

Accepted Manuscript

Preconception Care for Women with Type 2 Diabetes Mellitus: A Mixed-Methods Study of Provider Knowledge and Practice

J Klein, J Boyle, R Kirkham, C Connors, C Whitbread, J Oats, F Barzi, D McIntyre, I Lee, M Luey, J Shaw, A Brown, L Maple-Brown

PII: S0168-8227(16)31597-2

DOI: <http://dx.doi.org/10.1016/j.diabres.2017.03.035>

Reference: DIAB 6954

To appear in: *Diabetes Research and Clinical Practice*

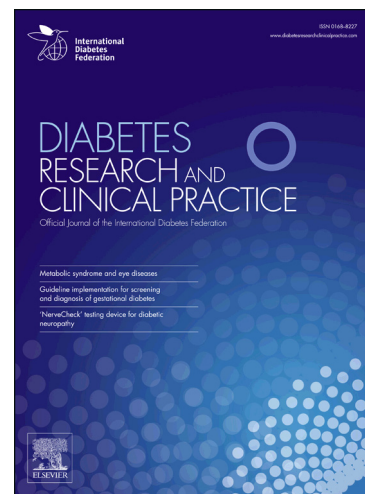
Received Date: 14 November 2016

Revised Date: 3 February 2017

Accepted Date: 28 March 2017

Please cite this article as: J. Klein, J. Boyle, R. Kirkham, C. Connors, C. Whitbread, J. Oats, F. Barzi, D. McIntyre, I. Lee, M. Luey, J. Shaw, A. Brown, L. Maple-Brown, Preconception Care for Women with Type 2 Diabetes Mellitus: A Mixed-Methods Study of Provider Knowledge and Practice, *Diabetes Research and Clinical Practice* (2017), doi: <http://dx.doi.org/10.1016/j.diabres.2017.03.035>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.



**Preconception Care for Women with Type 2 Diabetes Mellitus: A Mixed-
Methods Study of Provider Knowledge and Practice**

Authors

Klein J^{1,2*}, Boyle J^{3*}, Kirkham R⁴, Connors C⁵, Whitbread C^{1,4}, Oats J⁶, Barzi F⁴,
McIntyre D⁷, Lee I⁴, Luey M⁸, Shaw J⁹, Brown A^{10,11}, Maple-Brown L^{1,4}

*These authors contributed equally

1. Royal Darwin Hospital, Darwin, Australia
2. Department of Obstetrics and Gynaecology, Eastern Health, Melbourne, Australia
3. Monash Centre for Health Research and Implementation, School of Public Health and Preventive Medicine, Monash University, Melbourne, Australia
4. Menzies School of Health Research, Darwin, Australia
5. Northern Territory Department of Health, Darwin, Australia
6. Melbourne School of Population and Global Health, University of Melbourne, Melbourne, Australia
7. Mater Medical Research Institute, University of Queensland, Brisbane, Australia
8. Central Australian Aboriginal Congress, Alice Springs, Australia
9. Baker IDI Heart and Diabetes Institute, Melbourne, Australia
10. South Australian Health and Medical Research Institute, Adelaide, Australia
11. University of South Australia, Adelaide, Australia

Corresponding author:

Associate Professor Louise Maple-Brown,
Menzies School of Health Research, Charles Darwin University, PO Box 41096,
Casuarina, NT 0811, Darwin, Australia
Tel: +61 8 8922888; louise.maple-brown@menzies.edu.au

ABSTRACT

Aims

Preconception care may decrease adverse pregnancy outcomes associated with pre-existing diabetes mellitus. Aboriginal Australians are at high risk of type 2 diabetes mellitus (T2DM), with earlier onset. We explored practitioner views on preconception care delivery for women with T2DM in the Northern Territory, where 31% of births are to Aboriginal women.

Methods

Mixed-methods study including cross-sectional survey of 156 health practitioners and 11 semi-structured interviews.

Results:

Practitioners reported low attendance for preconception care however, 51% provided counselling on an opportunistic basis. Rural/remote practitioners were most likely to find counselling feasible. The majority (69%) utilised appropriate guidelines and addressed lifestyle modifications including smoking (81%), weight management (79%), and change medications appropriately such as ceasing ACE inhibitors (69%). Fewer (40%) prescribed the recommended dose of folate (5mg) or felt comfortable recommending delaying pregnancy to achieve optimal preconception glucose control (42%). Themes identified as barriers to care included the complexity of care setting and infrequent preconception consultations. There was a focus on motivation of women to make informed choices about conception, including birth spacing, timing and contraception. Preconception care enablers included cross-cultural communication, a multi-disciplinary care team and strong client-based relationships.

Conclusions

Health practitioners are keen to provide preconception counselling and reported knowledge of evidence-based guidelines. Improvements are needed in recommending high dose folate and optimising glucose control. Cross-cultural communication and team-based care were reported as fundamental to successful preconception care in women with T2DM. Continued education and policy

changes are required to support practitioners in opportunities to enhance pregnancy planning.

Keywords

Preconception care

Type 2 diabetes mellitus

Diabetes in pregnancy

Aboriginal health

ACCEPTED MANUSCRIPT

1.0 Introduction:

Pre-existing diabetes in pregnancy can result in a range of complications including significantly increased rates of miscarriage, congenital anomalies, stillbirth and macrosomia as well as longer-term complications for the mother and child[1]. These risks are increased with higher glycaemic levels[2, 3]. Preconception care, specifically with the aim of optimising glycaemic control, can reduce these adverse outcomes[4-7]. This care needs to incorporate contraception and pregnancy planning whilst optimising a woman's health to improve pregnancy outcomes. In addition to routine preconception measures such as screening for infections and ensuring vaccinations are up-to-date, preconception care for women with pre-existing diabetes focuses on reducing the metabolic, teratogenic and cardiovascular risks related to pregnancy for these women. Central elements of preconception care for this group include medication review, folic acid and iodine supplementation, weight loss, smoking cessation counselling, improved nutrition and exercise, as well as addressing other diabetes-related health problems[8, 9]. Facilitating an improved intra-uterine environment through improved preconception care which addresses glucose control and general health also confers long-term benefits to the future health of offspring including potential decreased risks of obesity and diabetes[10, 11].

The prevalence of diabetes in Aboriginal Australians is increasing, particularly in women and in remote areas with onset at an earlier age than in non-Aboriginal people[12]. While pre-existing diabetes currently affects less than 1% of Australian pregnancies, rates of type 2 diabetes mellitus (T2DM) among Aboriginal women in pregnancy are 10 times higher than those in non-Aboriginal women[13]. Preconception care is thus an important opportunity to optimise the woman's health, as well as that of her baby.

Aboriginal mothers account for 31% of births within the Northern Territory (NT) of Australia, and the majority live in rural or remote locations[14]. High rates of diabetes and the challenges of providing primary and specialist care in remote locations over vast distances pose unique challenges to the care of

women with pre-existing diabetes in this context. Challenges are further increased by the significant socio-economic disadvantage experienced by Aboriginal Australians[15]. Aboriginal women tend to present later in pregnancy for care than other Australian women[16],[17], rates of folic acid use are considerably lower than national averages[18] and Aboriginal mothers self-report higher cigarette and alcohol consumption during pregnancy[14]. Intervention in the preconception period therefore has the potential for significant maternal and child health gains.

Research across Australia and internationally has established that there are low rates of preconception care among women with T2DM[3, 19, 20]. A recent cross-sectional survey of healthcare professionals within the NT Diabetes In Pregnancy (DIP) Partnership highlighted that few women with T2DM are seen for preconception counselling[21].

In the context of high rates of pre-existing T2DM and low practitioner rates of reported preconception care[21], we undertook a mixed-methods study of practitioners providing preconception care to women with T2DM, aiming to identify:

1. Knowledge about and elements and practice of preconception care in the context of existing guidelines.
2. Practitioners' experiences of undertaking preconception care, including limitations and barriers.

2.0 Methods:

The National Health and Medical Research Council (NHMRC) funded NT DIP Partnership was established to address diabetes in pregnancy in the particularly high risk populations of this region[22]. The Partnership has three arms: (i) the establishment of the NT DIP Clinical register; (ii) improving models of care for mothers experiencing hyperglycaemia in pregnancy; and (iii) a longitudinal observational research study [22]. This research is a component of the models of care arm of this Partnership.

2.1 Health Practitioner Survey

A cross-sectional survey was designed for health practitioners based in all regions of the NT caring for women with pre-existing T2DM during their pregnancy and/or preconception. The survey was electronically distributed via a web-based site (using Survey Monkey) from October 2014 to March 2015. The survey was also distributed in hard copy to attendees at the Baker IDI Chronic Diseases Symposium in Alice Springs on 23rd-24th October 2014. All disciplines of healthcare practitioners were eligible to participate.

Survey respondents were purposively recruited through a primary contact in the following networks: NT Department of Health (Primary Health and relevant hospital departments), NT Medicare Local, Aboriginal Community Controlled Health Services, Healthy Living NT, NT GP Education Registrars, and Association of Diabetes Educators Australia NT members.

The CARPA (Central Australian Rural Practitioners Association) Minymaku Kutju Tjukurpa - Women's Business Manual (WBM) 5th Edition[8] incorporates current national and international guidelines[23]. Editorial panel review ensures the guideline applications are relevant to NT disease and living conditions and provide a regionally appropriate standard treatment manual from preconception through to post-partum care. The survey contained questions concerning practicalities of and barriers to preconception care and its delivery, guideline utilisation and the broad components of preconception care that they provided. The components of preconception care assessed in the questions related to the CARPA guidelines for optimisation of lifestyle factors, metabolic control, medication adjustment and management of chronic complications of diabetes. Practitioner occupational characteristics were assessed using the same groupings as those of the previously administered survey[21].

2.2 Health Practitioner Interviews

Semi-structured interviews (n=11) were conducted with key practitioners including diabetes educators, women's health nurses, obstetricians and general practitioners across urban, regional and remote locations of the northern region of the NT (referred to as Top End NT). Interview questions examined

practitioner experiences of preconception care delivery including general approach, establishing rapport, means of ascertaining that a client has understood the information delivered, addressing cultural beliefs and descriptions of any difficulties encountered. Participants were recruited using a purposive sampling strategy, inviting relevant health professionals who engaged with women of reproductive age with T2DM and who were known to the research team. Interviews were undertaken in person or via telephone after participants provided written consent. Interview responses were audio-recorded and transcribed verbatim.

Ethics approval for this study was obtained from the relevant Human Research Ethics Committees (HREC): the NT Department of Health and Menzies School of Health Research HREC, and the Central Australian HREC.

The transcribed interviews were thematically analysed by two authors (JK & RK). A coding structure was formed, and final themes were established by reviewer consensus[24].

2.3 Data analysis:

Frequencies of grouped and individual survey responses were calculated using Stata version 14 (STATA Corporation, College Station, TX, USA). Associations between responses to different questions were assessed using Fisher's exact test or Pearson's chi-square test.

3.0 Results:

3.1 Health Practitioner Survey

There were 167 survey respondents of whom 156 completed relevant sections and were eligible for analysis. Almost all practitioners worked with Aboriginal clients (93%) and 28% had been in their current role for 5 or more years (Table 1). Most respondents (68%) reported it was practical to undertake preconception care with 51% doing so opportunistically rather than through any specific health program or structures. Remote and regional practitioners were

more likely to report the provision of preconception care as feasible (77% NT remote/regional vs. 58% urban $p=0.016$). Contraception to avoid unplanned pregnancy with potentially sub-optimal diabetes control was routinely discussed by 54% of practitioners during consultations for unrelated matters and this was significantly higher amongst Diabetes Educators and GPs, 68% of whom as a combined group reported opportunistic contraception discussion compared with other professionals (45%) ($p=0.016$).

The majority (69%) agreed that they had clear and accessible preconception care guidelines with 109 identifying a specific guideline. Of the three specified guidelines, 51% reported using the CARPA WBM, 28% the General Practice guideline[25] and 24% the ADIPS guideline[23], each of which contain sections on preconception care.

There were high rates of practitioner self-reported adherence to CARPA preconception counselling regarding lifestyle modifications (Table 2), particularly for smoking cessation and weight loss. Of those practitioners who undertook weight loss counselling, 95% reported feeling comfortable having this discussion with women. Half the practitioners reported managing the required preconception medication change as being within their professional role, and these practitioners had good knowledge of and high adherence to changes required by the CARPA guidelines. There was less consistency with preconception supplementation; 79% of practitioners recommended folic acid supplementation (at the usual lower dose of 400mcg, either as part of a pregnancy multivitamin or single supplement) but only 40% reported prescribing the dose 5mg for women with T2DM. One third of respondents (33%) recommended iodine supplementation routinely.

The acceptable preconception glycaemic control target as specified within the CARPA manual of $HbA1c < 7\%$ (53mmol/mol) was identified by 78% of respondents (Table 3). However, only 42% of practitioners reported ever advising women against conception if $HbA1c$ was higher than recommended.

This practice was highest amongst diabetes educators 75% when compared to other professionals grouped together (38%) ($p=0.03$).

The survey contained open-ended questions regarding both barriers to preconception care and suggestions for improvement in preconception care for women with T2DM. A number of themes emerged concerning barriers, including lack of time during consultations, problems of language and cross-cultural communication and the transience of health practitioners in the remote Australian context. An additional theme centred on the common experience that pregnancies were generally unplanned and/or women presented to their primary healthcare practitioner once they were pregnant. Only 3% of respondents reported that they lacked the appropriate knowledge and/or desired further training in preconception care. Several respondents recommended preconception care be incorporated into the chronic disease healthcare plan for women with T2DM and one suggested incorporating preconception care into the bi-annual routine women's health check (STI and pap smear).

3.2 Semi-structured Health Practitioner Interviews

The six main themes of interviews with Health Practitioners in the Top End included systems and individual issues affecting preconception care provision. Each theme is briefly described below, with Table 4 summarising the enablers and barriers with example quotations for each theme.

3.2.1 Complexity of care setting

The delivery of preconception care was affected by the many social, cultural and economic complexities facing Aboriginal women, particularly those living in remote communities. Difficulties encountered include geographical distances and access to healthcare, as well as social determinants of health including inadequate housing and lack of employment.

3.2.2 Infrequent occurrence of preconception care consultations: infertility and contraception as main stimuli

Despite being purposively sampled as a cohort that was both familiar with, and adhered to, preconception guidelines, few practitioners reported having the opportunity to provide this care. Interviewees cited a lack of referrals from other health practitioners and of self-presentation prior to pregnancy. Infertility was the main condition identified by practitioners as a stimulus for women with T2DM seeking review prior to conception. In addition, practitioners reported that consultations concerning contraception provided an opportunity for incidental preconception care.

3.2.3 Empowerment regarding pregnancy choices and risks

Many practitioners felt that integral to the preconception process is improving health literacy; ensuring women understand the risks associated with conception in situations of poorly controlled T2DM and enabling them to be aware they have choices in pregnancy planning. The prevalence and damage that T2DM can cause is familiar to women due to high community prevalence, making discussions easy to start, but practitioners were wary of creating an overly negative picture of the problem. However, in cases where practitioners reported women had presented specifically for preconception care, they believed there had been worthwhile outcomes. A common sentiment expressed was the belief that when women understand the importance of glucose control in pregnancy they are more motivated to plan their pregnancy and manage their blood glucose.

3.2.4 Communication: challenges, opportunities, visual aids and the importance of continuity of care

Conveying messages around preconception care was described as complex. Practitioners identified the importance of gaining insight into clients' lives as a strategy for optimising communication and tailoring health care for individual needs. Being aware that English is generally not the first language of Aboriginal clients was also important for practitioners.

Important cultural aspects of care included recognition of the value of silence and giving people time to process messages about health care. Learning local

Aboriginal languages as an opportunity to enhance communication was mentioned by a number of practitioners.

One area of specific focus during the interviews was the challenging issue of how practitioners confirmed that women had understood the counselling provided. A number of strategies were mentioned, including asking about understanding, using visual resources, offering the opportunity for questions and feedback, as well as involving additional staff members, such as Aboriginal Health Practitioners (AHPs).

3.2.5 Strategies for improving preconception success – a team approach and storytelling

A number of different strategies were employed by practitioners to enhance the success of preconception care particularly collaboration with other members of the care team and especially AHPs. Inadequate access to AHPs was reported as a barrier to better care.

Interviewees also highlighted the importance of understanding storytelling as a way of communicating for many of their Aboriginal clients. Incorporating a storytelling approach into education and counselling were considered important enablers in improving preconception care. Awareness of the significant influence family and community have on an individual's health journey was also raised in the context of the guidance and impact that local AHPs have on patient care, as well as the understanding of diabetes gained by patients who have experienced family members with the condition and complications such as dialysis.

3.2.6 Systems improvements- information systems and checklists, staff awareness and chronic disease coordination

The shortcomings of current information systems in dealing with the complexity of care settings was cited as a barrier by a number of practitioners. Practitioners felt that the routine incorporation of standardised preconception templates and checklists in health software would increase awareness and improve knowledge

of preconception care components, particularly if linked to health care attendance such as sexually transmitted infection (STI) plans.

Teleconferences and telemedicine as relatively recent additional components to specialist outreach were also discussed as advances that have facilitated improved preconception care, facilitating access of remote clinics to endocrinologists and obstetricians.

4.0 Discussion:

We report three key findings from this mixed-methods study of preconception care among women with pre-existing T2DM in a region of Australia with increasing rates of DIP, particularly among Aboriginal women. Firstly, a broad group of health practitioners recognised the feasibility of preconception care and identified appropriate guidelines for its delivery, with a strong focus on smoking, weight loss advice, peri-conception medication changes and glycaemic targets. Secondly, due to the complexities of the care setting and high rates of unplanned pregnancy, many practitioners reported limited instances of preconception care but nonetheless aimed to offer it opportunistically. Thirdly, improved coordination of health systems, team-based care and cross-cultural communication are essential to optimise empowerment of women for informed choices and to facilitate practitioners implementing preconception care.

While there are a number of studies examining general preconception care from the practitioner perspective both internationally[26] and within Australia[27], these do not focus on care for women with pre-existing type 2 diabetes or Aboriginal women. Consistent with our findings of low rates of preconception care among Aboriginal women, existing evidence has identified that uptake of preconception care among women with T2DM was less likely in women from minority ethnicities and socioeconomic deprivation[28-30].

Practitioners reported that they generally adhered closely to lifestyle recommendations for smoking and obesity, which have increased prevalence in Aboriginal women and are additional risks for poor pregnancy outcomes[31].

Smoking prevalence rates in the first 20 weeks of pregnancy have been reported to be higher among Aboriginal than non-Aboriginal women (52% and 10% respectively)[14]. Unlike other studies[32], this survey reports that a high proportion of practitioners implement smoking cessation advice. This may reflect increased awareness and/or prioritisation of smoking cessation by health professionals for women with T2DM. Practitioners also reported high rates of weight-loss counselling as a component of preconception care and 95% of those who undertook these discussions with overweight and obese women reported feeling comfortable engaging in this practice. This is an important component of preconception care as obesity is an independent risk factor for reduced fertility[33] and weight management interventions are effective first line treatments for infertile or subfertile obese women[34, 35]. In addition, maternal obesity is associated with significant increases in complications and adverse outcomes in early pregnancy, later pregnancy, labour and the postnatal period[36].

Women with T2DM have a higher risk of neural tube defects and a higher dose of folic acid (5mg) is recommended in most guidelines. The higher recommended dose of folic acid was prescribed by 40% of practitioners in this study. Other studies assessing preconception folate in women with pre-existing diabetes report 45% of women had folate supplementation of any dose[29, 30]. Preconception care for women with diabetes has been shown to increase the number of women using 5mg folic acid compared with those who did not attend preconception care (88 vs. 27%)[28]. The proportion of women prescribed 5 mg folic acid by health providers in this study is higher than other studies without dedicated preconception care but still sub-optimal. Explanations for this may include awareness of mandatory fortification of flour in Australia resulting in increased dietary folate and the widespread use of pregnancy multivitamins in remote clinic formularies. However together these still provide insufficient folic acid for women with pre-existing diabetes. Folic acid dosing could be targeted for practitioner education and improvement, along with changes to remote clinic formularies.

Surveyed practitioners appeared to recognise that enhanced metabolic control in the preconception period was essential to improved pregnancy outcomes, with 78% recommending HbA1c target of <7% (53mmol/mol) consistent with local guidelines, with a third recommending tighter controls of HbA1c <6.5% (48 mmol/mol). Despite this, many did not actually recommend using contraception or delaying pregnancy until optimal control was achieved. Diabetes preconception guidelines internationally are consistent in counselling about ensuring adequate contraception until glycaemic control is achieved, but differences in recommended preconception HbA1c targets may contribute to clinical uncertainty[37]. Contributors to a lack of counselling for delaying pregnancy in this circumstance may be the complexity of care and cross-cultural communication difficulties as well as health providers not wishing to be overly negative or authoritarian.

Our second key finding was that due to the complexities of the care setting and high rates of unplanned pregnancy, many practitioners reported limited instances of preconception care but did aim to offer it opportunistically. Respondents reported that women with T2DM had a low level of awareness of the importance of preconception care contributing to low presentation in the preconception period. These findings concur with previous reports of high proportions of unplanned pregnancy (>50%) generally in Australia[38], and limited presentation for preconception care despite primary health care practitioners seeing this setting as ideal to provide preconception care[26] [27]. In a Western Australian prospective study of pregnant women with pre-existing diabetes, a significant proportion (45%) of pregnancies were also unplanned and only 8% of women had attended preconception care[39]. A large retrospective cohort study in the USA found that women with diabetes were less likely than women without a chronic condition to have documented receipt of any contraceptive counselling, prescriptions, or services[40], showing that contraception- an important aspect of timed conception- is often overlooked in women with complex medical needs. In addition, social determinants of health affect health optimisation in the preconception period through lack of access to

healthcare, ability to buy healthy food and suitable areas for storage of food and medicine.

Some studies report women avoided preconception care due to feelings of alienation and a desire to normalise their pregnancies following warnings of 'horror' outcomes by health professionals. Unplanned pregnancies were more common in women who felt that their pregnancies were discouraged compared with those who had been reassured they could have a healthy baby with appropriate care[19, 41]. Within our study, interviewees recognised the danger of disengaging women by conveying overly negative preconception counselling. Nonetheless, all clinicians agreed that some discussion regarding the risks of pregnancy in the context of suboptimal glucose control was central to this process. These findings all point to a need for preconception services that offer supportive, non-judgmental environments for women, with a focus on encouragement towards glycaemic targets and self-management and an emphasis on positive messages of improved outcomes.

Suggestions to improve preconception care in the context of the complexities outlined above included health systems improvements, such as incorporating preconception care into chronic disease care plans, and the use of preconception templates or checklists. Practitioners noted that a checklist within the routine medical software would not only offer a cognitive aid to instigate preconception care but would aid in its efficiency and quality. Other studies have also cited the use of checklists and software reminders, in addition to patient brochures, handouts and waiting room posters as practical systems developments to support preconception care[26, 27, 42]. Consultations for other reasons, such as attendance for infertility, were described as common opportunities for the provision of preconception care.

Thirdly, the importance of cross cultural communication and team-based care with AHPs was identified as fundamental to this approach. Abbott et al. described the important role of AHPs in health promotion and in assisting Aboriginal people and non-Aboriginal health care providers to communicate

more effectively[43]. AHPs have the unique ability to deliver culturally and linguistically appropriate education and understand how their clients manage their diabetes within their cultural and social context. Practitioners identified insufficient personal and healthcare resources, physical location and other personal circumstances as barriers that were often beyond the typical role of a single health clinician to influence. Thus the value of working within a multi-disciplinary care team with AHPs playing a central role was continually reinforced as a strategy to overcome some of these challenges. A 2006 review of the provision of culturally appropriate maternity services to remote Aboriginal women found that there were inadequacies at all levels including individual practitioner response and education, maternity service delivery and policy development[44]. Despite the generally well-reported uses of varying cross-cultural communication tools to improve patient counselling, interviewees identified the need for additional training in confirming women understood counselling. This highlights the continued education and support required for health professionals working with Aboriginal populations to build community health literacy[45].

There were a number of limitations to our study. Distribution of the survey relied on a primary distributor within each network. Numbers of invited participants are unknown (as invitations were distributed through networks) and a response rate unable to be calculated and the degree of nonresponse bias could not be determined. However, our response rate included 44% of 45 members of the Australian Diabetes Educators Association NT, and given the small numbers of rural/remote health professionals in the NT (estimated to be less than 500), n=156 is likely to be a reasonable response. The differing occupations of those interviewed meant that some themes were more commonly identified among particular professional groups. However, this heterogeneity also ensured that experiences and insights of varying members of the diabetes care team were acknowledged. Although there was diversity among professions of participants, they may have been a select group of informed clinicians as they were attending a conference and/or members of a professional organisation. Despite only 3% of this cohort reporting a desire for additional preconception

care training, less than half prescribed the correct dose of folic acid and advised against pregnancy. If a broader selection of practitioners had been included there may be even poorer knowledge and practice of preconception care, limiting the transferability of this study. Furthermore, assessing preconception practices regarding a number of the general care measures such as ensuring vaccination status- that would typically be offered to all women- was beyond the scope of this study. This limits a more comprehensive analysis of participant preconception provision. Additionally, the study focused largely on care for Aboriginal women. This was important in this context as whilst Aboriginal mothers only account for 31% of the NT population, they comprise 76% of NT mothers with pre-existing diabetes mellitus[14].

The strengths of this study are that we report on a large number of practitioners from a diverse range of occupations and practice locations. Additionally this is the first description of preconception care in Aboriginal women with diabetes and highlights important gaps in knowledge of women's views and potential areas for improvement at systems levels. Aboriginal women across Australia are at increased risk of diabetes, obesity and related chronic conditions and these findings may be applicable for preconception care for Aboriginal women in other areas of Australia as well as internationally.

In conclusion, we report health care practitioners' knowledge and provision of preconception care in women with T2DM across urban, rural and remote Australian regions. These regions have a high proportion of Aboriginal women who experience increased risk of T2DM. There appears to be willingness and potential for provision of preconception care, particularly in remote and regional settings and practitioners reported adherence to recommendations regarding lifestyle modification. However, further health professional education surrounding preconception folate and medication is required. Importantly, health care practitioners need to be equipped with culturally appropriate ways to discuss contraceptive use and pregnancy planning that aims for optimal glycaemic control. In order to facilitate women-centred approaches, further research is needed to explore preconception care delivery from women's perspectives. There is a strong need for continued education as well as policy

and procedure development at an organisational level to support practitioners in delivering preconception care. This will be the focus of further work by the NT DIP Partnership.

ACCEPTED MANUSCRIPT

Acknowledgements:

The authors would like to acknowledge the NT DIP Partnership investigators, partners, staff and clinical reference group, NT health professionals from NT Department of Health hospitals, remote primary health care and Aboriginal Community Controlled Health Organisations who have contributed to the Partnership activities. Investigators of The NT DIP Partnership in addition to those named as authors are: O'Dea K, Zimmet P, Moore E, Chitturi S, Thomas S, Dent G, Corpus S, Eades S, Stone M, Harris M, Inglis C, Dempsey K, Lynch M, Dowden, M.

Financial support:

The NT DIP Partnership is funded by NHMRC Partnership Grant #1032116, with additional support from NHMRC Program Grant #631974 and Global Alliance Chronic Disease NHMRC Grant #1092968. LMB was supported by NHMRC Practitioner Fellowship #1078477; IL was supported by Australian Postgraduate award and Menzies scholarship; JES was supported by NHMRC Fellowship #1079438; AB was supported by a Sylvia and Charles Viertel Senior Medical Research Fellowship.

Conflicts of interest: none

References:

- [1] Metzger, BE, Lowe, LP, Dyer, AR, Trimble, ER, Chaovarindr, U, Coustan, DR, et al. Hyperglycemia and adverse pregnancy outcomes. *The New England journal of medicine*. 2008;358(19):1991-2002.
- [2] Macintosh, MC, Fleming, KM, Bailey, JA, Doyle, P, Modder, J, Acolet, D, et al. Perinatal mortality and congenital anomalies in babies of women with type 1 or type 2 diabetes in England, Wales, and Northern Ireland: population based study. *BMJ (Clinical research ed)*. 2006;333(7560):177.
- [3] Gunton, JE, McElduff, A, Sulway, M, Stiel, J, Kelso, I, Boyce, S, et al. Outcome of pregnancies complicated by pre-gestational diabetes mellitus. *The Australian & New Zealand journal of obstetrics & gynaecology*. 2000;40(1):38-43.
- [4] Gizzo, S, Patrelli, TS, Rossanese, M, Noventa, M, Berretta, R, Di Gangi, S, et al. An update on diabetic women obstetrical outcomes linked to preconception and pregnancy glycemic profile: a systematic literature review. *TheScientificWorldJournal*. 2013;2013:254901.
- [5] Kitzmiller, JL, Gavin, LA, Gin, GD, Jovanovic-Peterson, L, Main, EK, Zigrang, WD. Preconception care of diabetes: Glycemic control prevents congenital anomalies. *JAMA*. 1991;265(6):731-6.
- [6] Wahabi, HA, Alzeidan, RA, Bawazeer, GA, Alansari, LA, Esmail, SA. Preconception care for diabetic women for improving maternal and fetal outcomes: a systematic review and meta-analysis. *BMC Pregnancy Childbirth*. 2010;10:63.
- [7] Kinsley, B. Achieving better outcomes in pregnancies complicated by type 1 and type 2 diabetes mellitus. *Clinical therapeutics*. 2007;29 Suppl D:S153-60.
- [8] Congress Alukra. *Minymaku Kutu Tjukurpa Women's Business Manual*. 5th edition ed. Alice Springs: Centre for Remote Health; 2014.
- [9] NICE. Diabetes in pregnancy: management from preconception to the postnatal period. In: [NG3] Ng, editor. February 2015; Last updated August 2015. <https://www.nice.org.uk/guidance/ng3> [accessed 26.01.17]
- [10] Fraser, A, Lawlor, DA. Long-term health outcomes in offspring born to women with diabetes in pregnancy. *Current diabetes reports*. 2014;14(5):1-8.
- [11] Silverman, BL, Rizzo, TA, Cho, NH, Metzger, BE. Long-term effects of the intrauterine environment. *The Northwestern University Diabetes in Pregnancy Center. Diabetes Care*. 1998;21 Suppl 2:B142-9.
- [12] Minges, KE, Zimmet, P, Magliano, DJ, Dunstan, DW, Brown, A, Shaw, JE. Diabetes prevalence and determinants in Indigenous Australian populations: A systematic review. *Diabetes Research and Clinical Practice*. 2011;93(2):139-49.
- [13] Australian Institute of Health and Welfare. Diabetes in pregnancy: its impact on Australian women and their babies. AIHW. Canberra; 2010 Cat. no. CVD 52. <http://www.aihw.gov.au/publication-detail/?id=6442472448> [accessed 19.07.16]
- [14] Hall, J, Case, A, O'Neil, L. Northern Territory Midwives' Collection. Mothers and Babies 2013. Department of Health. Darwin; 2015. <http://digitallibrary.health.nt.gov.au/prodjspui/handle/10137/640> [accessed 27.07.16]
- [15] Australian Health Ministers Advisory Council. Aboriginal and Torres Strait Islander Health Performance Framework 2014 Report. Canberra; 2015. <http://www.health.gov.au/indigenous-hpf> [accessed 27.07.16]

- [16] Zhang, X, Dempsey, KE, Johnstone, K, Guthridge, S. Trends in the health of mothers and babies, Northern Territory: 1986-2005. Department of Health and Families. Darwin; 2010
- [17] Wild, K, Maypilama, EL, Kildea, S, Boyle, J, Barclay, L, Rumbold, A. 'Give us the full story': Overcoming the challenges to achieving informed choice about fetal anomaly screening in Australian Aboriginal communities. *Social Science & Medicine*. 2013;98:351-60.
- [18] Rumbold, AR, Bailie, RS, Si, D, Dowden, MC, Kennedy, CM, Cox, RJ, et al. Delivery of maternal health care in Indigenous primary care services: baseline data for an ongoing quality improvement initiative. *BMC Pregnancy and Childbirth*. 2011;11:16-.
- [19] Holing, EV, Beyer, CS, Brown, ZA, Connell, FA. Why don't women with diabetes plan their pregnancies? *Diabetes Care*. 1998;21(6):889-95.
- [20] Slocum, JM. Preconception Counseling and Type 2 Diabetes. *Diabetes Spectrum*. 2007;20(2):117-23.
- [21] Edwards, L, Connors, C, Whitbread, C, Brown, A, Oats, J, Maple-Brown, L, et al. Improving health service delivery for women with diabetes in pregnancy in remote Australia: survey of care in the Northern Territory Diabetes in Pregnancy Partnership. *Australian and New Zealand Journal of Obstetrics and Gynaecology*. 2014;54(6):534-40.
- [22] Maple-Brown, LJ, Brown, A, Lee, IL, Connors, C, Oats, J, McIntyre, HD, et al. Pregnancy And Neonatal Diabetes Outcomes in Remote Australia (PANDORA) Study. *BMC Pregnancy Childbirth*. 2013;13:221.
- [23] McElduff, A, Cheung, NW, McIntyre, HD, Lagstrom, JA, Oats, JJ, Ross, GP, et al. The Australasian Diabetes in Pregnancy Society consensus guidelines for the management of type 1 and type 2 diabetes in relation to pregnancy. *Medical Journal of Australia*. 2005;183(7):373.
- [24] Strauss A., CJ. *Basics of Qualitative Research- Techniques and Procedures for Developing Grounded Theory*. London: Sage Publications; 1998 2nd Edition.
- [25] The Royal Australian College of General Practitioners. General practice management of type 2 diabetes: 2016-2018. RACGP. East Melbourne, VIC; 2016 <http://www.racgp.org.au/download/Documents/Guidelines/Diabetes/2015diabetesmanagement.pdf> [accessed 26.02.17]
- [26] Heyes, T, Long, S, Mathers, N. Preconception care: practice and beliefs of primary care workers. *Family Practice*. 2004;21(1):22-7.
- [27] Mazza, D, Chapman, A, Michie, S. Barriers to the implementation of preconception care guidelines as perceived by general practitioners: a qualitative study. *BMC Health Services Research*. 2013;13(1):36.
- [28] Murphy, HR, Roland, JM, Skinner, TC, Simmons, D, Gurnell, E, Morrish, NJ, et al. Effectiveness of a regional prepregnancy care program in women with type 1 and type 2 diabetes: benefits beyond glycemic control. *Diabetes Care*. 2010;33(12):2514-20.
- [29] Riskin-Mashiah, S, Auslander, R, Almog, R. The quality of preconception medical care in women with diabetes needs improvement. *Diabetes Care*. 2014;37(3):678-85.
- [30] Tripathi, A, Rankin, J, Aarvold, J, Chandler, C, Bell, R. Preconception counseling in women with diabetes: a population-based study in the north of England. *Diabetes Care*. 2010;33(3):586-8.

- [31] McDermott, R, Campbell, S, Li, M, McCulloch, B. The health and nutrition of young indigenous women in north Queensland - intergenerational implications of poor food quality, obesity, diabetes, tobacco smoking and alcohol use. *Public Health Nutr.* 2009;12(11):2143-9.
- [32] Bar-Zeev, S, Barclay, L, Kruske, S, Kildea, S. Factors affecting the quality of antenatal care provided to remote dwelling Aboriginal women in northern Australia. *Midwifery.* 2014;30(3):289-96.
- [33] Gesink Law, DC, Maclehose, RF, Longnecker, MP. Obesity and time to pregnancy. *Human Reprod.* 2007;22(2):414-20.
- [34] Norman, RJ, Noakes, M, Wu, R, Davies, MJ, Moran, L, Wang, JX. Improving reproductive performance in overweight/obese women with effective weight management. *Hum Reprod Update.* 2004;10(3):267-80.
- [35] Pasquali, R, Pelusi, C, Genghini, S, Cacciari, M, Gambineri, A. Obesity and reproductive disorders in women. *Hum Reprod Update.* 2003;9(4):359-72.
- [36] Dodd, JM, Grivell, RM, Nguyen, AM, Chan, A, Robinson, JS. Maternal and perinatal health outcomes by body mass index category. *The Australian & New Zealand Journal of Obstetrics & Gynaecology.* 2011;51(2):136-40.
- [37] Mahmud, M, Mazza, D. Preconception care of women with diabetes: a review of current guideline recommendations. *BMC women's health.* 2010;10:5.
- [38] Mazza, D, Harrison, C, Taft, A, Brijnath, B, Britt, H, Hobbs, M, et al. Current contraceptive management in Australian general practice: an analysis of BEACH data. *Medical Journal of Australia.* 2012;197(2):110-4.
- [39] Zhu, H, Graham, D, Teh, RW, Hornbuckle, J. Utilisation of preconception care in women with pregestational diabetes in Western Australia. *The Australian & New Zealand Journal of Obstetrics & Gynaecology.* 2012;52(6):593-6.
- [40] Schwarz, EB, Postlethwaite, D, Hung, YY, Lantzman, E, Armstrong, MA, Horberg, MA. Provision of contraceptive services to women with diabetes mellitus. *J Gen Intern Med.* 2012;27(2):196-201.
- [41] Murphy, HR, Temple R.C., Ball V.E., Roland J.M., Steel S., Zill-E-Huma R., Simmons D., Royce L.R., Skinner T.C., . Personal experiences of women with diabetes who do not attend pre-pregnancy care. *Diabetic Medicine : a journal of the British Diabetic Association.* 2010;27(1):92-100.
- [42] Mortagy, I, Kielmann, K, Baldeweg, SE, Modder, J, Pierce, MB. Integrating preconception care for women with diabetes into primary care: a qualitative study. *Br J Gen Pract.* 2010;60(580):815-21.
- [43] Abbott, P, Gordon, E, Davison, J. Expanding roles of Aboriginal health workers in the primary care setting: seeking recognition. *Contemp Nurse.* 2007;26(1):66-73.
- [44] Kruske, S, Kildea, S, Barclay, L. Cultural safety and maternity care for Aboriginal and Torres Strait Islander Australians. *Women Birth.* 2006;19(3):73-7.
- [45] Lambert, M, Luke, J, Downey, B, Crengle, S, Kelaher, M, Reid, S, et al. Health literacy: health professionals' understandings and their perceptions of barriers that Indigenous patients encounter. *BMC Health Serv Res.* 2014;14:614.

Table 1: Preconception care survey: Respondent Demographics

Characteristic	Frequency (%)
Occupation	
General Practitioner/ Trainee	35 (22)
Midwife	31 (20)
Diabetes Educator	20 (13)
Nurse	21 (13)
Medical Specialist / Trainee	20 (13)
Other Medical Practitioner	11 (7)
Health Service Manager	8 (5)
Dietician	7 (4)
Aboriginal Health Practitioner	3 (2)
Time in current position	
<1 year	47 (30)
1-5 years	66 (42)
5-10 years	21 (14)
>10 years	22 (14)
Region of Work (within NT)	
Central Australia Urban	17 (11)
Central Australia Regional or Remote	37 (24)
Top End Urban	60 (38)
Top End Regional or Remote	42 (27)
Client base	
Aboriginal or Torres Strait Islander peoples	78 (50)
Non-Aboriginal or Torres Strait Islander peoples	11 (7)
Both of the above	67 (43)

Table 2: Practitioner reported adherence to CARPA guidelines

	Frequency (%)
Smoking advice	
Yes	127 (81)
No	23 (15)
Not answered	6 (4)
Discussion of smoking-associated pregnancy risks	
Yes	99 (63)
No	34 (22)
Not answered	23 (15)
Weight loss advice	
Yes	123 (79)
No	26 (17)
Not answered	7 (4)
Organise eye checks	
Yes	68 (43)
No	67 (44)
Not answered	21 (13)
Folic acid supplementation	
Yes	123 (79)
No	9 (6)
Not answered	24 (15)
Folic acid 5mg dose	
Yes (Megafol 5.0 mg)	52 (40)
No (FGF, Elevit, Megafol 0.5mg)	65 (49)
Not answered	14 (11)
Not eligible	24
Iodine supplementation	
Yes	52 (33)
No	78 (50)
Not answered	26 (17)
Cease Metformin	
Yes	13 (14)
No	52 (54)
Not answered	30 (32)
Not eligible	61
Cease Sulphonylureas	
Yes	59 (63)
No	8 (9)

Not answered	26 (28)
Not eligible	63
Cease DPP4 inhibitor / Gliptin	
Yes	59 (63)
No	8 (8)
Not answered	27 (29)
Not eligible	62
Cease ACE inhibitor	
Yes	63 (69)
No	5 (5)
Not answered	24 (26)
Not eligible	64
Cease Statin	
Yes	57 (62)
No	7 (8)
Not answered	28 (30)
Not eligible	64

Table 3: Practitioner glycaemic control recommendations

HbA1c Level (% and mmol/mol) acceptable for conception planning	Frequency (%)
<6.0% (42 mmol/mol)	31 (20)
<6.5% (48 mmol/mol)	47 (30)
<7.0% (53 mmol/mol)	44 (28)
<7.5% (58 mmol/mol)	15 (10)
<8.0% (64 mmol/mol)	4 (3)
<8.5% (69 mmol/mol)	3 (2)
Not answered	12 (7)
Do you ever advise against conception?	
Yes	60 (38)
No	83 (53)
Not answered	13 (8)

TABLE 4: Barriers and enablers to diabetes preconception

Barrier	Enabler	Quote
Theme 1: Complexity of care setting		
<ul style="list-style-type: none"> • Geographical remoteness • Social determinants of health • Limited access to clinicians/ multi-disciplinary diabetes team 	<ul style="list-style-type: none"> • Outreach specialist services • Telemedicine 	<p>GP working in an urban setting described how a combination of these factors create challenges for appropriate care of ‘...a woman who had no food and no fridge and wasn’t taking her insulin, which was actually the safest option’ (GP, urban practice)</p> <p>‘Women move between Yirrkala and the homelands and sometimes we don’t know if someone has been seen for the first antenatal visit or preconception counselling or if they’ve had their Implanon™ removed’ (GP obstetrician, hospital and remote)</p> <p>‘Its common for the women to have a number of other children to care for – whether their own or not- and if they have diabetes it’s hard for them to manage that as we want them to because of those life stresses’ (GP, remote AMS)</p>
Theme 2: Limited consultations for preconception care		
<ul style="list-style-type: none"> • High rates of unplanned pregnancy • Low level of preconception awareness among women 	<ul style="list-style-type: none"> • Infertility and contraception and opportunities 	<p>‘To be honest, hardly any women come in saying, “hey I’d like to fall pregnant, what should I do?” More come saying, “Hey, I’ve missed my period 3 months ago” (GP, urban practice).</p> <p>‘It’s not common women will actually present for preconception care unless they’ve been trying to get pregnant for some time. So that’s the main opportunity to optimise their general health’ (GP obstetrician, hospital and remote outreach)</p> <p>‘There haven’t been a lot of women who have had uncontrolled T2DM who I’ve had the chance to talk about planning a pregnancy. I can’t think of a single one’ (GP, remote AMS)</p> <p>‘When I see women from 14-15 years and above I always talk about the</p>

		<i>chance of pregnancy.’ (Diabetes educator, urban)</i>
Theme 3: Empowerment; Pregnancy choices and risks		
<ul style="list-style-type: none"> • Sensitivity of advising against delaying pregnancy 	<ul style="list-style-type: none"> • Practitioner desire to empower and motivate women • Enabling informed choices 	<p><i>‘to let the women know that they do have a choice and they can time things and avoid pregnancy and they can try to be more ready’ (Specialist obstetrician, hospital and remote outreach)</i></p> <p><i>‘make them aware of the risk factors and how to avoid those risk factors for the safety of the duration of the pregnancy.’ (Diabetes educator, urban)</i></p> <p><i>‘I encourage them to have a break, not necessarily not to have another baby but wait until the time they are ready for it. [...] We do some education [...] and the main message: choose when you are going to have a baby, don’t just let it happen’ (Women’s health nurse, rural AMS)</i></p> <p><i>‘We spent quite a bit of time talking and I advised her that it would be better not to get pregnant but that it was her choice, and we talked about a high risk pregnancy’ (GP obstetrician, hospital and remote outreach)</i></p>
Theme 4: Communication		
<ul style="list-style-type: none"> • Difficulty confirming counselling was understood, health literacy • Language barriers 	<ul style="list-style-type: none"> • Established therapeutic relationships • Cross-cultural approach including language and visual aids • Aboriginal Health Practitioners 	<p><i>‘finding out about people’s family, country and schooling [...] that helps with knowing what sort of language to use’ (GP, urban practice).</i></p> <p><i>‘English might be their third or fourth language and there are great problems in trying to get the message across, in communication and concept’ (Diabetes educator, rural) because they are often ‘translating into their own language or trying to think in another language’ (GP, remote AMS)</i></p> <p><i>‘These are women with complicated lives [...] but do you think people are listening enough to what they want?’ (Specialist obstetrician, hospital and remote outreach)</i></p> <p><i>‘Giving people the opportunity to teach me about their language and culture and learning Yolngu Matha has been really helpful’ for ‘being aware that I need to be the learner instead of someone coming from outside</i></p>

		<p><i>dictating to people' (GP obstetrician, hospital and remote outreach)</i></p> <p><i>'The key thing for Aboriginal community work is having a relationship with the community and the people. So anyone who's done well with maintaining health or improving their diabetes, you can trace it back to their relationship with the practitioner' (GP obstetrician, hospital and remote outreach)</i></p>
Theme 5: Strategies for improving preconception care success		
<ul style="list-style-type: none"> • Conveying fear and negativity 	<ul style="list-style-type: none"> • Team approach • Storytelling • Aboriginal Health 	<p>One practitioner working in a community with three AHPs credited <i>'the number of local staff that we have here makes a big difference towards people feeling comfortable about accessing services' (Women's health nurse, remote AMS).</i></p> <p><i>'I am mindful about my role within the team and my limitations' (GP, urban)</i></p> <p><i>'I always try to talk about family history of diabetes, because some people have horrific stories' with the aim to 'establish from early on that hopeful, positive message' (Diabetes educator, rural)</i></p> <p><i>'If they have family with complications it helps them understand' (Women's health nurse, rural AMS)</i></p>
Theme 6: Systems approaches		
<ul style="list-style-type: none"> • Time constraints • Suboptimal chronic condition care coordination • Health information systems 	<ul style="list-style-type: none"> • Telemedicine • Checklists and templates 	<p><i>'Often we deal with such a scope of work, if [preconception care] is built into a template you'd be less likely to forget it' (Women's health nurse, remote AMS)</i></p> <p><i>'We have 15 minute consults and a different computer system without templates. I try to bring it up but often there is only time for the presenting problem' (GP, urban)</i></p> <p><i>'There is another service [...] which is a chronic disease clinic and it's not actually at the main site [...] so it does fragment and we don't often see people until they are pregnant' (Women's health nurse, regional AMS)</i></p>

		<p><i>'There is a small amount of staff; your time is taken up being reactive rather than proactive. You have to see what is walking through the door and can't go and seek out women to discuss preventative health' (Outreach Women's nurse)</i></p>
--	--	--

ACCEPTED MANUSCRIPT

Highlights

- Practitioners reported enthusiasm for preconception care and knowledge of guidelines
- Practitioners aimed to offer opportunistic preconception care despite limited instances
- Cross-cultural communication and a team-based approach were reported as fundamental

ACCEPTED MANUSCRIPT