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Collaborative diabetes virtual clinics – a service evaluation and clinical audit

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Background: Diabetes management in primary care is becoming increasingly complex. Integrated working between primary and specialist care teams is important in addressing this complexity. Diabetes virtual clinics (DVC) provide an opportunity for the diabetes specialist team to work collaboratively with the primary care team.
Aim: To evaluate the impact of a DVC on the clinical management and care outcomes of patients in primary care settings.
Methods: A prospective clinical audit of DVC patients was performed in seven general practices comparing data, at baseline and at 6 months. The audit measured changes in care provision and clinical performance. The primary audit standard was that 50% of cases with a baseline glycated haemoglobin (HbA1c) ≥58 mmol/mol (7.5%) would optimise HbA1c by a clinical significant reduction of 6 mmol/mol (0.4%).
Results: The audit examined 113 cases that were exposed to the DVC. Data were available on 73 cases at 6 months. The main theme for case discussion was treatment modification and titration (48%, $n = 54$), followed by: managing co-morbidities (24%, $n = 21$) and psychosocial factors (14%, $n = 12$). Primary care was the most common pathway identified, 35% ($n = 40$) cases avoided being referred to specialist care and 21 (23%) cases were transferred from specialist to primary care. At 6 months, HbA1c reduced by 7 mmol/mol (0.46%) from 73 mmol/mol (8.79%) to 67 mmol/mol (8.32%), $p = 0.001$. The audit standards were exceeded with 85% of patients achieving an improvement in their glycaemic control and 57% having a reduction in the HbA1c of ≥6 mmol/mol (0.4%).
Conclusions: The DVC resulted in a clinically and statistically significant improvement in HbA1c. It has also meant that more patients can be treated in primary care without the need for referral to specialists. The DVC could be an effective model for integrated working between primary and diabetes specialist services, providing an opportunity for shared learning.

Key words: Diabetes virtual clinics, diabetes service models, integrated care, glycaemic control, clinical audit

Abbreviations

DVC – Diabetes virtual clinic
HbA1c – glycated haemoglobin
ACR – albumin creatinine ration

Novelty

- First evaluation of a theoretically explicit model of a virtual clinic to enhance primary care management of diabetes.
- Provides some estimation of the potential benefits of this model of working in the context of the shift from specialist to primary care led management for Type 2 diabetes.

Introduction

The complications of Type 2 diabetes are associated with poor health outcomes, premature mortality, reduced quality of life and higher healthcare costs. These complications can be prevented or delayed with good metabolic control. However, data from the recent UK National Diabetes Audit[1] showed that fewer than 60% of patients under the age of 70 achieve good glycaemic control, HbA1c ≤ 58 mmol/mol (7.5%). The majority of these patients are managed in primary care. Therefore, to achieve better diabetes outcomes, it is necessary to develop strategies to support primary care teams to provide more effective and efficient care. Such strategies must address the rising demand for diabetes care and the increasingly complex nature of that care, with: the expansion of new therapies (DPPV-4 inhibitors and GLP-1 analogues); the need to treat significant co-morbidities (obesity and depression); increasing numbers of insulin requiring patients; and the shift towards more complex insulin models in Type 2 diabetes. Insulin is a particular challenge in primary care with many practices using the therapy sub-optimally.[2] Variations in the resources, training and skills within primary care teams impact on their capacity to improve the diabetes care they provide and to address these challenges. Inconsequently, there can be inequalities in the level of care provided and in the performance of different

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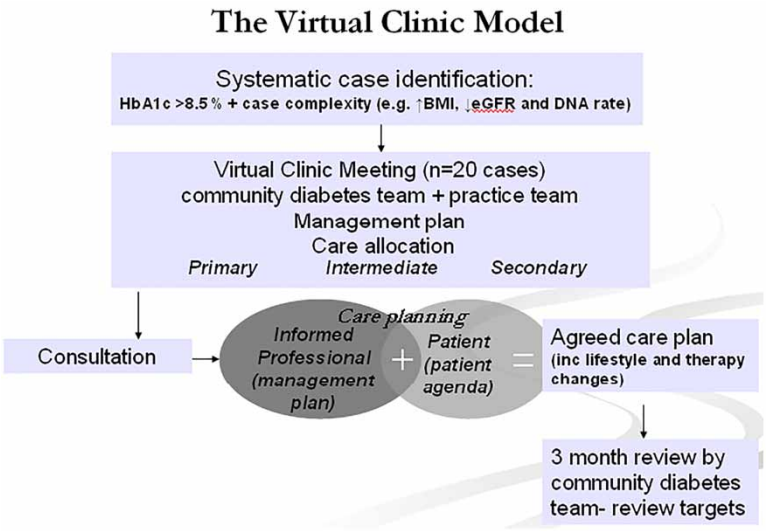

Figure 1 The diabetes virtual clinic model.

practices in achieving care outcomes.[3] Therefore, there is a need to develop effective methods for enhancing primary care-based diabetes that address these underlying challenges and practice variations.

Intermediate diabetes care teams can provide clinical support to primary care. Ideally, this support enhances care delivery rather than substitutes, enabling the primary care team to develop their service. An innovative method for providing this support is the virtual clinic. Virtual clinics can take different forms, they can either be remote professional patient consultations (tele-care) or professional to professional consultations (usually specialist to generalist) in which the patient is absent. It is this latter approach that is considered here. While previous studies of this type of virtual clinic[4–18] have found evidence of improved care processes, metabolic control, professional performance, patient satisfaction and healthcare efficiency, the underpinning theory of the virtual clinics has not been well described and the studies have been of a poor quality. This paper describes an integrated diabetes virtual clinic (DVC) that has been developed in South London and presents a preliminary evaluation of its impact on care processes and outcomes.

The diabetes virtual clinic model

The DVC is provided by an intermediate care team (comprising diabetes specialist nurses, a diabetologist and a general practice (GP) with special interest in diabetes). It is delivered in primary care to GP teams. The underpinning concept for this innovation is to bring specialist diabetes and primary care professionals together to jointly identify a management plan for individual patients prior to their next consultation (virtual). The components of the DVC are: systematic case identification; a virtual clinic in which cases ($n = 15$ to 20) are jointly discussed by the GP and DVC teams, to determine clinical and therapeutic needs, self-management needs and the most appropriate care provider; formulation of a management plan; a face to face appointment with the most appropriate member of the clinical team to develop an agreed care plan; and follow-up by the intermediate care team to evaluate the execution of the management and care plans. The DVC draws on Wagner *et al.*'s chronic care model[19] by enhancing *decision support* and by ensuring that an informed health professional works with the patient to develop and resource an individual care plan based on the strategy formulated by the team – *collaborative decision making*. The DVC aims to: enhance patient care delivery (optimisation of therapy, ensure appropriate care provider and place of care, and increase patient participation); improve the competence and skill of the primary care providers (through interactive discussion of cases); and improve general diabetes care provision in practices, by identifying and addressing systemic factors that may impede care delivery. The DVC targets patients with poor diabetes control, evidence of disengagement (non-adherence/attendance) and complex clinical need (an overview of the model is presented in Fig. 1).

The DVC model was recommended in the NHS London diabetes guide as a model for care integration between primary and specialist diabetes services.[20] This paper reports a preliminary evaluation of the DVC. The aim of the evaluation was to assess the impact of the DVC on care management and clinical outcomes.

Method

The evaluation was conducted as a prospective clinical audit to examine the impact of the DVC on the patients' metabolic control and care delivery.

Setting and participants

Seven practices participated in the audit. The practices were all from within one locality of a South London primary care trust (PCT). This locality has high levels of deprivation and is ethnically very diverse with a significant Black African and Caribbean and South-east Asian

(people with Pakistani, Indian and Bangladeshi heritage) populations. Local data show that socio-economically deprived patients and those from Black ethnic populations receive poorer health care and worse clinical outcomes compared to those from more affluent populations of White ethnicity.[21] Practice registers ranged from 3607 to 7897 patients and the recorded practice diabetes prevalence ranged from 2.44 to 6.32%, the overall PCT diabetes recorded prevalence is 3.2%. One DVC was conducted in each practice and all the patients discussed at the DVC were included in the audit ($n = 113$). There were 22 GPs and 8 practice nurses working in the practices who took part in the DVC.

Standards and measures

The analysis used the following routinely collected clinical data: HbA1c, blood pressure, lipids, glomerular filtration rate (eGFR) and body mass index (BMI). The primary focus of the audit was to establish the impact of the DVC on the following clinical outcomes:

- The proportion of patients achieving a clinically significant change (positive or negative) in HbA1c, ≥6 mmol/mol (0.4%)[22]
- The proportion of patients achieving a clinically significant change (positive or negative) in systolic pressure, ≥10 mmHg.[23]

Consideration was also given to: the overall change in clinical outcomes (mean); and the proportion of patients achieving current target levels for glycaemic control, an HbA1c of ≥53 mmol/mol (7%) or ≥58 mmol/mol (7.5%).[24–26] In terms of care processes, at the patient level observations included: the recorded destination for ongoing management (i.e., whether the primary, intermediate or specialist care teams would lead the patient's ongoing care); the presence of a recorded DVC action plan; and whether the patient was seen within 3 months of the DVC by the allocated care provider.

Data collection

The audit was designed to assess the clinical measures before and after exposure to the DVC. All the clinical data were extracted from the patients' records prior to the case discussion. The baseline data were collected within at the DVC. The patient's records were then re-audited at 6 months for both the clinical and process measures. The data on the conduct of the DVC were recorded at each session. The data were collected by a member of the DVC team (RA).

Data analysis

Descriptive data on the patients and their clinical and process data were compiled. The before and after data were used to identify the proportion of patients achieving significant clinical change (positive and negative) after the DVC. Changes in clinical data were assessed statistically using paired *t* tests. Exploratory analyses were undertaken to identify variations in patient characteristics (age, ethnicity and BMI) in relation to the observed clinical outcomes, and individual practice performance was also examined.

Ethical considerations

As an internal clinical audit of routinely collected data from the patient record, the evaluation did not require formal ethical approval. However, the evaluation did concord with ethical practice in that all the data were anonymised for the analysis and no patient-specific personal data were used.

Results

In total 113 cases were identified for discussion in the DVC, the characteristics of these patients are summarised in Table 1. The majority of cases had Type 2 diabetes with a mean age of 60 years (SD 14.57). The cases were divided equally between males and females. The ethnic mix reflected the local population with a high proportion of Black and South-east Asian (Pakistani and Indian) patients, ethnicity was not recorded in one-fifth of patients. The majority of patients were managed with established oral hypoglycaemic agents (metformin and/or a sulphonylurea), with just under a third of cases being on insulin.

The flow of case assessment in the audit is detailed in Fig. 2. It was only possible to undertake a full analysis on 73 (65%) of these cases for the following reasons: patient had left the practice or was aboard <3 months (*n*-14); or a missing HbA1c value ($n = 26$). The characteristics between those with complete data and those not included in the analysis where compared to identify any potential biases. These data showed that those lost to follow-up

Table 1 Summary case characteristics.

Characteristic	$n = 113$ (%)
Diabetes mellitus	
Type 1	7 (8%)
Type 2	106 (92%)
Age	
59.15 years (mean)	14.57 (SD)
Age groups	
0–29 years	2 (2%)
30–49 years	34 (30%)
50–69 years	44 (39%)
70 years and above	33 (29%)
Gender	
Male	59 (52.2%)
Female	54 (47.8)
Ethnicity	
Caucasian	28 (25%)
Black Caribbean and Black African	28 (25%)
South-east Asian	30 (26%)
Not recorded	21 (19%)
Other	6 (5%)
Treatment	
No oral anti-hyperglycaemic medication	3.5% (4)
Metformin	84 (74.3%)
Sulphonylurea	49% (43.4)
Post prandial regulators	3 (2.7%)
Glitazones	2 (1.8%)
Incretin therapy GLP1	2 (1.8%)
DVPP 4	3 (2.7%)
Insulin	36 (31.9%)

Presented as numbers (percentages rounded to the nearest whole number); age is presented as mean (standard deviation).

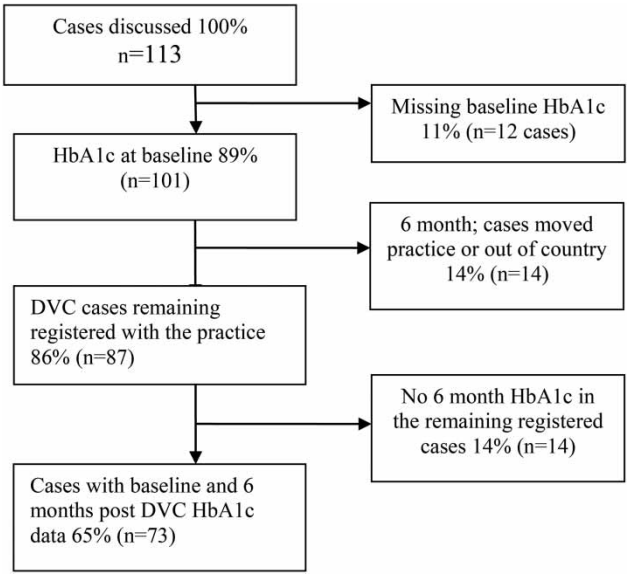

Figure 2 Audit case flow.

were similar in demographic and clinical characteristics, although there was a higher proportion of males (71%, $n = 20$) compared to those in the full analysis.

Impact on clinical outcomes

The baseline and 6 month clinical data are summarised in Table 2. Over half of those followed-up (57%, $n = 42$) achieved the primary glycaemic control audit standard, with a reduction of ≥6 mmol/mol (0.4%) in HbA1c, of the remainder 28% ($n = 20$) showed no clinical change and 15% ($n = 11$) deteriorated by ≥6 mmol/mol (0.4%). Overall, there was a 7 mmol/mol (0.46%) (95%CI, 0.2–0.72) reduction in HbA1c at follow-up ($p < 0.001$). Sub-group analysis showing a higher level of optimisation was achieved in: women, and Black and South-east Asian patients. These reductions in HbA1c were consistent in five of the participating practices.

In terms of blood pressure, half of the cases ($n = 36$) already had achieved optimal control of their blood pressure (systolic BP ≤130 mmHg). Of those with sub-optimal control, 43% ($n = 16$) achieved a reduction ≥10 mmHg in systolic blood pressure, 27% ($n = 10$) showed no change and 30% ($n = 11$) deteriorated. No clinically significant changes were observed for blood lipids, BMI or renal function. In the cases were an improvement in HbA1c (≥0.4%) was observed, there was no clinically significant weight gain, with 47% ($n = 34$) of cases reducing or maintaining their BMI, while the remainder had an increase of ≤0.4 kg/m^2.

Process measures

The average time per practice for conducting the DVC was 2 hours, with an average of 7.5 minutes per case. The main theme for case discussion was treatment modification and titration (48%, $n = 54$), followed by: managing co-morbidities (24%, $n = 21$); psychosocial factors (14%, $n = 12$); and allocation to care pathway (primary, intermediate or specialist care) (21%, $n = 18$). Primary care was the most common pathway identified, such that 40 (35%) cases avoided being referred to specialist care and 21 (23%) cases were transferred from specialist to primary care. Only five cases were referred to specialist care and 16 (11%) remained under the management of the specialist team. Thirteen patients were referred to the intermediate care team.

Following the DVC, 82% ($n = 83$) of cases attended a GP appointment for initiation of the management plan. However, there was variation amongst practices in the documentation of the DVC management, and in 51% ($n = 52$) of cases, the management plan was not documented in their notes.

Discussion

This evaluation shows that the DVC model has the potential to improve clinical performance in primary care. As reported in the introduction most previous studies have not described the model for their virtual clinics to allow adequate assessment of their impact.[4–18] The amount of clinical improvement in HbA1c observed was similar to the only other two studies to report glycaemic outcome.[4,12] The DVC directly addresses case complexity and therapy use and indirectly addresses self-management. The majority of cases discussions in the DVC were focussed on therapy adjustment and the management of co-morbidities, suggesting that this was the primary mechanism for the improvements in care observed. Psychosocial factors were also evident in the discussions, suggesting some attention to patient centred factors such as depression and a lack of motivation.

Table 2 A summary of all findings.

Biomedical marker	Cases (*n*)	Baseline mean (SD)	6-month mean (SD)	BI – 6 m mean change	Standard deviation (SD)	Confidence interval (CI)	*p* value
Glycaemic control (%)	73	8.79 (1.53)	8.32 (1.7)	0.46	1.12	0.20–0.72	0.001
mmol/mol		73	66	6			
Systolic blood pressure (mmHg)	73	132.05 (18.97)	130.44 (18.54)	1.17	19.38	−2.88 to 6.09	0.478
Diastolic BP (mmHg)	73	76.06 (10.06)	74.7 (9.39)	1.91	10.68	−0.57 to 4.38	0.129
Total cholesterol	61	4.42 (1.04)	4.32 (1.09)	0.06	0.71	−0.12 to 0.24	0.509
Body mass index	70	29.05 (5.88)	29.31 (5.87)	−0.26	1.22	−0.54 to 0.03	0.083
Albumin creatinine ratio	40	9.96 (10.75)	10.7 (49.9)	−0.79	3.13	−1.79 to 0.21	0.119
Glomerular filtration rate	54	83.59 (29.86)	83.88 (32.12)	−0.30	18.95	−5.46 to 4.87	0.909

Other factors that are associated with poor diabetes outcomes are socio-economic disadvantage and ethnic diversity.[21] This evaluation was conducted in area of high deprivation with a very diverse population. The fact the Black African and Caribbean patients had significantly better outcomes than Caucasians, demonstrates the potential of this model in addressing these social factors, and thereby addressing current inequalities in diabetes care provision.

Impact on service delivery

The DVC is a model for integrated diabetes care, and it has been recognised for some time that a lack of integration can negatively affect care outcomes and efficiencies.[27] The evaluation shows that if specialist and primary care teams can work together they can improve the care provided. The impact of care integration in the DVC model is evident in the evaluation in relation to the shift of patient management between service centres and in the clinical inertia provided by the model. In terms of the shift between services, the evaluation showed a reduction in patients being referred to diabetes specialist services and the discharge of patients from specialist to primary care. The patients who remained in primary care or were transferred from specialist care were optimised in the majority of cases. The smaller numbers of patients who were managed by the intermediate care team or remained in specialist care showed a modest decline in HbA1c of 0.32 and 0.26%, respectively. This observation may have reflected the more complex nature of those cases. This impact on reducing the need for specialist diabetes care was also observed in a study of 86 patients receiving virtual care input reported by Stanaway *et al*. with an overall 77% reduction in specialist referral, including 11% of complex cases.[16]

The DVC model also provides clinical inertia,[28] by stimulating a more analytical model of care management and by supporting therapy changes. This has also been a finding in other virtual clinic evaluations, which have reported improved clinical inertia with patients having more therapies prescribed.[4,15] There was evidence that many patients with poor outcomes had not been adequately treated, at baseline 55% of cases with HbA1c >7.5% were not prescribed a routine second line oral medication (sulphonylurea). The DVC highlights patients who are not achieving adequate control, thereby encouraging the primary care team to examine why a patient may be under-performing. This reflection and care management planning provides a learning opportunity. As has been reported in previous virtual clinic evaluations, an additional benefit is the provision of professional diabetes education to the primary care team.[4,14] However, it should be highlighted that the DVC is not unidirectional, as the primary care team contributes important contextual information giving insight into the patient's behaviours, psychosocial factors and other health problems they may have.

There are, however, some important challenges and potential limitations associated with DVC model. Within practice variation was observed suggesting some inconsistency in the effect of the DVC. While the clinical impact was evident in the majority of practices, there were two practices where the benefits were not so evident. These practices had limited care infrastructure (no practice nurse), poor registration process and a lack of diabetes training. In addition, these two practices contributed most to the missing follow-up data. This observation suggests that while DVC may enhance diabetes care, there is a need to ensure that the basic infrastructure in the practice is adequate to support care delivery.

Future development

While this evaluation supports the underpinning concept of this model of integrated diabetes care, there are a number of areas in which the DVC could be further enhanced. It could be possible to use e-Health technologies to expand the capacity and potentially reduce the cost of delivering the DVC. It would also be possible to have a system to identify cases in practices based on patient performance and risk stratification. There could also be a system through which health professionals can send summary reports through to the specialist team prior to the discussion.

The other area in which the DVC could contribute is in training and developing the primary care diabetes workforce. There is potential for clinical learning within the DVC by linking clinical experience, specialist support and targeted learning modules. This style of learning closes the loop between the educational input and the clinical outcome by contextualising the learning within the practice. In addition, the profile of the cases being identified for the DVC could enable learning to be targeted at specific areas of deficit in current clinical performance within a given practice.

Evaluation limitations

There are number of limitations to this evaluation, it was a relatively small project conducted in one geographical area, the data were only for 6 months follow-up and there was no control group. There were also a significant number of cases lost to follow-up ($n = 40$, 38%). The main reason that patients were not included in the analysis was missing data. As identified in the method, the evaluation relied on the availability of routine data from the patient record. In the UK, HbA1c is mandated to be recorded annually, which means that for the 6-month follow-up, some data were not available. There were also patients missing due to having moved away, this is a common problem in the study area as the population is transient and some patients leave the country for extend spells. This may have biased the study findings with those with no follow-up data having less favourable outcomes. Furthermore, the scale of the audit restricted the scope of the data collected. Data that were not collected, which may have been helpful in explaining the

effect of the DVC, included: duration of diabetes; kilogram weight change; changes in prescribing; number of additional investigations; access to self-management support and patient education. Therefore, other studies are required that both provided a more expansive assessment of the clinical impact of the model, incorporating an assessment of the cost effectiveness of the programme and its impact on care systems, health professionals and patient care. However, despite these limitations, this project is the first to present a clear theoretical description of the DVC model together with some assessment of its clinical impact. We will address many of these limitations and the inherent bias of a before and after study in a further study following a randomised control trial design.

Conclusion

The data from this evaluation suggest that the DVC could be a potentially useful model for integrated diabetes care. The data show clinical impact in terms of glycaemic control and impact on care delivery. The model enables primary care teams to accommodate more complex cases, cases that would have previously been referred to specialist care. The model may also be helpful in supporting the transition of patients from diabetes specialist services to primary care.

However, while the conceptual model for the DVC has been established, there is a need to develop and evaluate it further. Such developments should examine the use of e-Health technologies and the role of the DVC as a method for delivering diabetes professional education. There must also be further evaluation of the DVC model to assess its impact on clinical care, work force development and care efficiency. There is pressure on diabetes services to innovate and provide greater efficiencies of care and the DVC may support this.

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Ethics approval None.

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