Antenatal models of care for women with Gestational Diabetes Mellitus: Vignettes from an international meeting

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Abstract

Background:

Gestational diabetes (GDM) is one of the commonest pregnancy complications and is placing an increasing burden on diabetes and obstetric resources.

Aims

Describe different antenatal models of care that have developed to address the increasing proportion of pregnancies complicated by GDM.

Materials and Methods

Narrative review with thematic analysis from fifteen volunteer antenatal diabetes in pregnancy services from Australia and New Zealand identified through a national diabetes organisation. Main outcomes were approaches to patient education, medical nutrition therapy (MNT), ongoing management and escalation of therapy for women with GDM.

Results

All clinics provided at least one group education, and one MNT session, within 1-2 weeks of GDM diagnosis. Women from culturally and linguistically diverse communities usually required 1:1 education. Ongoing management of women with GDM was through either all women being seen in the GDM clinic, a step-up approach (ongoing management by the primary antenatal team with diabetes team referral if self-blood glucose monitoring (SBGM) or insulin therapy dosage criteria are reached) or step-down approach (ongoing management by the diabetes team with step-down to the primary antenatal team if SBGM criteria are reached). Telehealth was used to reduce the burden of clinic attendance, particularly in rural areas.

Conclusions

Increasing numbers, earlier diagnoses, the need to provide care to women in rural, remote areas, and cultural/language differences, have generated a range of different antenatal models of care, allowed better workload accommodation and probably reduced costs. Randomised controlled trials of different models of care, with associated health economic analyses, are urgently needed.

Introduction

Gestational Diabetes Mellitus (GDM) is associated with risks for the mother (pre-eclampsia, caesarean section and perineal trauma) and infant (macrosomia, shoulder dystocia, birth injuries, hypoglycaemia, respiratory distress, stillbirth and jaundice)[1], and long-term metabolic dysregulation in both mother and child [2, 3]. The prevalence of GDM has been increasing sharply in Australia and New Zealand, driven by demographic and lifestyle factors and, in Australia, by changes in the approach to diagnosis.

In 2014, the Australasian Diabetes in Pregnancy Society (ADIPS) set new diagnostic criteria and guidelines for the diagnosis of GDM for use in Australia in line with World Health Organisation endorsed International Association of Diabetes and Pregnancy Study Groups (IADPSG) recommendations [4,5]. Most Australian centres have now adopted the new ADIPS guidelines [6]. These recommend using a one-step, 3 point, 75 g oral glucose tolerance test (OGTT), instead of a two-step approach involving an initial 50g non-fasting glucose challenge test (GCT), followed by a 2 point 75g OGTT when the GCT is elevated. The OGTT criteria for GDM diagnosis have also changed to include a lower fasting plasma glucose cut-off (from ≥5.5 to ≥5.1 mmol/L), the addition of a one hour cut-off (≥10.0 mmol/L) and a higher two-hour level (from ≥8.0 to ≥8.5 mmol/L)[4- 6]. While the usual recommended time for OGTT testing is 24-28 weeks gestation, ADIPS recommends that high-risk women be tested at presentation in pregnancy and, if negative, be retested at 24-28 weeks[6].

All but the change in the 2 hour criterion increase the number of women diagnosed with GDM, with evidence of this change alone increasing prevalence from 9.6% to 13% [7,8]. Adding to the increasing GDM prevalence are factors such as increasing maternal age, a greater proportion of women from high risk ethnic groups, and more overweight and obese women, effects that began prior to the introduction of the new diagnostic criteria. [9]. This pre-existing growth resulted in the development of new approaches to deal with the rising service demands even before the new criteria were introduced [10].

Besides dealing with the growing numbers of women with hyperglycaemia in pregnancy, Australasia requires a range of models of care to address the different needs in remote, rural, peri-urban and metropolitan settings given the variation in access, staff and population profiles. With limited evidence to guide decisions over how to adapt to these increasing demands, individual centres have developed different models of care to the 'standard' GDM clinic that was tested in the landmark ACHOIS study [11].

In 2018, ADIPS held a symposium on existing models of care and these vignettes have been collated and discussed in this report. The purpose of these case vignettes is to compare and contrast models of care for GDM throughout Australasia. It is anticipated that sharing of this information will assist in developing improved models of care of GDM for the future.

Materials and Methods

ADIPS members were invited to present their model of care for women with GDM at the 2018 ADIPS annual scientific meeting. Presentations included approaches to patient education, dietetic input / medical nutrition therapy (MNT) and need for escalation of therapy. Analysis involved simple collation and tabulation of the presentations. The presentations also included identified challenges and potential strategies to address demand, women's preferences and the quality of care. These were collated using thematic analysis. One service included three hospitals operating three different models of care and these have been included separately, resulting in 15 models of care. Any gaps in information regarding the model of care were obtained by contacting the services directly. The study was exempted from ethics approval by the Western Sydney University Human Research Ethics Committee (Reference: EX2019-06).

Results

As shown in Table 1, the estimated frequency of GDM in the various clinic locations was 6.0-18.5% before and 10.4-26.9% after the change in diagnostic criteria. All clinics reported being 'busy' with a high workload. As shown in Table 2, the methods for delivery of the initial education, initial MNT, and approach for ongoing management, including that of escalating therapy were diverse across the clinic locations.

Initial education/MNT:

All clinics provide group (capped at 6 to 12 women) education classes coordinated by credentialed diabetes educators and dietitians and a 1:1 session before or after the group education. These sessions are also used to identify women requiring more rapid intensification of therapy. Two clinics had an additional component involving an endocrinologist and a physiotherapist session. Two clinics have sufficient numbers of women to run initial group sessions for women from culturally and linguistically diverse (CALD) backgrounds. Women are provided with a telephone number for the educator if glucose results are elevated. Additional review and fast track to the endocrinologist is available where considered needed.

Ongoing management following the initial education

The model of care for ongoing management for most clinics involved step-up clinics (where only selected women are seen by the diabetes educator/endocrinologist after the initial education/MNT sessions; this leaves most women under the primary antenatal team) (n = 10). Others varied from the traditional diabetes clinic where all women with GDM are seen by a diabetes physician as well as the obstetric/midwifery team (n = 1), a nurse practitioner run clinic (n=1), a clinic where all women are largely managed by the obstetricians even if treaed with insulin (n=1), shared care with general practitioners (GPs) (n = 1) and step-down care (where lower risk women are identified and discharged to the care of the obstetric/midwifery team (n = 1)). The frequency of follow-up after initial review varied between clinics from weekly to every 4 weeks. Insulin titration was conducted by different health care providers, generally by diabetes educators with advice from an endocrinologist (or directly by the endocrinologist). In obstetric based clinics, titration advice was provided by obstetricians. Most clinics use insulin (n = 9) as the first pharmacological agent, and metformin as the second, while others do not use metformin at all. Women with diabetes in pregnancy (DIP), including possible undiagnosed type 2 diabetes, were diagnosed with a fasting glucose of ≥7.0 mmol/l and/or 2 hour glucose 11.1+ mmol/l and/or HbA1c 6.5+% (50 mmol/mol in New Zealand). Management is based upon the degree of hyperglycaemia and any obstetric concerns, with priority for education, complication (eg retinopathy) screening and screening for type 1 diabetes antibodies and/or monogenic diabetes as clinically indicated. Postpartum testing is by HbA1c in the New Zealand site and OGTT in Australian sites depending on the degree of hyperglycaemia.

Solutions to challenges posed by increased numbers of women with GDM

Challenges in the provision of health care are summarised in Table 3 and include the growing number of patients, relative staff shortages, a large number of patients requiring insulin, lack of knowledge of different/optimal models of care, management of culturally and linguistically diverse (CALD) women. However, these challenges have stimulated the creation of novel solutions, including step-up and step-down approaches and group education.

Clinics with a step-up approach recorded their approach as a strength/enabler to overcome the high workload. This involves women staying with their midwives/obstetricians unless glycaemic or other criteria are identified (Table 2). From this point, women receive additional CDE input, unless significant insulin therapy (>30 IU /day at site 14; >32 IU /day at site 12) is required, additional endocrinologist follow-up occurs. Similarly a step-down approach was also considered as an enabler by the clinic where it had been developed and introduced [12]. This involves all women being seen by the diabetes team, but if identified as low risk for insulin (criteria shown in Table 2 and discussed below), they are referred back for midwife/obstetrician care alone. Insulin commencement strategies varied. In most clinics, diabetes educators assessed and identified the starting dose and commenced insulin therapy under the supervision of the endocrinologists / registrars. In the other clinics, the endocrinologist (and in one clinic, the obstetrician) determines whether insulin is required and manages the dose, with the educators teaching the practical aspects of insulin administration. In one rural clinic, a nurse practitioner initiates and titrates the insulin.

Urban vs rural/peri-urban Models of Care

Clinic organisation was more complex in non-urban regions (n = 3). Women with GDM attending the two clinics located in peri-urban Queensland, are scattered with no standard model of care. In the other regional/rural clinic (rural Victoria), the diabetes team attend the antenatal obstetric clinic one half day per week. Every effort is made to book women with diabetes into clinic on this day as traveling is difficult for patients. However, clinics are otherwise neither co-located nor co-administered.

Discussion

We have shown that the increase in demand for care for the growing number of women with hyperglycaemia in pregnancy has led to a range of local innovations in the model of care for women with GDM. However, no state-wide or national strategy has been developed to manage this increased workload. GDM management is anchored by the delivery of education and MNT by the

diabetes service, with education now largely provided in groups[13]. Developing models have included delegation of monitoring to the woman (through self-blood glucose monitoring and telephone or online contact), to the primary antenatal care staff (e.g. midwives, general practice, obstetric staff) and/or within the diabetes team. This has allowed CDEs and diabetes physicians to focus on the more complex patients. The need for this restructuring was predicted over 10 years ago [14]. Such models had already been required in rural and remote areas in Australia where access to diabetes specialist care remains limited (e.g. sites 3-4). With some notable exceptions (e.g. the step-down model[12]), evaluation has been limited, reinforcing the need for a national diabetes in pregnancy benchmarking programme as piloted by ADIPS 12 years ago [10].

The step-down model includes a risk score comprising the likelihood of insulin therapy (and several other adverse outcomes, including Caesarean section, early delivery, large for gestational age and abnormal postpartum OGTT) [12]. Based on this model, patients are referred to midwifery based antenatal clinic if they have 0 to 2 predictors and could be managed obstetrically in a midwives clinic[15]. The importance of the combined obstetric-diabetes service approach (including diabetes physicians) has been a foundation for quality diabetes in pregnancy care for many years [16] with improved neonatal outcomes (e.g. macrosomia and neonatal hypoglycaemia) in women with GDM using multidisciplinary services [16]. In addition, by providing a multidisciplinary approach, wider self-management benefits can accrue [17]. However, such approaches may not be possible/feasible in many Australasian rural and remote settings, due to limited space and workforce flexibility or expertise. With the step-up or step-down models, it is important that women in the lower risk clinics who develop deteriorating glycaemic control or features suggesting fetal compromise can be identified promptly and be transferred to a higher level of care. Communication between clinicians is essential and referral pathways must be established to allow women to be stepped up or stepped down in a timely and streamlined fashion.

One approach to increasing the efficiency of GDM management has been the introduction of group education sessions, provided in all of the vignettes[13]. Outside of pregnancy, this provides the same or better learning at a lower cost [18]. However, there is limited research on the group education approach among women with GDM [13]. A recent survey by ADIPS (2018: personal communication, ADIPS secretariat), included reports that the content of the initial group sessions may need to be repeated in the next 1:1 follow-up appointments since the women do not *feel comfortable* in addressing their individual concerns in a group session. The need to provide education in languages other than English can also require 1:1 education sessions. The short timeframe for management of women with GDM compared to those with pre-existing type 1 and 2 diabetes may have its own implications for the relative merits of group education and further evidence is required in this area.

One recent paper[13] reported that despite adjusting for all known potential confounders, group education, unlike individual education, remained a predictor of insulin therapy (but resulted in similar therapeutic and pregnancy outcomes to individual education).

Metformin, which is much easier to initiate than insulin, is increasingly being used in GDM. There is good evidence that pregnancy outcomes are similar to women treated with insulin and that women often prefer this therapy [19]. However, concern remains over the possible long-term effects of metformin use in pregnancy, as it freely crosses the placenta [20]. Currently, the limited long-term follow-up data from RCTs of the use of metformin in GDM do not allow certainty as to whether metformin's use in pregnancy is beneficial or harmful to the long-term metabolic health of the offspring. This is reflected by the fact that at most sites, insulin is still the first line therapy if glycaemic goals are not met with MNT.

The importance of providing quality care to rural and remote populations in Australia has led to a well-developed range of models of care. Telehealth, defined as "the use of telecommunications technology to provide medical information and service" [21] has been known as a potentially effective intervention to optimise service delivery / utilisation leading to similar and even better maternal and fetal outcomes (including glycaemic control, birth weight, incidence of macrosomia compared to the conventional care) [22-25]. A study by Peretz et al. (2010) [21] has shown that telehealth is effective in reducing the number of visits and unscheduled visits for women wth GDM. It is already normal practice to include telephone/email/SMS communication in the between-clinic follow up of women with GDM, and this may include meter uploading of monitoring data [26].

A lower level of English literacy among women from CALD backgrounds can contribute to difficulties in adhering to self-management [27]. Communication challenges often mean these women require a greater amount of time during each clinic review and present difficulties in follow-up via phone or email results reporting/insulin stabilisation. Three clinics reported challenges in coping with the large number of CALD patients. Models of care incorporating enhanced educational materials (e.g. translated online videos, leaflets, booklets) and ready access to interpreters are needed to address these issues. Increased cultural awareness of staff is necessary to manage GDM among women from diverse ethnic backgrounds, including indigenous women. One important example includes developing strategies to reduce the impact of fasting for religious reasons on the management of GDM.

The strengths of this work are its scale, diversity, its reach across Australia and New Zealand, and the number of issues that have been identified and local solutions sought and found. One of the issues, discriminating between GDM and undiagnosed diabetes, can often only be addressed with

postpartum testing, although a category known as “DIP”, was defined in the WHO but not the ADIPS guidelines [4 5]. The management of this group of women was similar across the sites. The weaknesses include the absence of reports from more remote settings and other sites in New Zealand. The work can not report what proportions of services use the different approaches.

In conclusion, we have provided examples of service providers across Australasia adapting to the growing numbers of women with GDM with approaches that differ from the traditional diabetes in pregnancy clinic used in the landmark RCTs [11, 28]. These adapted models of care have allowed greater reach and increased accommodation for women with GDM, and all clinics should review their current modus operandus. However, the strain on staffing resources is still universally reported and definitive evidence of safety and efficacy equivalent to the care provided in past RCTs is lacking. Obtaining evidence through an RCT of models of care may be challenging with the diversity of settings across Australasia. Participation in clinic benchmarking would allow comparison of different approaches across Australasia [10], of both process (e.g. the proportion of women requiring pharmacotherapy) and outcomes (eg neonatal hypoglycaemia rates) and is likely to be the most pragmatic way ahead.

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References:

1. Australian Institute of Health and Welfare. Incidence of gestational diabetes in Australia. Australian Institute of Health and Welfare: Canberra, 2019. Contract No.: Cat. no. CVD 85

2. Cheung NW, Byth K. Population health significance of gestational diabetes. Diabetes Care. 2003;26(7):2005-9.

3. Simmons D, Gatland BA, Leakehe L, Fleming C. Frequency of diabetes in family members of probands with non-insulin-dependent diabetes mellitus. Journal of internal medicine. 1995;237(3):315-21.

4. WHO. Diagnostic criteria and classification of hyperglycaemia first detected in pregnancy.Geneva: World Health Organisation; 2013. (https://apps.who.int/iris/bitstream/handle/10665/85975/WHO_NMH_MND_13.2_eng.pdf;jsessionid=017BAE3DF51E77D4C3BF0C0628620EFC?sequence=1) (viewed Jan 2019)

5. Metzger BE, Gabbe SG, Persson B, Lowe LP, Dyer AR, Oats JJN, et al. International Association of Diabetes and Pregnancy Study Groups Recommendations on the Diagnosis and Classification of Hyperglycemia in Pregnancy. Diabetes Care. 2010;33(7):e98.

6. Nankervis A, McIntyre HD, Moses RG, Ross GP, Callaway L, Porter C, et al. ADIPS Consensus Guidelines for the Testing and Diagnosis of Gestational Diabetes Mellitus in Australia Recommendations for diagnostic criteria for GDM (Modified June 2014)2014.

7. Moses RG, Morris GJ, Petocz P, San Gil F, Garg D. The impact of potential new diagnostic criteria on the prevalence of gestational diabetes mellitus in Australia. The Medical journal of Australia. 2011;194(7):338-40.

8. Sexton H, Heal C, Banks J, Braniff K. Impact of new diagnostic criteria for gestational diabetes. The journal of obstetrics and gynaecology research. 2018;44(3):425-31.

9. Abouzeid M, Versace VL, Janus ED, Davey M-A, Philpot B, Oats J, et al. A population-based observational study of diabetes during pregnancy in Victoria, Australia, 1999-2008. BMJ open. 2014;4(11):e005394-e.

10. Simmons D, Cheung NW, McIntyre HD, Flack JR, Lagstrom J, Bond D, et al. The ADIPS pilot National Diabetes in Pregnancy Audit Project. Aust N Z J Obstet Gynaecol. 2007;47(3):198-206.

11. Crowther CA, Hiller JE, Moss JR, McPhee AJ, Jeffries WS, Robinson JS. Effect of Treatment of Gestational Diabetes Mellitus on Pregnancy Outcomes. New England Journal of Medicine. 2005;352(24):2477-86.

12. Barnes RA, Wong T, Ross GP, Jalaludin BB, Wong VW, Smart CE, et al. A novel validated model for the prediction of insulin therapy initiation and adverse perinatal outcomes in women with gestational diabetes mellitus. Diabetologia. 2016;59(11):2331-8.

13. Barnes RA, Ross GP, Jalaludin BB, Flack JR. Initial group dietary education compared to individual education in gestational diabetes mellitus management: Do outcomes differ? Diabetes research and clinical practice. 2018;140:88-96.

14. Simmons D, Rowan J, Reid R, Campbell N. Screening, diagnosis and services for women with gestational diabetes mellitus (GDM) in New Zealand: a technical report from the National GDM Technical Working Party. The New Zealand medical journal. 2008;121(1270):74-86.

15. Scott P, Zhang Y, Nolan CJ. The gestational diabetes tsunami: Can we survive it? Australian and New Zealand Journal of Obstetrics and Gynaecology. 2016;56(4):333-5.

16. Rahmani A, Afandi B. Improving neonatal complications with a structured multidisciplinary approach to gestational diabetes mellitus management. Journal of neonatal-perinatal medicine. 2015;8(4):359-62.

17. Carolan-Olah MC. Educational and intervention programmes for gestational diabetes mellitus (GDM) management: An integrative review. Collegian. 2016;23(1):103-14.
18. Mash R, Kroukamp R, Gaziano T, Levitt N. Cost-effectiveness of a diabetes group education program delivered by health promoters with a guiding style in underserved communities in Cape Town, South Africa. Patient education and counseling. 2015;98(5):622-6.
19. Gui J, Liu Q, Feng L. Metformin vs insulin in the management of gestational diabetes: a meta-analysis. PloS one. 2013;8(5):e64585.
20. Lindsay RS, Loeken MR. Metformin use in pregnancy: promises and uncertainties. Diabetologia. 2017;60(9):1612-9.
21. Perez-Ferre N, Galindo M, Fernandez MD, Velasco V, Runkle I, de la Cruz MJ, et al. The outcomes of gestational diabetes mellitus after a telecare approach are not inferior to traditional outpatient clinic visits. International journal of endocrinology. 2010;2010:386941.
22. Rasekaba TM, Furler J, Blackberry I, Tacey M, Gray K, Lim K. Telemedicine interventions for gestational diabetes mellitus: A systematic review and meta-analysis. Diabetes research and clinical practice. 2015;110(1):1-9.
23. Homko CJ, Santamore WP, Whiteman V, Bower M, Berger P, Geifman-Holtzman O, et al. Use of an internet-based telemedicine system to manage underserved women with gestational diabetes mellitus. Diabetes technology & therapeutics. 2007;9(3):297-306.
24. Homko CJ, Deeb LC, Rohrbacher K, Mulla W, Mastrogiannis D, Gaughan J, et al. Impact of a telemedicine system with automated reminders on outcomes in women with gestational diabetes mellitus. Diabetes technology & therapeutics. 2012;14(7):624-9.
25. Perez-Ferre N, Galindo M, Fernandez MD, Velasco V, de la Cruz MJ, Martin P, et al. A Telemedicine system based on Internet and short message service as a new approach in the follow-up of patients with gestational diabetes. Diabetes research and clinical practice. 2010;87(2):e15-7.
26. Hawkins JS. Glucose monitoring during pregnancy. Current diabetes reports. 2010;10(3):229-34.
27. Carolan M, Gill GK, Steele C. Women's experiences of factors that facilitate or inhibit gestational diabetes self-management. BMC pregnancy and childbirth. 2012;12:99-102.
28. Landon MB, Spong CY, Thom E, Carpenter MW, Ramin SM, Casey B, et al. A multicenter, randomized trial of treatment for mild gestational diabetes. New England Journal of Medicine. 2009;361(14):1339–48

Table 1. Clinical settings

Clinics	State	Metropolitan, Regional or rural	Prevalence of GDM		Separate clinic for Pre-existing Diabetes	Special issues
			Prior to ADIPS new criteria	After ADIPS new criteria		
1	WA	Metropolitan	13%	20%	Yes	No post-delivery follow-ups
2	WA	Metropolitan	NA	22%	Separate site	Increasing levels of early diagnoses, high insulin requiring rate; lack of workforce flexibility; education, CALD patients, data collection
3	QLD	Metropolitan	8.8%	15.2%	No	Obstetric clinic located elsewhere, women with GDM scattered, Group education with dietitian
4	QLD	Peri-urban	8.4%	21.4%	No	Needs CDE FTE, group education with no dietitian; women with GDM are scattered across different models of care; Limited endocrinologists availability to discuss medication requirements
5	QLD	Peri-urban	8.8%	26.9%	No	Obstetric clinic located elsewhere, women with GDM scattered, Group education with dietitian; women with GDM are scattered; limitted doctor availablity to discuss medication requirements
6	NSW	Metropolitan	18.5%	26.6%	No	Introduction of Step-Down service
7	NSW	Metropolitan	13%	25%	Partial	Large number of women from CALD and women with low health literacy

8	NSW	Metropolitan	17.8%	23.9%	No	Large CALD population
9	NZ	Metropolitan	6.5% by NZ criteria	Not adopted	No	New Zealand diagnostic criteria fasting: ≥5.5 mmol/L or 2-hour ≥ 9.0mmol/L. >50% CALD; HbA1c used to identify women most at risk in the first trimester
10	SA	Metropolitan	10.4 %	14.7%	Yes	Long waiting times for educational sessions (4-6 weeks); building a sustainable service to meet current/new recommendations; growing numbers
11	SA	Metropolitan	9.9%	25%	Yes and women with GDM requiring insulin > 20 units /day	No review appointment for women with GDM unless using insulin >20 units/ day
12	VIC	Metropolitan	6.0%	10.4 %	Yes	Patients attitudes; cost; overflow of the previous systems; ultrasound, no insulin start session
13	VIC	Metropolitan	11.8%	15.7%	Yes	Women notified by mail (report anxiety) 2 week turnaround. CALD women notified by phone via in-house or agency interpreters
14	VIC	Rural	11.3%	15.5%	Yes	CALD/refugee community and women difficult to engage/contact
15	ACT	Metropolitan	9.2%	12.7%	Yes	Staffing resource needed for managing women with GDM is impacting on quality of care that can be offered to an increasing number of women with pre-existing diabetes in pregnancy

SA: South Australia; QLD: Queensland; WA: Western Australia; NSW: New South Wales; NZ: New Zealand; ACT: Australian Capital Territory; VIC: Victoria; CDE: Credentialed Diabetes Educator; FTE: Fulltime employment: CALD: Culturally and Linguistically Diverse; NA=Not Available

Table 2. Characteristics of Model of Care in 15 clinics

Clinics	Form of Initial MNT appointment	Time given for MNT to work (days)	Treatment targets (2+elevated in a week unless stated)			Approaches for ongoing management	Escalating therapy			
			Fasting	2hr PP	Other		First option	Second option	Insulin group start	HCP titrating insulin
1	Face to face	7 post group education	≤ 5.0	≤ 6.7	Fetal growth	Specialised NP clinic for women with GDM	Insulin	Metformin	Yes	CDE's with physician/NP support
2	Face to face	7 post initial group education	≤ 5.0	≤ 6.7	Nil	Step-up	Insulin	Metformin & insulin	No	CDE with Endocrinology support
3	Face to face	7 post diagnosis	≤ 5.0	≤ 6.7	Fetal growth 1 hr PP prebed to allow early bed	Step-up	Individualised	Metformin	No	CDE with endo's support if needed
4	Face to face	7 post-diagnosis	≤ 5.0	≤ 6.7	Fetal growth	Step-up	Individualised	Metformin	No	CDE with endo's support if needed
5	Face to face	7 post-diagnosis	≤ 5.0	≤ 6.7	Fetal growth	Step-up	Insulin	Metformin	No	CDE with endo's support if needed
6	Face to face	7-14 post education	≤ 5.1	≤ 6.8	1-hr PP ≤ 7.4	Step-down-based upon risk score* (12)	Insulin	Nil	No	Endocrinologist

7	Face to face	7 post education	≤ 5.2	≤ 6.9	20% elevated BGL in 1 week	Step-up and step down	Insulin	Metformin	Yes	Endocrinologist
8	Face to face	7-14 post initial group education	≤ 5.2	≤ 6.7	Nil	Step-up Criteria below**;	Metformin & Insulin	Metformin & Insulin	Yes	CDE and Endocrinologist
9	Face to Face	7-14 post education	≤ 5.0	≤ 6.7	1-hr PP ≤7.4 3 elevated in 1 week	Specialised clinic for all women with GDM	Metformin or Insulin	Metformin or Insulin	No	Physician & CDE between clinics
10	Face to face	7 post initial group education	≤ 5.0	≤ 6.7	Nil	Step-up	Metformin & Insulin	Metformin & Insulin	No	CDE Endocrinologist support
11	Face to face for CALD only	7 post initial group education	≤ 5.0	≤ 6.7	Nil	Step-up	Insulin	Metformin and insulin	Yes	CDE with Endocrinology support
12	Face to face	14 post-education	≤ 5.0	≤ 6.7	Nil	General obstetric clinic unless high dose (> 40 units/day) insulin or early diagnosis	Insulin	Metformin	No	Obstetrician/CDE
13	Face to face	7 post initial group	≤ 5.4	≤ 6.5	3 elevated levels in 1	Step-up	Insulin	Metformin + insulin	No	CDE with endocrinology support

		in the initial group education, follow up by referral. if required	education			week, Fetal growth					(Clinical Practice Guidelines)
14	Face to face	7 with the option to make contact sooner	≤ 5.0	≤ 6.7	Nil	Shared care-work with DEs and GPs in outlying areas to manage women with GDM, mentorship by endocrinologists	Insulin	Insulin	No	Endocrinologist, NP CDE, endo
15	Face to face	7 post initial group education	≤ 5.2	≤ 6.9	3 or more elevated BGLs within 5 day period	Step-up	Insulin	Metformin	Yes	

– CDE: Credentialed Diabetes educator; DN: Dietitian; Post Prandial BGL: Blood glucose level; MNT: Medical Nutrition Therapy Glycaemic criteria reached (e.g. if fasting > 5.2 mmol/L or 2 hour PP > 6.7 mmol/L despite MNT.1 hour > 7.4 mmol/L)-refer to educator- for insulin dose of 30+ units/day or metformin treatment-refer to endocrinologist; CALD: Culturally and linguistically diverse; NP=Nurse Practitioner

– All services provided access to CDE telephone contact/support between clinics

– *Having two or more of the following criteria: insulin therapy (and also of several adverse outcomes, including Caesarean section, early delivery, large for gestational age and abnormal postpartum OGTT) (12).

- **Having two or more of the following criteria: Missing records of blood glucose and/or meal/snacks in > 3 occasions within the past week; feeling hungry often or waking up with hunger at night, LGA, unexplained weight-loss or weight-gain, ≥ fasting BGL reading or ≥ post meal BGL readings above target, urine Ketones or large present, HbA1c ≥ 5.7% (39 mmol/mol)
- All clinics provided groujp education with CDE and dietitian
- Clinic settings are shown in Table 1 using the same clinic number

Table 3. Challenges in provision of antenatal care to women with GDM and potential solutions

Challenges	Potential Solutions
Busy clinics	• Change to a systematic model of care: Triaging process to DE and endocrinologist with most diet treated women staying with antenatal care primary provider e.g. midwife/obstetricians/GP. Can be shared care, combined care, stepdown care, step-up care-needs clear guidelines • Interdisciplinary approach including mentorship (3x nurse practitioners + Endocrinologists) e.g. for outlying services • GDM Midwifery Champions program • Reduce the need for some 1:1 appointments with: • Technology: Online portal, telephone/online support • Group education and insulin starts • Increase the number/sessions endocrinologists, diabetes educators and dietitians and clinic space • Increase the efficiency of clinics e.g. nurse, admin support e.g. follow up schedule, reduce failure to attend • Virtual clinic / telehealth if no other reason to come in (e.g. Ultrasound) with women uploading their BG results and either email or telephone follow up.
Lack of co-ordination between obstetric and diabetes care	• Co-located clinic at the same time • Shared clinical records with a shared form to be used by obstetrics or midwifery/endocrinology/allied health on the same day allowing stream-lined communication between all involved parties • Handover meeting prior to/after clinic
CALD	• In-house interpreters as women notified by mail (report anxiety) • Other educational resources e.g. DVDs, pamphlet's • Group Education/interpreter block bookings • Employ clinicians from the same cultural background to establish greater rapport • Increased staff cultural awareness e.g. impact of fasting/Ramadan on diabetes in pregnancy
Health Service management Costs	• Health service/ Economic analysis of adverse outcomes/costs avoided • Maternity Services Review • Obstetric champion
Longer-term follow-up	• Promotion of long acting hormonal contraception prior to birth and implementation after birth (where agreed) • GP follow-up of postpartum glucose screening • Referral to community-based diabetes prevention programs

Large numbers requiring insulin	• A novel validated model for the prediction of insulin therapy initiation • Obstetricians can initiate insulin • Robust clinical practice guidelines • Standardised treatment plans e.g. insulin orders • Virtual (email/phone) insulin titration clinics • Patient self-titration guides
Ultrasound	• Growth scans at28 / 32 / 36 weeks in some clinics NZ Ministry of Health guidelines are for ultrasound at diagnosis and again at 36-37 weeks to plan for birth, but only need USS in-between if indicated by the first USS e.g. macrosomia, polyhydramnios:
Seeing patients (for patients from regional areas)	• On call service • Flexibility/time to review women • Co-consultation with obstetric and midwifery team • Timely specialist appointments • Work with CDEs and GPs in outlying areas to manage women with GDM • Communication via email/on line portal

CDE: Credentialed Diabetes Educator; CALD: Culturally and Linguistically Diverse; ; USS: Ultrasound

Table 1. Clinical settings

Clinics	State	Metropolitan, Regional or rural	Prevalence of GDM		Separate clinic for Pre-existing Diabetes	Special issues
			Prior to ADIPS new criteria	After ADIPS new criteria		
1	WA	Metropolitan	13%	20%	Yes	No post-delivery follow-ups
2	QLD	Metropolitan	8.8%	15.2%	No	Obstetric clinic located elsewhere, women with GDM scattered, Group education with dietitian
3	QLD	Peri-urban	8.4%	21.4%	No	Needs CDE FTE, group education with no dietitian; women with GDM are scattered across different models of care; Limited endocrinologists availability to discuss medication requirements
4	QLD	Peri-urban	8.8%	26.9%	No	Obstetric clinic located elsewhere, women with GDM scattered, Group education with dietitian; women with GDM are scattered; limitted doctor availablity to discuss medication requirements
5	NSW	Metropolitan	18.5%	26.6%	No	Introduction of Step-Down service
6	NSW	Metropolitan	13%	25%	Partial	Large number of women from CALD and women with low health literacy
7	NZ	Metropolitan	6.5% by NZ criteria	Not adopted	No	New Zealand diagnostic criteria fasting: ≥5.5 mmol/L or 2-hour ≥ 9.0mmol/L. >50% CALD; HbA1c used to identify women most at risk in the first trimester
8	SA	Metropol	10.4 %	14.7%	Yes	Long waiting times for educational sessions (4-6 weeks);

		itan				building a sustainable service to meet current/new recommendations; growing numbers
9	VIC	Metropolitan	6.0%	10.4 %	Yes	Patients attitudes; cost; overflow of the previous systems; ultrasound, no insulin start session
10	WA	Metropolitan	NA	22%	Separate site	Increasing levels of early diagnoses, high insulin requiring rate; lack of workforce flexibility; education, CALD patients, data collection
11	SA	Metropolitan	9.9%	25%	Yes and women with GDM requiring insulin > 20 units /day	No review appointment for women with GDM unless using insulin >20 units/ day
12	VIC	Metropolitan	11.8%	15.7%	Yes	Women notified by mail (report anxiety) 2 week turnaround. CALD women notified by phone via in-house or agency interpreters
13	ACT	Metropolitan	9.2%	12.7%	Yes	Staffing resource needed for managing women with GDM is impacting on quality of care that can be offered to an increasing number of women with pre-existing diabetes in pregnancy
14	NSW	Metropolitan	17.8%	23.9%	No	Large CALD population
15	VIC	Rural	11.3%	15.5%	Yes	CALD/refugee community and women difficult to engage/contact

SA: South Australia; QLD: Queensland; WA: Western Australia; NSW: New South Wales; NZ: New Zealand; ACT: Australian Capital Territory; VIC: Victoria; CDE: Credentialed Diabetes Educator; FTE: Fulltime employment: CALD: Culturally and Linguistically Diverse; NA=Not Available

Table 2. Characteristics of Model of Care in 15 clinics

Clinics	Initial Group education		Form of Initial MNT appointment	Time given for MNT to work (days)	Treatment targets (2+elevated in a week unless stated)			Approaches for ongoing management	Escalating therapy			
	CDE	DN			Fasting	2hr PP	Other		First option	Second option	Insulin group start	HCP titrating insulin
1	Yes	Yes	Face to face	7 post group education	≤ 5.0	≤ 6.7	Fetal growth	Specialised NP clinic for women with GDM	Insulin	Metformin	Yes	CDE's with physician/NP support
2	Yes	Yes	Face to face	7 post diagnosis	≤ 5.0	≤ 6.7	Fetal growth 1 hr PP prebed to allow early bed	Step-up	Individualised	Metformin	No	CDE with endo's support if needed
3	Yes	Yes	Face to face	7 post-diagnosis	≤ 5.0	≤ 6.7	Fetal growth	Step-up	Individualised	Metformin	No	CDE with endo's support if needed
4	Yes	Yes	Face to face	7 post-diagnosis	≤ 5.0	≤ 6.7	Fetal growth	Step-up	Insulin	Metformin	No	CDE with endo's support if needed
5	Yes	Yes	Face to face	7-14 post education	≤ 5.1	≤ 6.8	1-hr PP ≤ 7.4	Step-down-based upon risk score* (12)	Insulin	Nil	No	Endocrinologist

6	Yes	Yes	Face to face	7 post education	≤ 5.2	≤ 6.9	20% elevated BGL in 1 week	Step-up and step down	Insulin	Metformin	Yes	Endocrinologist
7	Yes	Yes	Face to Face	7-14 post education	≤ 5.0	≤ 6.7	1-hr PP ≤7.4 3 elevated in 1 week	Specialised clinic for all women with GDM	Metformin or Insulin	Metformin or Insulin	No	Physician & CDE between clinics
8	Yes	Yes	Face to face	7 post initial group education	≤ 5.0	≤ 6.7	Nil	Step-up	Metformin & Insulin	Metformin & Insulin	No	CDE Endocrinologist support
9	Yes	Yes	Face to face	14 post-education	≤ 5.0	≤ 6.7	Nil	General obstetric clinic unless high dose (> 40 units/day) insulin or early diagnosis	Insulin	Metformin	No	Obstetrician /CDE
10	Yes	Yes	Face to face	7 post initial group education	≤ 5.0	≤ 6.7	Nil	Step-up	Insulin	Metformin & insulin	No	CDE with Endocrinology support
11	Yes	Yes	Face to face for CALD only	7 post initial group education	≤ 5.0	≤ 6.7	Nil	Step-up	Insulin	Metformin and insulin	Yes	CDE with Endocrinology support
12	Yes	Yes	Face to face in the initial	7 post initial group education	≤ 5.4	≤ 6.5	3 elevated levels in 1 week, Fetal	Step-up	Insulin	Metformin + insulin	No	CDE with endocrinology support

			group education, follow up by referral. if required				growth					(Clinical Practice Guidelines)
13	Yes	Yes	Face to face	7 post initial group education	≤ 5.2	≤ 6.9	3 or more elevated BGLs within 5 day period	Step-up	Insulin	Metformin	Yes	Endocrinologist
14	Yes	Yes	Face to face	7-14 post initial group education	≤ 5.2	≤ 6.7	Nil	Step-up Criteria below**;	Metformin & Insulin	Metformin & Insulin	Yes	CDE and Endocrinologist
15	Yes	Yes	Face to face	7 with the option to make contact sooner	≤ 5.0	≤ 6.7	Nil	Shared care-work with DEs and GPs in outlying areas to manage women with GDM, mentorship by endocrinologists	Insulin	Insulin	No	Endocrinologist, NP CDE, endo

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