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Author/s:

MacKay, D;Freeman, N;Boyle, JA;Campbell, S;McLean, A;Peiris, D;Corpus, S;Connors, C;Moore, E;Wenitong, M;Silver, B;McIntyre, HD;Shaw, JE;Brown, A;Kirkham, R;Maple-Brown, L;Chitturi, S;Eades, S;Inglis, C;Dempsey, K;Lynch, M;Skinner, T;Wright, R;O'Dea, K;Oats, J;Zimmet, P;Sinha, A;Hanley, AJ;Whitbread, C;Barzi, F;Davis, B;Mein, J;McDermott, R;Canuto, K

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CLINICAL ARTICLE

Improving systems of antenatal and postpartum care for hyperglycemia in pregnancy: A process evaluation

Diana MacKay^{1,2}, Natasha Freeman¹, Jacqueline A Boyle³, Sandra Campbell⁴, Anna McLean^{1,5}, David Peiris⁶, Sumaria Corpus⁷, Christine Connors⁸, Elizabeth Moore⁹, Mark Wenitong¹⁰, Bronwyn Silver¹¹, H David McIntyre¹², Jonathan E Shaw¹³, Alex Brown^{14,15}, Renae Kirkham^{1,*}, Louise Maple-Brown^{1,2}, on behalf of the Diabetes Across the Lifecourse: Northern Australia Partnership

1. Menzies School of Health Research, Charles Darwin University, Darwin, Australia.
2. Department of Endocrinology, Royal Darwin Hospital, Darwin, Australia.
3. Monash Centre for Health Research and Implementation, School of Public Health and Preventive Medicine, Monash University, Melbourne, Australia.
4. College of Nursing and Midwifery, Charles Darwin University, Cairns, Australia.
5. Department of Diabetes and Endocrinology, Cairns and Hinterland Hospital and Health Service, Australia.
6. Centre for Health Systems Science, The George Institute for Global Health, Sydney, Australia.
7. Danila Dilba Health Service, Darwin, Australia.
8. Top End Health Service, Northern Territory Department of Health, Darwin, Australia.
9. Aboriginal Medical Services Alliance Northern Territory, Darwin, Australia.

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10. School of Exercise and Nutrition Sciences, Queensland University of Technology, Brisbane, Australia.
11. Central Australian Aboriginal Congress, Alice Springs, Australia.
12. Mater Research, The University of Queensland, Brisbane, Australia.
13. Aboriginal Health Domain, Baker IDI Heart and Diabetes Institute, Melbourne, Australia.
14. South Australian Health and Medical Research Institute, Adelaide, Australia.
15. Faculty of Health and Medical Science, University of Adelaide, Adelaide, Australia.

Renae Kirkham and Louise Maple-Brown contributed equally to this study.

Correspondence

Renae Kirkham, Menzies School of Health Research, PO Box 41096, Casuarina, NT 0811, Australia

Email: renae.kirkham@menzies.edu.au

KEYWORDS

diabetes in pregnancy, gestational diabetes, health systems, hyperglycemia in pregnancy, Indigenous health, process evaluation, quality improvement

SYNOPSIS

A complex health systems intervention resulted in perceived improvements in systems of care for women with hyperglycemia in pregnancy in regional and remote Australia.

ABSTRACT

Objective: To identify successes to date and opportunities for improvement in the implementation of a complex health systems intervention aiming to improve antenatal and postpartum care and health outcomes for women with hyperglycemia in pregnancy in regional and remote Australia.

Methods: A qualitative evaluation, underpinned by the RE-AIM framework (reach, effectiveness, adoption, implementation, maintenance), was conducted mid-intervention. Semi-structured interviews were conducted with 45 participants, including clinicians; regional policymakers and managers; and study implementation staff.

Results: Interviewees reported the early phase of the intervention had resulted in establishment of a clinician network, increased clinician awareness of hyperglycemia in pregnancy, and improvements in management including earlier referral for specialist care and a focus on improving communication with women. Enablers of implementation included existing relationships with stakeholders and alignment of the intervention with health service priorities. Challenges included engaging remote clinicians and the labor-intensive nature of maintaining a clinical register of women with hyperglycemia in pregnancy.

Conclusion: The early phase of this health systems intervention has had a positive perceived impact on systems of care for women with hyperglycemia in pregnancy. Findings have informed modifications to the intervention, including development of a communication and engagement strategy.

1 INTRODUCTION

Hyperglycemia in pregnancy, encompassing pre-existing diabetes (diagnosed prior to pregnancy), gestational diabetes (GDM), and overt diabetes in pregnancy (blood glucose levels during pregnancy meeting diagnostic criteria for diabetes outside of pregnancy), is associated with adverse pregnancy and long-term health outcomes for mothers and children [1-3]. Internationally, Indigenous populations are disproportionately affected; in Australia, Aboriginal and Torres Strait Islander women are 11 and 1.3 times as likely to have pre-existing diabetes and GDM, respectively, compared to non-Indigenous women [4, 5]. Rates of pre-existing diabetes and GDM among Aboriginal women in Australia's Northern Territory (NT) have dramatically increased over recent decades, from 0.6% and 3.4% respectively in 1987 to 5.7% and 13% in 2016 [6].

The time during and after pregnancy is an ideal opportunity to improve the health of women and their children. However, care provided for hyperglycemia during pregnancy and postpartum often falls short of recommendations [7, 8]. In the NT in 2013-2014 only 54% of remote-dwelling Aboriginal women with GDM had glucose testing performed within 12 months postpartum [9]. Multiple barriers to providing care for women with hyperglycemia in pregnancy in remote and regional Australia exist, including limited clinician confidence and a lack of clarity around clinician roles

relating to service provision [10-12]. These barriers apply across the spectrum of hyperglycemia in pregnancy (including GDM, overt diabetes in pregnancy and pre-existing diabetes). Improving antenatal and postpartum systems of care for women with hyperglycemia in pregnancy is a priority of the International Federation of Gynecology and Obstetrics (FIGO) [7].

The Diabetes Across the Lifecourse: Northern Australia Partnership (formerly the Northern Territory (NT) and Far North Queensland (FNQ) Diabetes in Pregnancy Partnership, “the Partnership”) was established in 2012 in the NT as a collaboration between clinicians, researchers, health services and policymakers. The Partnership expanded to include FNQ in 2015. Between 2016 and 2020, the Partnership implemented a complex health systems intervention to improve antenatal and postpartum care for women across the spectrum of hyperglycemia in pregnancy through addressing identified barriers to care and opportunities for improvement [10, 11]. Here we report an interim process evaluation of this health systems intervention.

2 METHODS

Setting

The NT and FNQ is home to 500,000 inhabitants, speaking over 200 languages, across 1.6 million square kilometres [13–15]. Approximately 22.5% of the population identify as Aboriginal and/or Torres Strait Islander, compared with 3.2% across Australia [13-16]. There are approximately 7,000 births across NT and FNQ annually [13, 14, 17]. In the NT in 2016, 11.4% of births to all women were complicated by GDM and 2.1% by pre-existing diabetes; for Aboriginal women, these rates were 12.1% and 5.6% respectively [4]. An audit of births to Aboriginal and Torres Strait Islander women in FNQ showed the prevalence of GDM and T2DM in 2008 to be 14.2% and 2.3% respectively [18]. In FNQ more recently 20% of all pregnancies between January 2019 and June 2020 were complicated by hyperglycemia (Cairns and Hinterland Hospital and Health Service, Casemix Report: Pregnancies complicated by diabetes, 2020; unpublished).

Healthcare for women with hyperglycemia in pregnancy in the NT and FNQ is provided by a complex network of services, including Aboriginal Community Controlled Health Organisations, private primary care services, and government

services at the primary, secondary and tertiary levels. Clinicians in the study regions use multiple guidelines to inform practice, including those published by the Australasian Diabetes in Pregnancy Society [19] and World Health Organisation [20], and local guidelines such as the Queensland Clinical Guidelines [21] and Central Australian Remote Practitioners Association Women's Business Manual [22].

Health Systems Intervention Design

Methods for this health systems intervention have been described in detail previously [23]. Five key components were identified through health professional focus groups in 2016-17:

1. Increasing workforce capacity, skills and knowledge and improving the health literacy of clinicians and women.
2. Improving access to healthcare through culturally and clinically appropriate pathways.
3. Improving information management and communication.
4. Enhancing policies and guidelines.
5. Embedding a clinical register for women with hyperglycemia in pregnancy [24] within the models of care.

Implementation activities were developed in consultation with health professionals and other stakeholders, guided by the above components (Figure 1; Supplementary table 1), including:

- Educational sessions and resources promoting evidence-based care for hyperglycemia in pregnancy according to local guidelines;
- Iterative stakeholder engagement and consultation, including establishment of reference/working groups;
- Improvement of recall and reminder systems;
- Updating of relevant guidelines and policies and embedding these in practice;
- Use of a Diabetes in Pregnancy (DIP) Clinical Register as a clinical support tool, for provision of data for epidemiological and quality improvement purposes, and to assist with follow-up and recall.

Activities have been implemented across primary, secondary and tertiary health services throughout three study regions, being Top End and Central Australia in the NT, and FNQ.

Evaluation Methods

Design

This interim evaluation was designed by NF, an evaluation officer with extensive experience working in the remote Australian context, in consultation with investigators and the implementation team. Design focused on identifying and exploring enablers and barriers to implementation. Evaluation indicators were underpinned by the RE-AIM framework (reach, effectiveness, adoption, implementation and maintenance) [25] (Table 1).

Six primary healthcare services participated as evaluation sites; these primary care services included one government and one Aboriginal community-controlled service in each study region, to facilitate diversity of the services represented. Clinicians involved in the care of women with hyperglycemia in pregnancy at each evaluation site, as well as at the major referral hospital within each region, were invited to participate. Participants also included the intervention implementation team (implementers), and policymakers and managers at the regional health service level. Individuals who had played key roles in promoting and implementing the health systems intervention were considered 'champions'. Potential participants were recruited by email or opportunistically in person at evaluation sites.

Interviews were conducted by NF in person at participant workplaces (e.g. clinic, hospital, research institution) (n=39), or by phone if in person was not feasible (n=4). Interviews were guided by a social constructionist epistemological perspective, utilising a descriptive phenomenological approach [26]. Interview topics were guided by evaluation indicators (Table 1). Average interview duration was 30 minutes (range 8-77 minutes), with most (74%) interviews longer than 20 minutes.

Analysis

Interview transcripts were coded independently using a hybrid inductive-deductive approach by NF and DM, a clinician-researcher with experience in diabetes

management and Aboriginal health. Deductive analysis was underpinned by the pre-specified evaluation indicators. NF and DM each developed a coding structure independently, which was refined through discussion between NF, DM and RK, a qualitative researcher with ten years of experience in health research with Aboriginal communities. Themes were examined across the intervention as a whole and by study region. Analysis was assisted by use of NVivo (version 12; QSR International, Melbourne, Australia).

Ethics Approval and Informed Consent

This study was prospectively approved by the FNQ Human Research Ethics Committee (approval HREC/16/QCH/15-1029), the Central Australian Human Research Ethics Committee (approval HREC-15-345) and the Human Research Ethics Committee of the Northern Territory Department of Health and Menzies School of Health Research (approval HREC-2015-2461). Evaluation participants provided written, informed consent.

Use of Evaluation Findings

Findings were discussed with investigators and implementers in a series of meetings and workshops, both across the Partnership as a whole and within each study region, in late 2018 – early 2019 to identify opportunities for improvements to implementation of intervention activities.

3 RESULTS

NF interviewed 45 informants in 43 semi-structured interviews (Table 2). Seven participants publicly identify as Aboriginal and Torres Strait Islander people, although participants were not specifically asked about their identification so we acknowledge there may be others where this is not known. An additional 11 potential participants were invited; nine of these individuals declined to participate due to being unavailable while two did not respond. Key findings are summarised in Table 3 according to the RE-AIM framework. The first theme detailed below, improvements in the clinical management of hyperglycemia in pregnancy, related to effectiveness; other themes explored recurred across the RE-AIM constructs, with the relevant constructs identified in bold.

Improvements in the clinical management of hyperglycemia in pregnancy

Several improvements in management of hyperglycemia in pregnancy were described by clinicians, including earlier referral for specialist care, improved postpartum follow-up and greater consistency in practice. These were attributed to Partnership activities including clinician education and the promotion of relevant guidelines:

“I find that it’s better [postpartum] follow up for everybody: it’s our follow up [diabetes educator], it’s GPs’ follow up.” (Clinician)

“So they’re [clinicians] all following the same kind of guidelines on how to increase insulin or medication or that kind of thing. So that’s much more streamlined now.” (Champion)

The importance of relationships in implementing health system change

Interviewees consistently reported strong relationships between program implementers, service champions and clinicians as essential to **implementation**.

The presence of the Partnership in the NT for several years prior to this health systems intervention had contributed to establishing deep relationships in Top End and Central Australia. Implementers in these regions when intervention activities commenced had been clinicians within the respective regions’ referral centre for many years; they therefore had a dual implementer/clinician role which facilitated influencing practice (**reach; adoption; implementation**):

“She’s [co-implementer] got those connections as well... when you are affiliated with someone, it helps with the relationships and the trust and the confidence.”

(Implementer)

This contrasted with FNQ, where the Partnership was in an earlier phase and less recognised:

“Generally everywhere we’ve been for face to face updates only a couple of people have actually heard about the Diabetes in Pregnancy Partnership.” (Implementer)

FNQ champions with established relationships with partner health services were important in bridging this gap.

Despite relationships being an enabler of the health systems intervention, implementers perceived communicating with clinicians and partners as challenging due to the substantial workload this entailed (**implementation**): *“but keeping up to*

date with your contact with everyone is also hard, because there are so many people to keep in contact with” (Implementer).

The creation of networking opportunities, particularly face-to-face, was a highly valued outcome of the intervention (**effectiveness**), again emphasising the importance of relationships: *“I think just knowing there’s a supportive network out there, that we’re all trying to achieve the same goal” (Clinician).* These networks enabled the identification of issues and solutions, and the sharing of information and resources: *“So you know it [request for more education] came from the local teams who identified their needs and it ... went up through the group and then back down to provide that service” (Clinician).*

Essential role of champions

Champions in each region throughout all phases of the health systems intervention were seen as instrumental. These champions varied in their clinical backgrounds and contributions to the intervention, but all had worked as clinicians and/or policymakers in the respective region for years, were widely recognised as advocates and were influential in impacting the practice of other clinicians, using both grassroots and top-down approaches (**reach, adoption**):

“She [champion] was able to direct really practical solutions. She was also able to listen, and she was able to make changes... she had the ear of the right people, and then that filtered down to the workforce.” (Implementer)

The trust with which champions were viewed across their networks made them an effective means of promoting the health systems intervention, expanding the **reach** beyond existing Partnership networks. Champions in the NT were in positions enabling them to influence regional health service priorities, policies and guidelines, regarded as an important avenue to ensure **adoption** of recommended changes to practice: *“But ‘cause it has to just go in policy. And once it’s there you [clinician] just have to do what your policy is.” (Clinician).*

Alignment with health service priorities

There was a broad perception that activities of the health systems intervention aligned with clinical priorities (**adoption, implementation**): *“Our goals [Partnership and health service] are the same so you work together to meet them”* (Clinician). This alignment was enhanced by the responsiveness of implementers to the requests and concerns of health services: *“Anything we ever need or having problems with she [implementer]’s always very supportive in helping us”* (Clinician). Champions anticipated that data from the DIP Clinical Register would inform future decision-making regarding service delivery issues highly important to local communities, for example, enabling women to birth closer to home rather than requiring transfer to the tertiary centre if the data supported revisions to birth risk stratification.

Integration of DIP Clinical Register with existing systems

Clinician **adoption** of aspects of the DIP Clinical Register varied depending on integration with their own clinical processes. Clinicians did not access the DIP Clinical Register for individual patient care, largely because it was not integrated with existing clinical systems: *“And do you want to get on a standalone register that really just has two women that you’re actually looking at... people didn’t want to use it as a day-to-day working tool”* (Implementer). However, clinicians reported receiving aggregate data from the DIP Clinical Register as *“really good, because I even used that a little bit in my six-monthly report”* (Champion). Clinicians in primary care reported there were already so many tasks to complete during a clinical encounter with a woman that there was insufficient time to also discuss the DIP Clinical Register, obtain consent and complete a registration form. This contrasted with champions in a referral centre who had adopted the DIP Clinical Register registration form as an efficient way to collect required clinical information. Notably, an implementer was embedded at this referral centre, potentially influencing DIP Clinical Register use.

Aboriginal and Torres Strait Islander representation

Given the importance of hyperglycemia in pregnancy as a health issue for Aboriginal and Torres Strait Islander women, it was seen as essential to highlight *“the importance of Aboriginal and Torres Strait Islander leadership within the project”* (Implementer) (**implementation**). An Aboriginal implementer stated *“I feel I have to*

be an advocate for my people and for Indigenous researchers as well, and ensuring that our research is done appropriately" (Implementer). Strategies to ensure Aboriginal and Torres Strait Islander voices are prominent in decision-making included partnerships with Aboriginal Community Controlled Health Organisations, initiation of an Indigenous Reference Group (IRG) and employment of Aboriginal and Torres Strait Islander staff. Membership of the IRG comprises female clinicians and community members, and is chaired by a project implementer who has a lived experience of hyperglycemia in pregnancy. Improving processes across the Partnership to ensure research aligns with community concerns and that findings are communicated to and benefit community members is an identified priority.

Overlap between barriers to care and implementation barriers

Existing barriers to care were also barriers to **implementation** and **adoption** of health systems improvements. The most pervasive of these was high clinician turnover, which was consistently reported across all regions: *"The turnover of staff in the primary care setting is so much, whatever you do, you have to redo it again and again and again..."* (Champion). Although generally viewed as having negative consequences, staff turnover was reported as a potential antidote to clinician inertia, as clinicians new to the area were potentially more receptive to adopting recommended practices compared to those who were *"stuck in their ways"* (Champion).

Adopting recommended clinical practices for women with hyperglycemia in pregnancy *"easily go by the wayside"* (Implementer) due to limitations on clinician capacity. Geographic remoteness was also a barrier; delivering education locally in remote FNQ had met with some success, but was difficult to coordinate: *"A lot of the clinicians are based in Cairns and are travelling all over the place, so it's hard to get a particular time to meet with everyone that works."* (Implementer).

Clinicians in Top End and FNQ reported the health systems intervention had highlighted the importance of hyperglycemia in pregnancy and prompted them to spend more time with women to communicate relevant health messages (**effectiveness**): *"I probably focus more, spend more educational time ... really try to get that message across."* (Clinician). However, language and cultural differences

were reported as barriers to **adoption** and **implementation** of guideline-based care, with clinicians raising concerns about the effectiveness of information transfer between themselves and women.

The broader context in which care is being provided, where a substantial proportion of women have pressing priorities associated with the social determinants of health, such as housing and food insecurity, was also identified in all regions as being a significant barrier to the **adoption** of recommended practices. Champions reported changes being needed at a social level to address determinants of health while expressing “*we can’t do everything*” (Champion).

Opportunities for Improvements

Proposed modifications to intervention implementation (Table 4), as identified by implementers and stakeholders in response to evaluation findings, included: the development of a communication and engagement strategy; shifting the focus of the DIP Clinical Register to providing epidemiological and quality improvement data and assistance with patient recall rather than being a web-based clinical tool; and development of culturally appropriate education resources for Aboriginal and Torres Strait Islander women.

4 DISCUSSION

This interim evaluation of a complex health systems intervention to improve antenatal and postpartum care for women with hyperglycemia in pregnancy identified several early successes. Highly valued among these was the establishment of a network of clinicians. Collaborative healthcare networks have been previously reported to enhance care coordination and improve quality and safety [27]. Access to such a network is of particular importance for clinicians practicing in the remote setting, who are at risk of becoming professionally as well as geographically isolated [28]. The sustainability of such a network in a setting with high clinician turnover may prove challenging, and will thus be of interest in the final evaluation.

The high value placed on establishing a network exemplified the recurring theme of the importance of relationships in achieving health systems improvements. This finding is in line with Sheikh’s conceptual framework of health policy and systems, in

which 'hardware' components of health systems, such as information systems and human resources, interact with 'software' components including ideas and interests, relationships and power, and values and norms [29]. Our findings suggest that enhancements in 'hardware' such as policies and guidelines or the DIP Clinical Register are most likely to contribute to meaningful health systems improvement if adequate attention is also paid to 'software' elements.

An additional success of the health systems intervention was perceived change in practice, including clinician reports of earlier referral of women to specialist services. While positive, this observation requires verification with objective data. This is of particular interest, with previous studies suggesting an inverse relationship between early access to specialist care and adverse outcomes including macrosomia and large for gestational age [30, 31].

A number of challenges to implementation were identified. Maintaining stakeholder relationships and the DIP Clinical Register both required large investments in implementer time, limiting their capacity to conduct other health system improvement activities. Face-to-face contact between implementers and clinicians, while highly valued, was not always practical due to the large geographic areas spanned and capacity limitations of both implementers and clinicians. The paradox whereby geographically remote communities most in need of support to implement health system improvements, are by virtue of their remoteness the same communities where achieving strong engagement to implement such measures is most difficult, has been highlighted in other settings [32]. The position of implementers in relation to health services had a substantial impact on their ability to enact systems changes, with those holding a dual implementer/clinician role having greater influence, exemplifying the importance of peers in influencing health professional adoption of practice innovations [33].

Challenges in cross-cultural communication reported by clinicians in this evaluation have been described previously [34]. Encouragingly, clinicians' reports of investing more time in communication indicates a recognition of this as being essential in empowering Aboriginal and Torres Strait Islander women in optimising their health. Development of culturally appropriate resources will be a priority in the remaining

phase of this health systems intervention based on the findings of this interim evaluation. Important opportunities to improve communication and cultural safety which have been emphasised by others include providing messages in Aboriginal and Torres Strait Islander languages and the involvement of families in these conversations [35, 36], with the latter embracing family networks as a key strength of Aboriginal and Torres Strait Islander culture.

Implementation of the health systems intervention in the NT was facilitated by previous work of the Partnership, contrasting with FNQ where the Partnership did not have an established profile. This difference was partly offset by the pre-existing relationships of key champions in FNQ, demonstrating the value of time invested in relationship-building [37]. However, there was some confusion in the NT between other projects and the current study, highlighting the need for effective communication strategies with partner organisations and clinicians. A clear understanding of the Partnership's program of work among stakeholders will aid in empowering partners to be involved in setting program priorities. This is of high importance, as translation of research findings to practice is heavily dependent on the key users of such findings initiating and developing research priorities [38]. The Partnership to date has emphasised stakeholder involvement in priority-setting, contributing to alignment of this intervention with health service priorities, although confusion about the Partnership's work suggests improvements can still be made. The final evaluation will provide a valuable opportunity to explore the influence that the Indigenous Reference Group has had on the activities and implementation of the intervention.

The social determinants of health, including housing and food insecurity, were identified as significant barriers to health services engaging with women during and after a pregnancy complicated by diabetes. High staff turnover and limitations on clinician capacity, widely reported previously as barriers to improving health services for Indigenous peoples in Australia and elsewhere [10, 11, 39-42], were also identified in our evaluation. Approaches on the part of health services to overcome the impacts of these social determinants on access to care essential, and indeed the need to prioritise health equity in implementation science has recently been highlighted [43]. In line with this, while beyond the scope of the current health

systems intervention, a priority of current and future work of the Partnership is exploring and enhancing supports beyond health services for Aboriginal and Torres Strait Islander women with a pregnancy complicated by diabetes, and identifying opportunities for integration of health services with such supports.

This evaluation is impacted by several limitations. There are challenges in attributing perceived changes in systems or clinical practice to the intervention due to the study design lacking a control group. A control group was not feasible as implementation activities included changes to systems, such as electronic health records, in use across entire study regions. This interim evaluation did not include objective data to confirm reports of practice changes. It is unknown whether the views expressed by those at evaluation case study sites would be shared by clinicians at other healthcare services within the study regions, although this evaluation provided an opportunity to reflect deeply about impacts of the project and enabled changes to implementation strategies. These latter limitations will be addressed in the final evaluation utilising mixed methods including surveys and interviews, facilitating capture of both a breadth and depth of views, as well as objective audit data from the DIP Clinical Register and primary care electronic health records. A pre- and post-analysis to further determine impacts of the intervention will be conducted using the quantitative data sources (survey and audit).

Strengths of this evaluation include the use of purposive sampling, ensuring inclusion of a diverse range of perspectives across all study regions and enabling thematic saturation. The use of the RE-AIM framework facilitated the exploration of a wide range of factors, while hybrid inductive-deductive coding ensured that interviewee responses falling outside RE-AIM constructs were not disregarded. Interviews were conducted by a non-clinician, which may have allowed interviewees to be more comfortable when discussing potentially contentious issues. This interim evaluation was well-timed to ensure findings could be translated to modifications to maximise the impact of this health systems intervention.

5 CONCLUSION

The early phase of a complex health systems intervention to improve systems of care for women with hyperglycemia in pregnancy has resulted in the development of

a strong network of clinicians and changes to clinical practice. Project champions and stakeholder relationships have been instrumental in achieving these early successes.

Author contributions

DM: data analysis and interpretation; primary author of manuscript. NF: evaluation design; data collection; data analysis and interpretation; manuscript preparation. RK: study and evaluation design; supervision of data collection and interpretation; manuscript supervision and revision for critical intellectual input. JB, SCa, AM, DP, SCo, CC, EM, MW, BS, HDM, JS, AB: study design and manuscript review for critical intellectual input. LMB leads all aspects of this study including study concept and design; obtaining funding and ethics approval; supervision of data collection and implementation; and manuscript supervision and revision for critical intellectual input. All authors have read and approved the manuscript.

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Conflicts of Interest

The authors have no conflicts of interest.

LIST OF ABBREVIATIONS

DIP – Diabetes in Pregnancy

FNQ – Far North Queensland

GDM – gestational diabetes mellitus

NT – Northern Territory

RE-AIM – Reach, Effectiveness, Adoption, Implementation, Maintenance

T2DM – type 2 diabetes mellitus

The Partnership – the Diabetes Across the Lifecourse: Northern Australia Partnership (formerly the Northern Territory and Far North Queensland Diabetes in Pregnancy Partnership)

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FIGURE LEGEND

Figure 1. Logic model for a health systems intervention to improve care for women during and after a pregnancy complicated by diabetes (licensed under CC BY 4.0 by MacKay D et al.)

TABLE 1. Indicators for the interim evaluation of a health systems intervention to improve care during and after a pregnancy complicated by diabetes

RE-AIM	Indicator
Reach - <i>levels of participation and characteristics of participants</i>	Awareness of the Partnership and associated activities Role of participant and level of engagement with hyperglycemia in pregnancy clients
Effectiveness - <i>positive and negative consequences of the intervention</i>	Perceived level of effectiveness of resources/activities for improving management of hyperglycemia in pregnancy Acknowledgement of factors that contribute to effectiveness/explanation of varying levels of effectiveness
Adoption - <i>proportion and representativeness of settings and providers who have adopted the intervention (or components of it)</i>	Knowledge and/or resources have been adopted in practice or intended to be adopted (i.e. improved management practices adopted such as – follow-up plans, oral glucose tolerance tests, Chronic Disease Management Plans) Issues related to not taking up Partnership activity opportunities and/or not implementing related activities
Implementation - <i>the intervention is delivered as intended</i>	Extent that the Models of Care components ^a /implementation activities are being delivered as planned/expected, by whom and when Adaptations made to original implementation plan
Maintenance - <i>practice or policy becomes routine and part of everyday culture and norms</i>	Extent that the Models of Care components ^a /implementation activities have been embedded into regular practice Intention to continue new practices beyond the project's funding cycle

^aModels of Care Components: 1 – Increasing workforce capacity, skills and knowledge and improvement in the health literacy of health professionals and women; 2 – Improving access to culturally and clinically appropriate healthcare; 3 – Improving information management and communication; 4 – Enhancing policy and guidelines; 5 – Embedding the Diabetes in Pregnancy Clinical Register as a component with the Models of Care

TABLE 2. Participants in the interim evaluation of a complex health systems intervention to improve systems of care for hyperglycemia in pregnancy

	Far North Queensland	Central Australia	Top End	Total
Clinicians	9	6	9	24
Midwife		3	2	5
Diabetes Educator	6	1	1	8
Aboriginal Health Practitioner/Worker		1	1	2
Maternal and/or Child Health Worker	2	1	1	4
Medical Practitioner	1		4	5 ^a
Champions	5	5	4	14
Midwife	2	3	1	6
Diabetes Educator	1	1	1	3
Medical Practitioner	2	1	2	5 ^a
Implementers	2	2	3	7
Total	16	13	16	45

^aTen total medical practitioners; includes four general practitioners/general practitioner-obstetricians

TABLE 3. Findings of an interim evaluation using the RE-AIM framework

Domain	Finding	Supporting extracts
Reach	Variable knowledge of the Partnership and health systems intervention amongst clinicians High awareness of Diabetes In Pregnancy Clinical Register among participants, although described lack of awareness within their professional networks	When I started talking to midwives and anyone [in the register]. <i>Champion</i> It's been brought out to the midwives in the h... so they're still kind of getting their head round... ...it seems that we're now getting the ball rolling... people know that ... <i>Implementer</i>
	High engagement with educational events Most participants having attended Partnership educational sessions Multiple avenues for finding out about educational events, including direct contact (email or face-to-face) with implementers, or indirectly through health service managers or champion Difficulty attending educational events for remote	So, we had an after-work education session... something. <i>Clinician</i> Yeah, the diabetes educators. It'll [informative]... it's relevant or any benefit to me she would find... A lot of clinics won't let them go unless it's for...

	clinicians due to time required for travel	and replacement. <i>Champion</i>
	Barriers to reach: High clinician turnover Difficulty reaching peripheral centres within Top End and FNQ Reaching professional groups beyond existing networks Variable degree of clinician interest Intervention activities not recognised as being implemented by the Partnership in Central Australia	...you've actually already captured all of the m heap leave and more come. <i>Clinician</i> So I think it [reach] was patchy, yeah. <i>Implementer</i> And then in [remote communities], what have work with them yet. <i>Champion</i> The network I struggle with I think is doctors network with them. <i>Implementer</i> I think everyone has their own little areas of i pregnancy...aren't on your radar, really hard It hadn't really clicked for me that a lot of wha the diabetes clinic is coming from that project
	Enablers of reach: Champions expand reach beyond existing Partnership networks Linking in with existing educational programs, e.g. remote midwifery education calendar in Central Australia	And I don't know that the activities has been information through. It's very much through t I forward a lot of things onto her [midwife], ac Partnership because it's part of her core busi <i>Champion</i> We've always included them in the remote m everyone out there about what the Partnersh
Effectiveness	Improved awareness of hyperglycemia in pregnancy Increased awareness of magnitude as a public health issue Improved knowledge of recommended care and pathways to access care	I didn't realise how big an issue it is, the diab It's kept diabetes in pregnancy in the forefron and pull it together and work together becaus control. <i>Champion</i> There is a better awareness of the need to fo the ladies with gestational diabetes and diab the care of these ladies. <i>Clinician</i> So I feel that over the course of the Partnersh midwives and nurse in clinics and things have aiming for and why we're aiming for it. So I th education. <i>Champion</i>
	Improved communication between stakeholders Facilitation of a network for support and information-sharing Clarification of messages for women with hyperglycemia in pregnancy	And then networking's really important. You Everyone needs to give the same message a are out there ... otherwise it's confusing... so

Implementers an approachable source for up-to-date and reliable information	[implementers] played a big role in that. <i>Champion</i> She gave me all the latest guidelines, so I did... delivered to me, basically. <i>Clinician</i>
Value of the DIP Clinical Register data An epidemiological tool with the local relevance of region-specific data Useful for clinicians for their own reporting purposes Enables identification of service gaps and facilitates ongoing monitoring for quality improvement purposes	It is such a valuable database; it's got great info... also getting statistics out of it. <i>Clinician</i> And so really at the end of the day thank goodness... So I think as we see more data sets and come... Every year I have to do my own reporting so... the numbers for us... so we can have a snapshot... But also a real interest from either at a local level... information, and either to look at their service... diabetes in pregnancy are ... in terms of making... management targets, and those sorts of things... So we are hoping the register can give us that... our own work here in Alice Springs. <i>Champion</i> And those reports, like I said, they [health services]... the value in them, and I think if it's able to provide... their models, 'cause if they've got high rates... that sort of timely information on what you're... <i>Champion</i>
Improvements in clinical management of hyperglycemia in pregnancy Increased involvement of midwives in management of hyperglycemia in pregnancy, especially postpartum follow-up (FNQ) Earlier referral of women for specialist care (Top End, Central Australia) Facilitation of postpartum follow-up by providing details of women with a recent pregnancy complicated by hyperglycemia Increased time spent with women to communicate health messages relating to hyperglycemia in pregnancy (Top End and FNQ) More consistency of practice	So, yeah, it's been really good in terms of just... involved with the diabetic management... Well, you know, someone else does that. <i>Champion</i> Their pathway is to refer women as soon as they... [diabetes antenatal] clinic, and so that's certainly... <i>Implementer</i> With the diabetes in pregnancy I get a list from... follow them up... And so basically so those gaps... through the cracks. <i>Champion</i> Having this gives us great access to who's doing... done, and it saves a lot of time. <i>Clinician</i> I probably focus more, spend more education... message across ...sort of just try to make the... them at this stage, you know, especially when... Prior to that I guess everybody came with the... it whereas this has made a much more consistent...
Updating clinical guidelines and ensuring updates	Cause some of that stuff, you know it's transferred...

	communicated to clinicians (Central Australia and Top End)	now, which is what we work by, that's our business. We do a lot of education around that change, and then that's solid.... And it's been really good, really good. <i>Champion</i>
	An opportunity to improve health outcomes for women with hyperglycemia in pregnancy , although unclear impact on access to culturally and clinically appropriate pathways	But I think just being aware of the Partnership has just given that opportunity for greater teamwork as well. <i>Clinician</i> I'm trying to think how the project has made a difference. I don't know if I can speak to that. <i>Champion</i>
	Challenges in demonstrating impacts of the intervention, and relationship between the intervention and perceived practice changes	Has that [early referrals to diabetes antenatal] increased for women, or has it increased because the clinicians are more in? But also, has it increased because we've been doing it in pregnancy, and so they've actually done the tests a lot better. So I think all of that, it's a real change. But again how much that education update has helped in applying practices. It's a bit hard to tell. <i>Implementer</i>
Adoption	Underutilisation of DIP Clinical Register for individual patient care Clinicians not accessing or making referrals to the DIP Clinical Register despite being aware of it Lack of integration of DIP Clinical Register with existing clinical systems	I think I've got two remote midwives who do see everybody in Central Australia I've got two people who I know about the register but I must admit I haven't used it. I think I logged on once, and I thought, I don't know who it's for. <i>Champion</i> I think people have not been going to the register for that information... So I just feel that we're, yeah, I think that I'm probably not the only one with that problem. It goes back to you need to have ease in your workflow with different computer interfaces and log in to different systems where things fall away. <i>Implementer</i> But I didn't think it [clinical register] was really useful. It doesn't seem to connect to anything else, and so we have to look at this extra thing that doesn't do anything other than what we already know about that. <i>Champion</i>
	Enablers: Changes to guidelines and policies Organisational support for clinicians to attend educational events DIP Clinical Register registration form used in FNQ as efficient means to collect clinical information	But 'cause it has to just go in to policy. And once it's in policy is. <i>Champion</i> [Health service] is really supportive of getting further my education as well. And then I can help my clients. <i>Clinician</i> As part of us looking after the ladies with gestational diabetes the form is what we need anyway, so we can't do without it. <i>Champion</i>

		the form, and kill two birds with one stone. <i>Champion</i>
	Barriers: Clinician capacity, with multiple competing priorities High clinician turnover, especially in remote regions Care for hyperglycemia in pregnancy perceived by some clinicians as outside their role Language and cultural differences between clinicians and women with hyperglycemia in pregnancy, with concerns about effectiveness of information transfer Social determinants of health, e.g. housing, food insecurity	Unfortunately, I haven't been able to attend a... started and the clinics were really busy and b... But it just depends on human input doesn't it... because what I do and what the next person... another barrier. <i>Champion</i> People are quite stuck in their own roles. Th... babies and the child health nurse looks after... little patch... we need to try not to work in our... whole person. <i>Champion</i> And I know the chronic disease, no, the diabe... said, "Well, why should I have to see this per... and already been seen by the midwife?" <i>Imple</i> So I don't know whether we've been that effe... scaring them either and I don't know if I've be... just trying to gain their trust to get them in. <i>Ch</i> But then the patients are very transient who h... with people with no food, no money for food, ... of staying with family but there's six of them i... in that house. Diabetes and being pregnant, ... encouraging them to take more control is act
Implementation	Enablers: Champions in each region, recognised as advocates and in positions of influence Established presence of the Partnership in Top End and Central Australia, with existing strong relationships between stakeholders Implementation staff in FNQ being physically	But thankfully with the project here [endocrine] she's, for us, we're fortunate she's in that pos... I think in terms of relationships and stuff, bec... long, those relationships have been able to b... And really, being here for a period of time an... you know, and those relationships are alread... quite well supported because of our connecti... underestimate that face to face contact that y... with stakeholders and that connection, yeah. I didn't necessarily know that I had some of t... I guess they've grown over the time. <i>Impleme</i> But one thing, the most important things is th... guys [implementers] represent you really, rea... engagement. <i>Champion</i> And I also think that, I guess having the posit... with the hub and spoke model that the Diabe... So I'm hearing – so I'm actually having discu

	embedded in regional referral centre facilitated influencing practice at that centre Responsiveness of implementers to requests and concerns of health services High degree of support from clinicians and services across the regions for the health systems intervention, with perception that it is well-aligned with clinical priorities Strategies to ensure Aboriginal and Torres Strait Islander representation: • Partnerships with the Aboriginal community-controlled health sector • Establishment of an Indigenous Reference Group • Employment of Aboriginal and Torres Strait Islander staff in the implementation team	issues are you having, and that's all being fed back. <i>Champion</i> I find [champion] very, very aware of the Aboriginal and processes and things like that.... <i>Champion</i> I'm very limited on time, so, but happy to contribute. They could ask me and I would never say "No". The nurses, etcetera, the midwives, the dietitians. I think they're moving towards a success in terms of. Particularly when there's things that can make summaries means that they don't have to make. They can see benefits for more efficient collection of help. <i>Implementer</i> So we had our first one [Indigenous Reference Group] getting their feedback, their input, what will work. <i>Implementer</i> And Aboriginal and Torres Strait Islander people [Indigenous implementer] as part of the project.
	Barriers: Partnership in an earlier phase in FNQ, without established presence prior to this health systems intervention Limited existing relationships with clinicians providing postpartum care Communicating with clinicians and partners • Face-to-face highly valued but not always practical due to large geographic area spanned by each study region • Messages perceived by implementers as overly complex with lack of clear dissemination strategy • Lack of implementer confidence in delivering education, being outside area of expertise	We've actually struggled to actually make people there I think slowly. <i>Champion</i> There's actually different clinicians who work. That's also another concern, is whether we have don't do pregnancy but do post-partum. <i>Champion</i> Well obviously I think it makes a huge difference to face and that's limited. You know you can't. I think we have to just really concentrate on getting it simple. I think we're complicating things so much like that can be complicated for people. <i>Implementer</i> I think that's one of the things I struggle with, breastfeeding, and I can talk about diabetes, the preconception counselling is not my area.

	• Some terminology, e.g. “models of care”, not well understood • Difficulty balancing frequency of communication to maintain enthusiasm and momentum while not overburdening an already stretched workforce Labour-intensive nature of maintaining DIP Clinical Register, requiring manual data collection and entry Turnover of implementation staff in Top End and FNQ with associated loss of momentum and delays in implementation activities Implementers in Central Australia and FNQ isolated from larger research team in Darwin	It's that term “models of care” and I don't think with it. I don't know. And I know, I had trouble. Can I say models of care, that whole phrase, never really understand what it means. <i>Champion</i> Yeah, I do wonder, like a once a year annual do in-between times? That's what I would love clinicians, how can we remind them about the <i>Champion</i> But the big problem with this register is that it's writing all their notes and it's all very nice and it's just a, such a clunky system in this day and age. So there was quick turnaround of staff, which was the – from when the project first kicked off and different to who did the initial survey and the then to then me coming on board. <i>Implementer</i> I don't really have a good feel for what has happened there's anything that they've done that we should. The only thing I suppose is ... I suppose that like, Facetime or video connections more so
	Adaptations: Focus of DIP Clinical Register shifted to providing epidemiological and quality improvement data rather than as a hands-on clinical tool, given low clinician engagement with this register function	I think we've all agreed that use is not logging, suppose use is just being aware of the data and your practice to reflect that, or supporting change. <i>Champion</i> We initially did try to promote the clinical register very early days of the Partnership, and we were <i>Implementer</i>
Maintenance	Maintaining a Diabetes In Pregnancy Clinical Register Hyperglycemia in pregnancy recognised as a growing problem, and value of the DIP Clinical Register perceived to increase over the long-term with the ability to identify and monitor Factors required to maintain the register included integration with existing electronic health records and adequate resourcing	I would just love to see it [DIP Clinical Register] I'd love to see it continue and to grow more, and now ... And unfortunately they're not going away. I think it [DIP Clinical Register] could be something beyond the life of the project because I think what numbers of we were talking about and we think beyond the life of the project it's still working ... so they might like something that links directly example. That would make the most sense to me. Yeah, that's tricky because you'd probably need managing it. <i>Clinician</i> Well I'd love to think that there's a pool of money

		somebody to—like [implementer], to be carry everything going. <i>Clinician</i>
	Embedding health systems intervention activities in clinical practice	... unless there's someone sort of driving the clearly embedded in the current practices. <i>CA</i>

DIP – Diabetes in Pregnancy; FNQ – Far North Queensland; the Partnership – Diabetes Across the Lifecourse: Northern Australia

TABLE 4. Actions to address identified challenges in implementation of a complex health systems intervention, by RE-AIM component

Challenge	Proposed action
Reach	
Clinician engagement highest in regional centres and within some professional streams (midwives, diabetes educators), with limited engagement beyond these groups	Flexible education delivery – online, pre-recorded, “train-the-trainer” model Communication strategy with partner organisations Regional champions Specific engagement strategies for Aboriginal health practitioners, including invitations as presenters/participants at education sessions, financial incentives for attending meetings/forums, and integration of messages relating to hyperglycemia in pregnancy in training curriculum Seek feedback from clinicians regarding most effective methods for engagement
Adoption	
Low utility of web-based individual patient clinical tool aspect of Diabetes In Pregnancy Clinical Register	Focus shifted to providing epidemiological and quality improvement data (grouped de-identified data)
Siloed approach to managing women’s health	Engagement of child health nurses and general practitioners to promote opportunistic screening and diabetes care, such as during mother’s attendance for child’s health review
Ineffective information sharing with women	Development of culturally appropriate resources, in consultation with Partnership Indigenous Reference Group
Inability to address social determinants impacting on women’s competing priorities and health management	Promote awareness of broader social determinants through intervention education/engagement activities
Implementation	
Loss of momentum between large annual educational symposium	Communication strategy to maintain engagement between annual symposia

Complexity and inconsistency of educational messages being delivered	Dissemination of consistent and accurate messaging, with assistance of content area experts
<i>Maintenance</i>	
Maintaining Diabetes In Pregnancy Clinical Register in current form is labour-intensive	Explore potential of direct data extraction from existing electronic health records

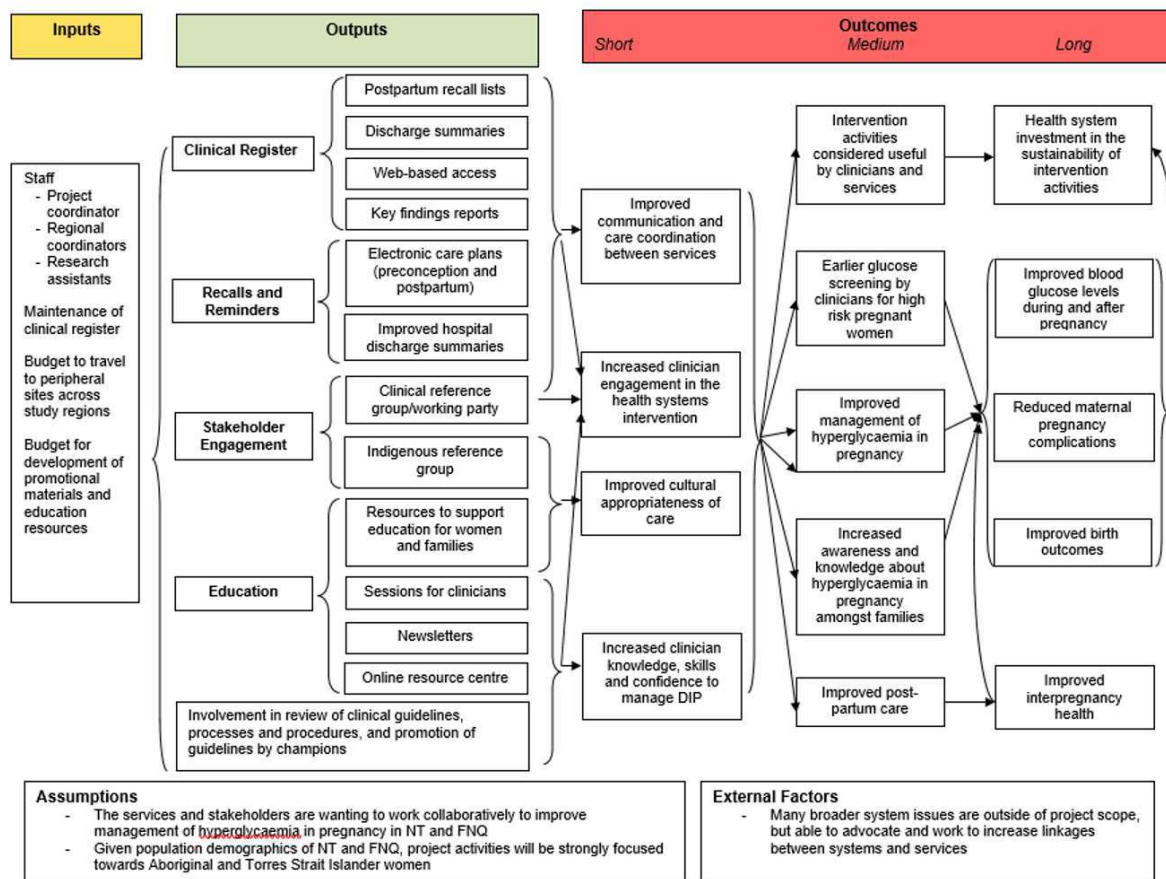


Figure 1 – Logic model for a health systems intervention to improve care for women during and after a pregnancy complicated by diabetes (by MacKay D et al, licensed under CC BY 4.0)