two-sample *t*-test of BMI by sex in the sample population after a 6-months follow-up.

Table 5 provides the results of the sample t-test of BMI by sex. For body mass index, the sample *t*-test after 3 months showed the mean difference in BMI was not significant between males and females at the baseline ($p > 0.05$). The mean difference was 4.15 kg/m^2, $p = 0.115$ with 95% CI (−9.37; 1.08). However, after the 6-months intervention of the two components of the Chronic Care Model in the sample of the population, the mean difference in BMI between males and females was significant ($p < 0.05$). The mean difference was 4.97 kg/m^2, $p = 0.040$ with 95% CI (−0.243; −9.690).
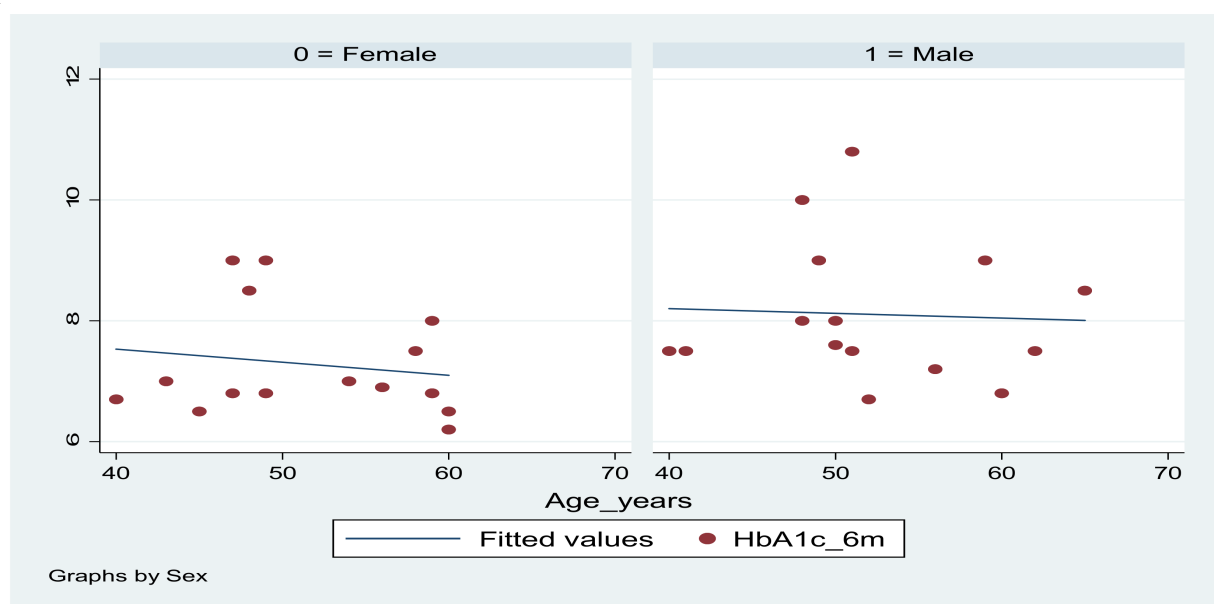
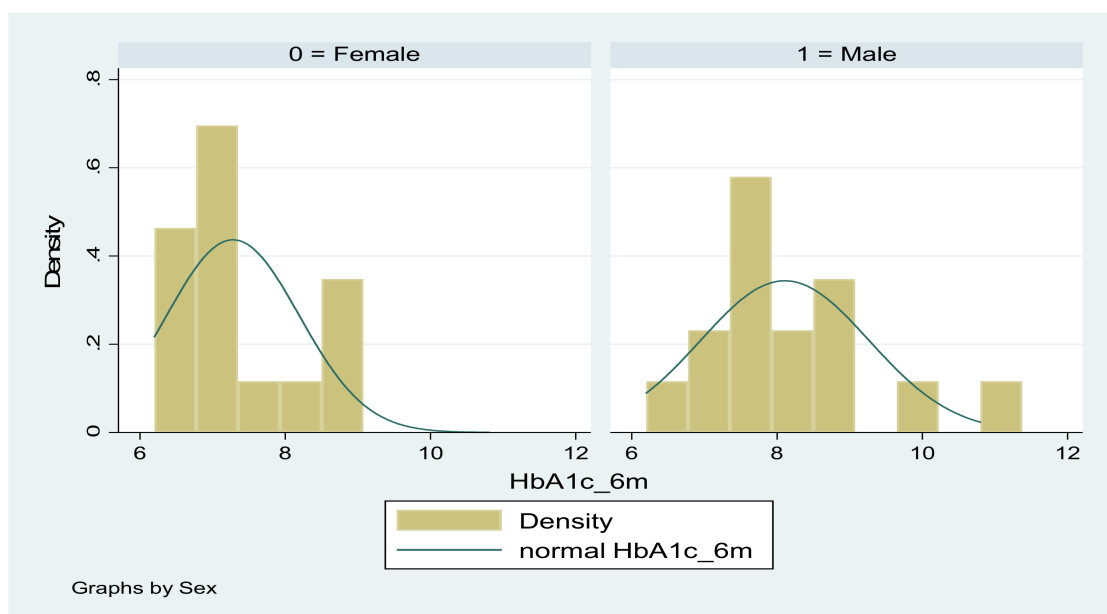**Figure 8.** Scatter plots of HbA1c and age variables by sex after 6 months.

Figure 9. The histograms of HbA1c variable by sex after the 6-month intervention.

Table 5. Summary statistics of two-sample *t*-test of BMI by sex in the sample of population after a 6-months follow-up.

Sex	N	Mean BMI (Kg/m^2)	SD	Confidence Interval (CI)	
Male	15	29.43	5.67	25.61–33.26	
Female	15	24.43	6.90	21.33–27.60	
Combined	30	26.95	1.22	24.45–29.45	
Difference		Mean	*t*-value	CI	*p*-value
(Male-Female)		4.97	−2.154	−0.243–(−9.69)	0.040

5. Discussion

Implementation of the Chronic Care Model aimed to manage the predicted increase in chronic disease by emphasizing a patient-centred approach that focuses on the individual managing and living with chronic disease, illness, and disability (Plumb et al., 2012 [50]). Furthermore, the successful implementation of the Chronic Care Model provided general practitioners with an effective framework for supporting diabetes self-management education and support (Roberto et al., 2012 [51]).

Davy et al. (2015) [52] demonstrated the necessity of including human aspects, including the influence that various stakeholders have on the success or failure of adopting a CCM, through a systematic review. Successful implementation of complex interventions such as a CCM may rely not only on adequate resources and the establishment of effective systems and processes but also on a diverse variety of different stakeholders who will understand and influence the process.

Timpel et al. (2020) [53] developed an evidence-based and expert-driven chronic care management model for patients with diabetes. The Manage Care Model provided guidance for the development and implementation of chronic care programmes, regional networks, and national strategies. They have also suggested that future research will be required to validate the model as an instrument of regional chronic care management.

The two key components of the Chronic Care Model in this study assessed their relevance, feasibility, acceptability, and effectiveness in the primary healthcare system of rural Pakistan. Studies that assessed the effectiveness of the Chronic Care Model also revealed some progress in terms of health outcomes for people living with chronic diseases when delivery system design and self-management assistance were used, and the results of these studies corroborate our findings (Baptista et al., 2016 [41]; Molayaghobi et al., 2019 [54]).

The studies on diabetes knowledge, beliefs, and practices among people with diabetes provided further evidence that there was a lack of information available to people with diabetes in Pakistan as the large population has never received any diabetes education (Rafique and Shaikh, 2000 [35]; Afridi and Khan, 2003 [55]).

Implementation of the two core elements of the Chronic Care Model, "Delivery System Design" and "Self-management Support, helped to influence the self-management activities of the middle-aged population of rural areas. The quantitative analysis demonstrated that, when compared to standard diabetes care, multi-faceted care delivered via CCM components improved HbA1c levels in all type 2 diabetes patients. This finding is in line with several healthcare settings internationally with a specific focus on diabetes, where implementation of the CCM model was found to be the most effective in clinical practice (Busetto et al., 2016 [56]).

The results of the analysis revealed that all the patients who participated in this study had shown a significant reduction in HbA1c ranging from 0.5% to 1% without experiencing hypoglycaemia as per the electronic record of the clinic. The results have addressed the research question and demonstrated that the two components of CCM were effective and improved clinical outcomes for patients with type 2 diabetes in the rural areas of Pakistan. These results are significant as reducing the HbA1c level by 0.2% could lower the mortality due to diabetes by 10% (S herwani et al., 2016 [57]). These findings are in agreement with the studies carried out by Stratton et al. (2000) [58] that a reduction in HbA1c is likely to reduce the risk of complications.

The quantitative analysis demonstrated that diabetes self-management has a gendered dimension as the mean of HbA1c among male patients of type 2 diabetes was 8.11% after a 6-months intervention of the two components of the Chronic Care Model, compared to female patients, whose mean HbA1C was 7.28%, there was a promising difference of 0.83%. Similar results were obtained for body mass index as the mean BMI among male patients was 29.43 kg/m^2 after a 6-months intervention of the two components of the Chronic Care Model, compared to female patients, whose mean BMI was 24.43 kg/m^2, there was a difference of 4.97 kg/m^2. These results are in agreement with other studies

reporting the aspect of gender differences in the self-management of type 2 diabetes (Ansari et al., 2019 [19]).

The two subthemes of "Delivery System Design" that received the most attention from participants and health professionals were task distribution among team members and planned interactions to support evidence-based care. The approach of collaboration was deemed to be the most beneficial in terms of optimizing general practitioners' time, as there is a shortage of general practitioners in rural areas of Pakistan, and therefore, more patients will have access to the physicians through a teamwork approach (Shaikh and Hatcher, 2004 [59]; Ansari et al., 2016 [60]).

The previous studies using the two main components of the Chronic Care Model such as patient self-management and delivery system design were found to be the most effective interventions (Fisher et al., 2005 [61]; Foy et al., 2011 [15]; Lee et al., 2011 [16]; Molayaghobi et al., 2019 [54]). The results of these studies are in agreement with our findings, suggesting that in the context of primary healthcare in Pakistan, the two components of CCM were found to be most suitable and effective.

6. Strength and Limitations

The study's strength was in evaluating the two critical components of the Chronic Care Model's relevance, feasibility, acceptability, and effectiveness in rural Pakistan's primary healthcare system. The study emphasized the healthcare system's influence on diabetes self-management outcomes. Previous studies did not address this issue and instead focused exclusively on patient-related factors.

The limitation is related to the delivery system, that is, the absence of workforce structure in rural locations: the absence of dietitians, social workers, and diabetes health educators. In addition, involving family members in this study might have been beneficial, providing significant insight into their perspectives of diabetes self-management practices.

7. Relevance to Clinical Practice

The two main themes of CCM at the practice level, namely, the self-management support (SMS) and delivery system design (DSD), have shown their effectiveness in primary healthcare settings in rural areas of Pakistan. Additionally, family participation in such organizations is critical for the members' own diabetes education and for receiving information on the best ways to support a family member with type 2 diabetes. Diabetes self-management education, preventive and monitoring programmes that consider gender-specific methods, and recommendations would be more suitable and successful in the rural areas of Pakistan.

8. Conclusions

The two elements of the Chronic Care Model were found to be most suitable, feasible, and effective after their implementation in a primary healthcare clinic, and implementation of all the components of CCM in the future will improve the overall efficiency of the health care system of the rural areas of Pakistan. The implementation of the two core elements of CCM in a primary healthcare clinic setting reflected that evidence-based approaches to dealing with this culturally diverse community are effective.

References

1. World Health Organization. WHO Framework Convention on Tobacco Control. 2003. Available online: https://www.who.int/tobacco/resources/publication/fctc/en/index.html (accessed on 10 May 2022).
2. Jafar, T.H.; Chaturvedi, N.; Pappas, G. Prevalence of overweight and obesity and their association with hypertension and diabetes mellitus in an Indo-Asian population. *CMAJ* **2006**, *175*, 1071–1077. [CrossRef] [PubMed]
3. Akhtar, S.; Nasir, J.A.; Abbas, T.; Sarwar, A. Diabetes in Pakistan: A systematic review and meta-analysis. *Pak. J. Med. Sci.* **2019**, *35*, 1173–1178. [CrossRef]
4. Whiting, D.R.; Guariguata, L.; Weil, C.; Shaw, J. IDF Diabetes Atlas: Global estimates of the prevalence of diabetes for 2011–2030. *Diabetes Res. Clin. Pract.* **2011**, *94*, 311–321. [CrossRef] [PubMed]
5. Adnan, M.; Aasim, M. Prevalence of Type 2 Diabetes Mellitus in Adult Population of Pakistan: A Meta-Analysis of Prospective Cross-Sectional Surveys. *Ann. Glob. Health* **2020**, *86*, 7. [CrossRef]
6. Australian Government Department of Health and Ageing (AGDHA). National Chronic Disease Strategy. 2006. Available online: www.health.gov.au/internet/main/publised (accessed on 10 May 2022).
7. Anderson, N.A.; Bridges-Webb, C.; Chancellor, A.H.B. *General Practice in Australia*; Sydney University Press: Sydney, Australia, 1986; pp. 3–4.
8. Burke, S.D.; Sherr, D.; Lipman, R.D. Partnering with diabetes educators to improve patient outcomes. *Diabetol. Metab. Syndr. Obes.* **2014**, *7*, 45–53. [CrossRef]
9. Bojadzievski, T.; Gabbay, R.A. Patient-centered medical home and diabetes. *Diabetes Care* **2011**, *34*, 1047–1053. [CrossRef]
10. Stellefson, M.; Dipnarine, K.; Stopka, C. The Chronic Care Model and Diabetes Management in US Primary Care Settings: A Systematic Review. *Prev. Chronic Dis.* **2013**, *10*, 120–180. [CrossRef]
11. Piatt, G.A.; Orchard, T.J.; Emerson, S.; Simmons, D.; Songer, T.J.; Brooks, M.M.; Zgibor, J.C.; Ahmad, U.; Siminerio, L.M.; Korytkowski, M. Translating the chronic care model into the community: Results from a randomized controlled trial of a multifaceted diabetes care intervention. *Diabetes Care* **2006**, *29*, 811–817. [CrossRef]
12. Hiss, R.G.; Armbruster, B.A.; Gillard, M.L.; McClure, L.A. Nurse care manager collaboration with community-based physicians providing diabetes care: A randomized controlled trial. *Diabetes Educ.* **2007**, *33*, 493–502. [CrossRef]
13. Piatt, G.A.; Anderson, R.M.; Brooks, M.M.; Songer, T.; Siminerio, L.M.; Korytkowski, M.M.; Zgibor, J.C. 3-year follow-up of clinical and behavioral improvements following a multifaceted diabetes care intervention: Results of a randomized controlled trial. *Diabetes Educ.* **2010**, *36*, 301–309. [CrossRef]
14. Carter, E.L.; Nunlee-Bland, G.; Callender, C. A patient-centric, provider-assisted diabetes telehealth self-management intervention for urban minorities. *Perspect. Health Inf. Manag.* **2011**, *8*, 1b. [PubMed]
15. Foy, R.; Eccles, M.P.; Hrisos, S.; Hawthorne, G.; Steen, N.; Gibb, I.; Grimshaw, J.; Croal, B. A cluster randomized trial of educational messages to improve the primary care of diabetes. *Implement. Sci.* **2011**, *6*, 129. [CrossRef] [PubMed]
16. Lee, A.; Siu, C.F.; Leung, K.T.; Lau, L.C.H.; Chan, C.C.M.; Wong, K.-K. General practice and social service partnership for better clinical outcomes, patient self-efficacy and lifestyle behaviours of diabetic care: Randomized control trial of a chronic care model. *Postgrad. Med. J.* **2011**, *87*, 688–693.
17. International Diabetes Federation. Diabetes Prevalence. 2019. Available online: http://www.idf.org/home/index.cfm (accessed on 15 June 2021).
18. World Health Organization. Non-Communicable Diseases, Geneva: World Health Organization. 2013. Available online: http://www.who.int/mediacentre/factsheet/en (accessed on 10 May 2022).
19. Ansari, R.M. Effect of physical activity and obesity on type 2 diabetes in middle-aged population. *J. Environ. Public Health* **2009**, *2009*, 4–9. [CrossRef] [PubMed]
20. Wagner, E.H.; Austin, B.T.; Von Korff, M. Organizing care for patients with chronic illness. *Milbank Q.* **1996**, *74*, 511–544. [CrossRef]
21. Bodenheimer, T.; Wagner, E.H.; Grumbach, K. Improving primary care for patients with chronic illness: The chronic care model, Part 2. *JAMA* **2002**, *288*, 1909–1914. [CrossRef] [PubMed]
22. Bodenheimer, T.; Wagner, E.H.; Grumbach, K. Improving primary care for patients with chronic illness. *JAMA* **2002**, *288*, 1775–1779. [CrossRef]

23. Tsai, A.C.; Morton, S.C.; Mangione, C.M.; Keeler, E.B. A Meta-analysis of Interventions to Improve Care for Chronic Illnesses. *Am. J. Manag. Care* **2005**, *11*, 478–488.

24. Zwar, N.; Harris, M.; Griffiths, R.; Roland, M.; Dennis, S.; Powell Davies, G.; Hasan, I. *A Systematic Review of Chronic Disease Management*; Research Centre for Primary Health Care and Equity, School of Public Health and Community Medicine, UNSW: Sydney, Australia, 2006.

25. Deakin, T.; McShane, C.E.; Cade, J.E.; Williams, R. Group based training for self-management strategies in people with type 2 diabetes mellitus. *Cochrane Database Syst. Rev.* **2005**, *6*, CD003417. [CrossRef]

26. Norris, S.L.; Engelgau, M.M.; Narayan, K.M. Effectiveness of self-management training in type 2 diabetes: A systematic review of randomized controlled trials. *Diabetes Care* **2001**, *24*, 561–587. [CrossRef]

27. Norris, S.L.; Nichols, P.J.; Caspersen, C.J.; Glasgow, R.E.; Engelgau, M.M.; Jack, L.; Snyder, S.R.; Carande-Kulis, V.G.; Isham, G.J.; Garfield, S. Increasing diabetes self-management education in community settings: A systematic review. *Am. J. Prev. Med.* **2002**, *22* (Suppl. S4), 39–66. [CrossRef]

28. Faas, A.; Schellevis, F.G.; Van Eijk, J.T. The efficacy of self-monitoring of blood glucose in NIDDM subjects: A criteria-based literature review. *Diabetes Care* **1997**, *20*, 1482–1486. [CrossRef] [PubMed]

29. Loveman, E.; Cave, C.; Green, C.; Royle, P.; Dunn, N.; Waugh, N. The clinical and cost-effectiveness of patient education models for diabetes: A systematic review and economic evaluation. *Health Technol. Assess.* **2003**, *7*, iii-1. [CrossRef] [PubMed]

30. van Dam, H.A.; van der Horst, F.; van den Borne, B.; Ryckman, R.; Crebolder, H. Provider-patient interaction in diabetes care: Effects on patient self-care and outcomes. A systematic review. *Patient Educ. Couns.* **2003**, *51*, 17–28. [CrossRef]

31. Powell, H.; Gibson, P.G. Options for self-management education for adults with asthma. *Cochrane Database Syst. Rev.* **2002**, *2010*, CD004107. [CrossRef]

32. Toelle, B.G.; Ram, F.S.F. Written individualized management plans for asthma in children and adults. *Cochrane Database Syst. Rev.* **2004**, CD002171. [CrossRef]

33. Turnock, A.C.; Walters, E.H.; Walters, J.A.E.; Wood-Baker, R. Action plans for chronic obstructive pulmonary disease. *Cochrane Database Syst. Rev.* **2005**, CD005074. [CrossRef]

34. Boulware, L.E.; Daumit, G.L.; Frick, K.D.; Minkovitz, C.S.; Lawrence, R.S.; Powe, N.R. An evidence based review of patient-centered behavioral interventions for hypertension. *Am. J. Prev. Med.* **2001**, *21*, 221–232. [CrossRef]

35. Rafique, G.; Shaikh, F. Identifying needs and barriers to diabetes education in patients with diabetes. *J. Pak. Med. Assoc.* **2000**, *56*, 347–352.

36. American Diabetes Association Standards of Medical Care in Diabetes. *J. Clin. Appl. Res. Educ. Diabetes Care* **2016**, *39* (Suppl. S1). Available online: www.diabetes.org/diabetescare (accessed on 15 June 2021).

37. Hakeem, R.; Fawwad, A. Diabetes in Pakistan, Epidemiology, Determinants and Prevention. *J. Diabetol.* **2010**, *3*, 4.

38. Ansari, R.M.; Hosseinzadeh, H.; Zwar, N. Primary Healthcare System of Pakistan: Challenges to Self-Management of Type 2 Diabetes. *Open J. Endocr. Metab. Dis.* **2016**, *6*, 173–182. [CrossRef]

39. Page, T.; Lockwood, C.; Conroy-Hiller, T. Effectiveness of nurse-led cardiac clinics in adult patients with a diagnosis of coronary heart disease. *Int. J. Evid.-Based Healthc.* **2005**, *3*, 2–26. [PubMed]

40. Weingarten, S.R.; Henning, J.M.; Badamgarav, E.; Knight, K.; Hasselblad, V.; Gano, A., Jr.; Ofman, J.J. Interventions used in disease management programmes for patients with chronic illness-which one's work? Meta-analysis of published reports. *BMJ* **2002**, *325*, 925. [CrossRef]

41. Baptista, D.R.; Wiens, A.; Pontarolo, R.; Regis, L.; Reis, W.C.T.; Correr, C.J. The chronic care model for type 2 diabetes: A systematic review. *Diabetol. Metab. Syndr.* **2016**, *8*, 7. [CrossRef] [PubMed]

42. Reynolds, R.; Dennis, S.; Hasan, I.; Slewa, J.; Chen, W.; Tian, D.; Bobba, S.; Zwar, N. A systematic review of chronic disease management intervention in primary care. *BMC Fam. Pract.* **2018**, *19*, 11. [CrossRef] [PubMed]

43. International Diabetes Federation. Diabetes Prevalence. 2014. Available online: http://www.idf.org/home/index.cfm (accessed on 10 May 2022).

44. Narayan, K.M.V. The Diabetes Pandemic: Looking for the silver lining. *Clin. Diabetes* **2005**, *23*, 51–52. [CrossRef]

45. Hasan, Z.U.; Zia, S.; Maracy, M. Baseline disease knowledge assessment in patients with type 2 diabetes in a rural area of northwest of Pakistan. *J. Pak. Med. Ass.* **2000**, *54*, 67–73.

46. Coleman, K.; Austin, B.T.; Brach, C.; Wagner, E.H. Evidence on the Chronic Care Model in the new millennium. *Health Aff.* **2009**, *28*, 75–85. [CrossRef]

47. Rich, M.W.; Beckham, V.; Wittenberg, C.; Leven, C.L.; Freedland, K.E.; Carney, R.M. A multidisciplinary intervention to prevent the readmission of elderly patients with congestive heart failure. *N. Engl. J. Med.* **1995**, *1*, 1190–1195. [CrossRef]

48. Shojania, K.G.; Ranji, S.R.; McDonald, K.M.; Grimshaw, J.M.; Sundaram, V.; Rushakoff, R.J.; Owens, D.K. Effects of quality improvement strategies for type 2 diabetes on glycemic control: A meta-regression analysis. *JAMA* **2006**, *4*, 427–440. [CrossRef] [PubMed]

49. Ansari, R.M.; Harris, M.F.; Hosseinzadeh, H.; Zwar, N. Applications of a Chronic Care Model for Self-Management of Type 2 Diabetes: A Qualitative Analysis. *Int. J. Environ. Res. Public Health* **2021**, *18*, 10840. [CrossRef]

50. Plumb, J.; Weinsten, L.C.; Brawer, R.; Scott, K. Community-Based Partnerships for Improving Chronic Disease Management. *Prim. Care Clin. Off. Pract.* **2012**, *39*, 433–447. [CrossRef]

51. Roberto, N.; Katie, C.; Rafael, B.; Sauto, R. Integrated care for Chronic Conditions: The contribution of the ICCC framework. *Health Policy* **2012**, *105*, 55–64.

52. Davy, C.; Bleasel, J.; Liu, H.; Tchan, M.; Ponniah, S.; Brown, A. Factors influencing the implementation of chronic care models: A systematic literature review. *BMC Fam. Pract.* **2015**, *16*, 102. [CrossRef] [PubMed]

53. Timpel, P.; Lang, C.; Wens, J.; Contel, J.C.; Schwarz, P.E.H.; On behalf of the MANAGE CARE Study Group. The Manage Care Model–Developing an Evidence-Based and Expert-Driven Chronic Care Management Model for Patients with Diabetes. *Int. J. Integr. Care* **2020**, *20*, 2. [CrossRef]

54. Molayaghobi, N.S.; Abazari, P.; Taleghani, F.; Iraj, B.; Etesampour, A.; Zarei, A.; Hashemi, H.; Abasi, F. Overcoming challenges of implementing chronic care model in diabetes management: An action research approach. *Int. J. Prev. Med.* **2019**, *10*, 13.

55. Afridi, M.A.; Khan, M.N. Role of Health Education in the Management of Diabetes Mellitus. *J. Coll. Physicians Surg.—Pak.* **2003**, *13*, 558–561.

56. Busetto, L.; Luijkx, K.; Elissen, A.; Vrijhoef, H. Intervention types and outcomes of integrated care for diabetes mellitus type 2, A systematic review. *J. Eval. Clin. Pract.* **2016**, *22*, 299–310. [CrossRef]

57. Sherwani, S.I.; Khan, H.A.; Ekhzaimy, A.; Masood, A.; Sakharkar, M.K. Significance of HbA1c Test in Diagnosis and Prognosis of Diabetic Patients. *Biomark. Insights* **2016**, *11*, 95–104. [CrossRef]

58. Stratton, I.M.; Alder, A.I.; Neil, H.A.W.; Matthews, D.R.; Manley, S.E.; Cull, C.A.; Holman, R.R.; Turner, R.C.; Hadden, D. Association of glycemic with macro vascular and microvascular complications of type 2 diabetes: Prospective observational studies. *BMJ* **2000**, *321*, 405–412. [CrossRef] [PubMed]

59. Shaikh, B.T.; Hatcher, J. Health Seeking Behaviour and Health Service Utilization in Pakistan, Challenging the Policy Makers. *J. Public Health* **2004**, *27*, 49–54. [CrossRef] [PubMed]

60. Ansari, R.M.; Hosseinzadeh, H.; Zwar, N. Application of Chronic Care Model for self-management of type 2 diabetes: Focus on the middle-aged population of Pakistan. *Int. J. Med. Res. Pharm. Sci.* **2016**, *3*, 1–7. [CrossRef]

61. Fisher, E.B.; Brownson, C.A.; O'Tool, M.L.; Shetty, G.; Anwuri, V.V.; Glasgow, R.E. Ecological approaches to self-ma agement: The case of diabetes. *Am. J. Public Health* **2005**, *95*, 1523–1535. [CrossRef] [PubMed]