Diabetes in Pregnancy in CMDHB

Trends Over Time, a 2011 Snapshot

and Service Implications

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in collaboration with

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Disclaimer

This report should be considered a 'work in progress', which will need to be modified and updated as new information comes to hand. Its development was an iterative process, arising from the Population Health Review undertaken by CMDHB during 2012 and it is acknowledged it raises as many questions as it answers. Feedback is welcomed; please direct that to Doone Winnard at Doone.Winnard@middlemore.co.nz .

Every effort has been made to ensure that the information in this report is correct. Counties Manukau District Health Board and the authors do not accept any responsibility for information which is incorrect and where action has been taken as a result of the information in this report.

Executive Summary

Diabetes in pregnancy (DIP), which includes both Gestational Diabetes (GDM) and pre-existing diabetes, represents a significant risk for poorer pregnancy outcomes and has implications for the future health of both mother and baby. Concern has been expressed locally and internationally about the increasing prevalence of diabetes in pregnancy. This paper summarises and compares data about diabetes in pregnancy for both the CMDHB resident population and the population delivering at CMDHB facilities, to attempt to quantify and better understand the 'current state' for CMDHB. It draws on National Minimum Data Set (NMDS) and CMDHB DIP service data. Results of analyses have been discussed with leaders of the CMDHB Diabetes in Pregnancy service to ensure they are consistent with observations in clinical practice and to consider the implications for service planning and delivery.

The screening and management pathways for diabetes in pregnancy are currently somewhat in a state of flux, with national guidelines about GDM under current review and differential implementation of an early pregnancy screening pathway across the Auckland region. This impacts on comparisons over time and between DHBs but nevertheless this report has identified some important overarching concerns:

- While the total number of deliveries (8,500) and the number and proportion of deliveries by age for CMDHB women over the last six years has remained fairly constant, using the National Minimum Data Set (NMDS) the number of deliveries for CMDHB women identified with GDM has almost doubled over the six years from 2006/07 (225) to 2011/12 (407).

- The crude rate of deliveries identified with GDM for CMDHB women has correspondingly increased from 2.7% to 4.8%. The highest rates are in Indian (9.6%), Chinese (8.6%) and other Asian women (7.7%), but the largest volume of cases continues to be women of Pacific ethnicities (154 in 2011/12). [Note: The differences by ethnicity across a range of parameters in relation to diabetes in pregnancy highlight the need, as for other areas, to disaggregate data so that the issues for different groups can be adequately explored].

- The total number of deliveries with pre-existing diabetes has also increased over the last six years (106 in 2011/12), with the biggest proportionate increases being for Pacific, Indian and other Asian women, although numbers are small for Indian and other Asian groups.

- Young women with Type 2 diabetes, with co-morbidities not usually expected until later in life, are of principle concern for staff of the DIP service. In their experience young women with diabetes frequently seem to have very limited understanding of the risks to their pregnancy and the future health of their child from poorly controlled diabetes.

- Overall the volume of deliveries complicated by diabetes in 2011/12 was over 500, representing a crude rate of 6% of all deliveries for women resident in CMDHB.

- Looking at the overall group of CMDHB resident women (eligible to deliver at CMDHB) with either GDM or pre-existing diabetes in 2011, the percentage delivering at CMDHB facilities was very high for Maaori (90%), Pacific (95%) and Indian (82%) women. It was 70% or over

for women of European/Other and non-Indian/non-Chinese Asian groups but much lower for Chinese women (30%), who were more likely to deliver at ADHB facilities.

- In 2011 there were also 36 women from other DHBs who delivered at CMDHB facilities who were identified as having diabetes in pregnancy. 72% of these women were of Pacific or Indian ethnicity and 55% were from Otahuhu.

- If the trends of overall rates of diabetes in pregnancy of the past six years continue, with no change in definition of GDM or screening practices and a stable birth cohort size, there would be an expected increase of nearly 25% (8% per annum) on 2011/12 volumes of CMDHB women needing to be managed by diabetes in pregnancy services by 2014/15. Although not all of these women will be managed by the CMDHB service, there are also women from other DHBs who deliver at CMDHB and require care under the CMDHB service.

- These projections may overestimate or underestimate future demand depending on changes in the ethnic mix of the CMDHB population, the rates of obesity in women of childbearing age and potential changes in screening and diagnostic pathways for DIP. However the expected changes in all of these drivers are likely to be upward rather than downward.

- According to the National Women's Annual report, in 2011 approximately 11% of women who birthed at NW were reported as diagnosed with GDM; i.e. nearly twice the prevalence identified in this report for CMDHB women. Although the delivery population at ADHB facilities is considerably older than the CMDHB population, which increases their risk of GDM, age specific rates by ethnicity were higher across all age groups than CMDHB rates. Discussion with CMDHB clinicians suggests this is related to screening and diagnostic pathways, but the differences become material for service planning and/or research which extends across the region, and warrant further discussion with relevant clinicians. It also raises questions about the appropriateness of polycose screening, which is not weight-adjusted, for the CMDHB population with concern that is resulting in false negatives in the CMDHB population so that women are not receiving further (appropriate) investigation.

- However, there are also concerns by CMDHB clinicians about further overloading the DIP service by diagnosing more women with GDM at the mild end of the spectrum rather than addressing the higher risk patients and diluting their care before there is an adequate pathway for those currently being diagnosed.

Screening and Postnatal Follow Up

- Close to three quarters (73%) of CMDHB woman without pre-existing diabetes were screened by a polycose test for GDM and a further 7-8% underwent GGT. Maaori women had the lowest rate of polycose screening at 61%, and this lower screening rate needs to be addressed, whatever decisions are made about screening pathways going forward.

- Overall, if the women who weren't screened and/or tested had the same GDM rates as those who were, there may have been approximately 70 women and infants in 2011 (based on current practice) whose outcomes could have been impacted by undiagnosed GDM.

- Women with GDM have a significant risk of future Type 2 diabetes and improving postnatal screening for underlying diabetes in women with GDM has been an area of significant attention in recent years in CMHDB. In 2011 63% of CMDHB resident women identified with GDM had a GGT or HbA1c within six months of delivery. This means there is still a significant proportion of women with GDM who are not currently followed up postnatally as recommended in guidelines, despite efforts to improve this. Importantly there are interventions to reduce their risk of future diabetes but not a robust pathway to support this at present.

- There has been a recent regional discussion about the possibility of using HbA1c at 12 weeks postpartum as an alternative to the currently recommended 75gm OGTT at six weeks post-partum for diabetes screening as it is anticipated this change would improve postnatal screening rates.

- There is also potential for a GDM register to support robust more screening and intervention.

In summary, diabetes in pregnancy is a significant issue for the current and future generations of the CMDHB population and creates considerable health system demand; increased efforts to both prevent and better diagnose and manage DIP need to be an important feature of population health activity for CMDHB.

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Introduction and purpose

Diabetes in pregnancy, which includes both Gestational Diabetes and pre-existing diabetes, represents a significant risk for poorer pregnancy outcomes and has implications for future health, for both mother and baby.

There is increasing evidence that early life environmental factors influence the development of chronic disease and obesity, with the period of importance being from embryo to early childhood. The importance of addressing both prevention and management of diabetes in pregnancy is seen as an integral part of influencing the peri-conceptual and in utero environments to prevent future 'non-communicable diseases' (NCDs, including diabetes, CVD and cancer), and as such is strongly promoted by the Prime Minister's Chief Scientific Advisor, Professor Peter Gluckman (e.g. Gluckman & Hanson, 2012). It is suggested that this emphasis on early life means it is still important to encourage good nutrition and an active lifestyle for people of all ages, but an acceptance that prevention efforts in adulthood may have limited success because of epigenetic factors which are determined in early life (Hanson & Gluckman, 2011). This has been highlighted as part of the current Population Health review in CMDHB.

In addition, the 2011 Perinatal Mortality in Counties Manukau report identified diabetes in pregnancy as a significant factor contributing to the increased stillbirth rate in CMDHB (Jackson, 2011). The importance of diabetes in pregnancy was reiterated in the 2012 external review of maternity services in CMDHB (Paterson et al, 2012).

Women who are older, those of non-Caucasian ethnicities and those who are obese are at increased risk of both GDM and pre-existing diabetes (Wijayaratna, 2011). Concern has been expressed locally and internationally about the increasing prevalence of diabetes in pregnancy. This paper attempts to quantify that for CMDHB to better understand the 'current state' and inform future service planning. It builds on three previous, relatively recent, local reports which gave some indication of local epidemiology of diabetes in pregnancy based on information in health datasets:

- Smith J, Papa D, Jackson G (2008) Diabetes in CMDHB and the northern region: Estimation using routinely collected data. Counties Manukau District Health Board.
- Wijayaratna A (2011) An overview of diabetes in pregnancy in the Counties Manukau District Health Board area. Counties Manukau: Diabetes Projects Trust
- Jackson C (2011) Perinatal mortality in Counties Manukau. Counties Manukau District Health Board.

The 2008 report of Smith et al identified 498 women with diagnosis codes for new diabetes in pregnancy over a period of two years (2006-2007). 44% of these women were Pacific, 25% Asian, 15% Maaori and 17% European/Other ethnicities. Wijayaratna cited the work of Smith et al and also noted the potential for increasing prevalence of diabetes in pregnancy due to the obesity rates and ethnic mix of the CMDHB population. Jackson found a prevalence of gestational diabetes, pre-existing diabetes, and/or previous gestational diabetes in pregnant women in CMDHB in 2009 of 4.6% (95% CI: 4.2-5.1) which was significantly higher than the national prevalence at 3.7% (95% CI: 3.5-3.8). She noted that the higher prevalence of pre-existing or gestational diabetes in CMDHB

women was driven by significantly higher rates than the New Zealand rates for CMDHB women aged 25-34 years and 35 years and older.

Historically there has also been concern expressed that clinical coding and information in the hospital and national information systems does not accurately reflect the rates of diabetes in pregnancy. However there has been work done to improve this and it is anticipated that various data sources should now be more consistent.

This report summarises three pieces of work

- analysis of encrypted, National Minimum Data Set records for deliveries for women resident in CMDHB,
- analysis of records from the CMDHB Diabetes in Pregnancy service database, and
- analysis of an extract from the DHB record system PIMS of information about patients booked and seen by at diabetes in pregnancy clinics at CMDHB.

The NMDS analysis includes two components, trends over the last six financial years (so as to include the most current complete year of data), and a snapshot of the calendar year 2011, so as to try to align with a calendar years' worth of DIP service data.

Although there has not been work to formally match data, an attempt has been made to compare the NMDS and DIP service data for 2011 to understand how well the information in the NMDS currently correlates with the DIP service data for the CMDHB population. Using several different sources of data was considered important to get a more robust picture of the current situation, given it was initially unclear how well the different sources would align. Results were discussed with leaders of the CMDHB Diabetes in Pregnancy service to consider the implications for service planning and delivery. These aspects are further outlined in a discussion section on P 46.

Methods

It is important to understand that the three pieces of work summarised in this paper each have different 'denominators', populations of pregnant women whose health records are being analysed. These are described further below. Note that for each denominator, it is the number of deliveries rather than infants born that is being considered; because of multiple births, the number of infants born is higher than then number of deliveries. Because this paper is about a maternal condition, it focuses on the number of deliveries.

National Minimum Data Set analysis

Data is entered into the NMDS retrospectively, after the utilisation event has taken place, so deliveries are counted in the year in which they took place. For the trend analysis, records were extracted for deliveries recorded for women resident in CMDHB in the National Minimum Data Set (NMDS) in the last six financial years, 2006/07 – 2011/12, stratified by age and ethnicity.

Comparisons of volumes and rates across those six years assume the definition of gestational diabetes has not changed across that time period. There has been a national group looking at the diagnostic criteria for GDM for the past three years and it is likely there will be decisions made about this in late 2013 which will affect future analysis of trends. Work by LabTests in 2010 suggested proposed changes to diagnostic criteria could identify an additional 150 cases of GDM each year for CMDHB women based on prevalence rates at that time. In 2009 the College of Midwives updated their consensus statement about Gestational Diabetes in response to recommendations from the National GDM Technical Working Part at the time (Simmons et al, 2008) and this may have raised awareness among College members about screening and management implications related to diabetes in pregnancy; this is pertinent for the analyses in this paper and that has been noted in the relevant sections.

Recently there has been regional development of an algorithm to improve early identification of pre-existing diabetes in pregnancy, which has been implemented in Waitemata and Auckland DHBs in late 2010 but not yet in CMDHB. Analysis of the implications for CMDHB suggests implementation could identify an additional 160-170 women with pre-existing diabetes in pregnancy from the CMDHB population each year because of the high rate of risk factors such as obesity and non-Caucasian ethnicities in the CMDHB population. It was planned to implement this algorithm in CMDHB from the beginning of 2013 but instead it has been decided to wait until the release of the Guidelines for screening, diagnosis and management of gestational diabetes in New Zealand, due to be released in November 2013. This again will have implications for future analyses as well as service planning. Current screening and diagnostic criteria used in CMDHB as described in Appendix One.

For the snapshot analysis, records were extracted for deliveries recorded for women resident in CMDHB in the National Minimum Data Set (NMDS) in the 2011 calendar year, stratified by age, ethnicity, and facility of delivery. Analysis by facility allows an analysis of how many of these women would be expected to be under the care of the Diabetes in Pregnancy Service at CMDHB (those booked to deliver at a CMDHB facility) and how many might be attending services in other DHBs (primarily those booked to deliver at ADHB).

Delivery outside CMDHB is usually because of the DHB at which a woman's Lead Maternity Carer has an access agreement; a small number of women are referred to ADHB because of fetal anomalies. Some women initially booked to deliver at CMDHB and registered with the DIP service at CMDHB move residence during pregnancy and deliver at a non-CMDHB facility (personal communication, Lesley MacLennan, Diabetes Midwife); this is discussed further under the methods section for Diabetes in Pregnancy Service analysis below.

After comparison of the NMDS data for women resident in CMDHB with the numbers of women referred to the CMDHB Diabetes in Pregnancy service at CMDHB, data was also extracted for women delivering at CMDHB facilities who were resident in other DHBs; women with diabetes from this group will also be seen by the CMDHB Diabetes in Pregnancy service.

Deliveries were identified as being complicated by Gestational Diabetes (GDM) if in the year of their delivery record they had an ICD code 'Diabetes arising in pregnancy'. These codes are detailed in Table 51 Appendix One. Of note, traditionally GDM was seen as a condition usually arising in the second trimester, secondary to acquired insulin resistance and resulting carbohydrate intolerance. However current practice in the Auckland region and Australasia is for diabetes detected at any stage of a pregnancy, where there is not a clear history of pre-existing diabetes, to be labelled as 'Arising in pregnancy' or GDM. This is important in relation to implementation of HbA1c at booking for women at risk of diabetes as per the regional algorithm discussed above. Women with an HbA1c elevated to the level suggesting diabetes, but without a pre-existing diagnosis will be labelled as GDM, whereas in reality they most likely have pre-existing diabetes. The fact that ADHB and WDHB have implemented the algorithm but CMDHB has not could be impacting differentially on the number of women identified as having 'GDM' across the DHBs.

There were a small number of deliveries (1-9 per year) with an ICD code of diabetes in pregnancy with unspecified onset (as per the ICD codes in Table 52 in Appendix Two). These were counted with the GDM records.

Women with pre-existing diabetes were identified as those with the ICD codes for pre-existing diabetes in pregnancy (as per Table 53 in Appendix Two) or diabetes as a stand-alone coded diagnosis (ICD codes also in Table 53 in Appendix Two) in the year of their delivery, or some other admission in the previous five years; i.e. pre-existing diabetes, recorded in relation to pregnancy or some other admission in the last 5 years.

It is recognised that some women with GDM may have unrecognised pre-existing diabetes; these women will be correctly reclassified postpartum with a postpartum OGTT or HbA1c, providing this is actually undertaken. However this reclassification will not be captured in the NMDS, as the birth event is coded within a week or two of mother's discharge and not updated by a postpartum diagnosis. This is a general limitation of NMDS data in relation to post-discharge diagnoses, not limited to diabetes in pregnancy.

There were a small number of women who had both a code consistent with GDM at their recent delivery, and a code indicating pre-existing diabetes. For this analysis these women have been categorised as having pre-existing diabetes and subtracted from the GDM numbers.

Diabetes in Pregnancy Service analysis

The Diabetes in Pregnancy (DIP) service data is stored by Expected Date of Delivery (EDD) at referral. The data extracted for 2012 included bookings up until early Oct (when the work on this report first commenced) which means the majority of those who have an EDD in 2012 would be identified, but there will be some further cases referred so the data needs to be considered incomplete. *Communication 7 November:* A further 6 cases have been referred since the data was extracted and another two or so cases could be expected before the end of the year based on previous years' referrals.

As noted previously, some women who are initially booked to deliver at CMDHB and registered with the DIP service at CMDHB

- move residence during pregnancy and deliver at a non-CMDHB facility
- come under the care of an LMC who has an access agreement at another DHB so change to the DIP service and deliver at another DHB
- are transferred to ADHB because of fetal anomalies
- miscarry after being seen in early pregnancy.

Women referred to the CMDHB DIP service in 2011 and coming under these categories totalled 28 in 2011.

Occasionally women deliver at home or on route to the hospital who have been under the care of the DIP service; these women would be recorded as having an unplanned home birth, and discharged from the hospital they were booked at, so would be coded as having diabetes in pregnancy.

Data was extracted by Lesley MacLennan, Diabetes Midwife. Ethnicity recording in the DIP service database prior to 2010 is not comparable with current data so figures for 2010 – 2012 were extracted, stratified by GDM or pre-existing diabetes and ethnicity.

A spreadsheet was also available from Fawsia Saleem, Decision Support analyst for women's health, detailing diagnosis (GDM or other), ethnicity, age, BMI (not complete), mode of delivery and infant birth weight for women booked between January and December 2011 who had diabetes clinic visits.

Trends over time

Context

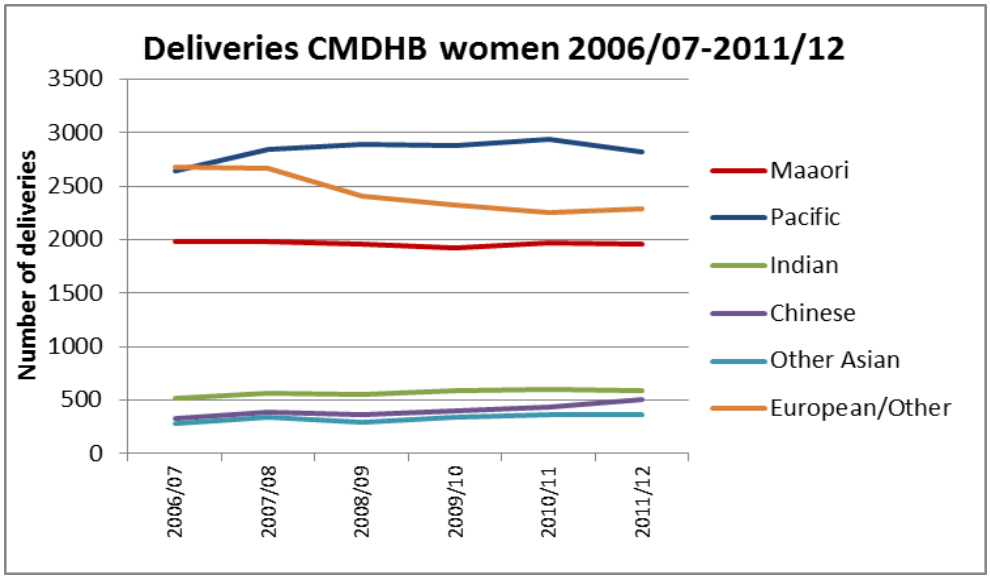
As demonstrated in Table 1 and Figure 1, the total number of deliveries for CMDHB women over the last six years has remained fairly constant at about 8,500; the proportion by ethnicity has changed a little, with less women identified as European/Other and more in the Asian ethnic groups.

Table 1 Deliveries for CMDHB resident women, FY[1] 2006/07 – 2011/12 by ethnicity

Ethnicity	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12
Maaori	1983	1987	1959	1922	1969	1953
Pacific	2641	2839	2892	2882	2938	2818
Indian	516	567	548	586	597	586
Chinese	330	389	364	401	431	509
Other Asian	285	345	294	336	359	364
European / Other	2675	2662	2405	2321	2249	2290
Total	**8430**	**8789**	**8462**	**8448**	**8543**	**8520**

Source: NMDS, analysed by CMDHB 2012.

Figure 1 Deliveries for CMDHB resident women, FY 2006/07 – 2011/12 by ethnicity



Source: NMDS, analysed by CMDHB 2012.

The number and proportion of deliveries by age has changed little between 2006/07 and 2011/12, with approximately 9 % of women aged under 20 years and 17% aged 35 and over (Table 2 & Table 3; Figure 2).

[1] Financial year for the DHB, 1 July to 30 June of the subsequent year

[2] This was not a specific data request for this paper but material that had been extracted previously in relation

Table 2 Deliveries for CMDHB resident women, FY 2006/07 by age and ethnicity

Deliveries for CMDHB resident women	< 20	20-24	25-29	30-34	35-39	40 and over	Total	Ethnicity as % of total deliveries
Maaori	407	557	480	319	181	39	**1983**	23.5%
Pacific	222	697	730	576	329	87	**2641**	31.3%
Indian	8	117	211	136	38	6	**516**	6.1%
Chinese	5	42	89	108	60	26	**330**	3.9%
Other Asian	11	52	89	72	41	20	**285**	3.4%
European / Other	144	353	635	896	545	102	**2675**	31.7%
Total	**797**	**1818**	**2234**	**2107**	**1194**	**280**	**8430**	
Age group as % of total deliveries	9.5%	21.6%	26.5%	25.0%	14.2%	3.3%		

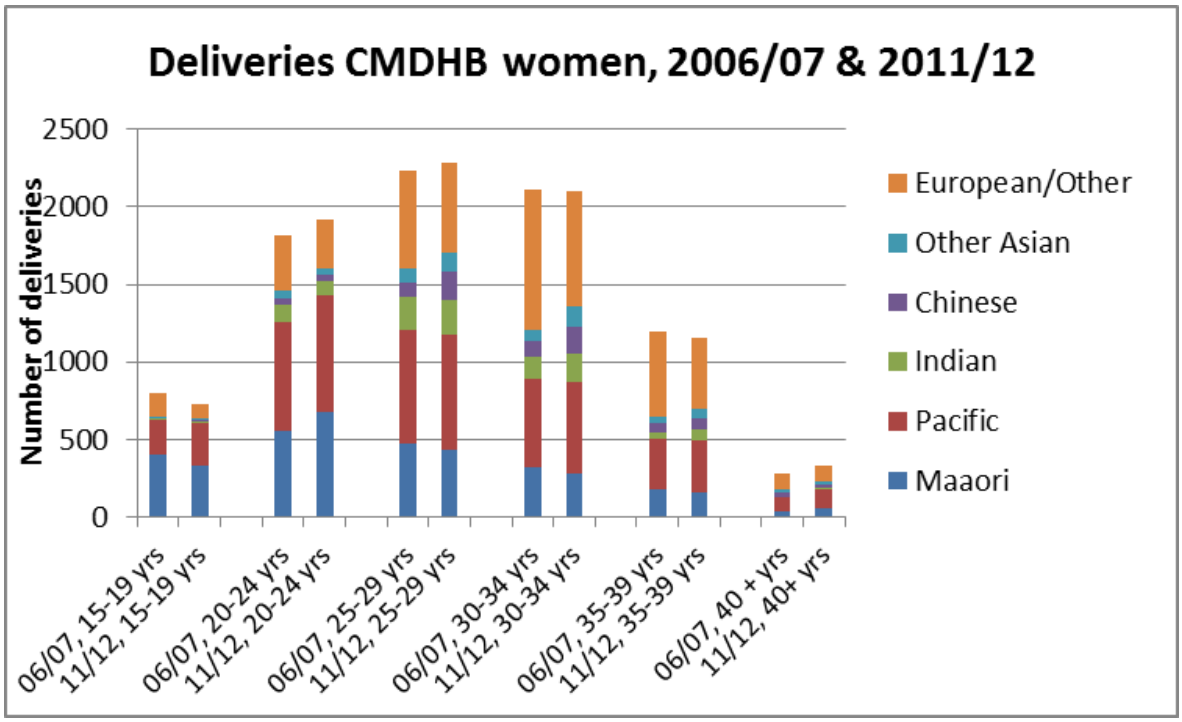
Source: NMDS, analysed by CMDHB 2012.

Table 3 Deliveries for CMDHB resident women, FY 2011/12 by age and ethnicity

Deliveries for CMDHB resident women	< 20	20-24	25-29	30-34	35-39	40 and over	Total	Ethnicity as % of total deliveries
Maaori	338	677	436	284	161	57	**1953**	22.9%
Pacific	273	757	736	592	335	125	**2818**	33.1%
Indian	12	88	229	175	71	11	**586**	6.9%
Chinese	4	41	184	180	76	24	**509**	6.0%
Other Asian	8	34	117	129	59	17	**364**	4.3%
European / Other	96	317	580	743	456	98	**2290**	26.9%
Total	**731**	**1914**	**2282**	**2103**	**1158**	**332**	**8520**	
Age group as % of total deliveries	8.6%	22.5%	26.8%	24.7%	13.6%	3.9%		

Source: NMDS, analysed by CMDHB 2012.

Figure 2 Deliveries for CMDHB resident women, FY 2006/07 and 2011/12 by age and ethnicity



Source: NMDS, analysed by CMDHB 2012.

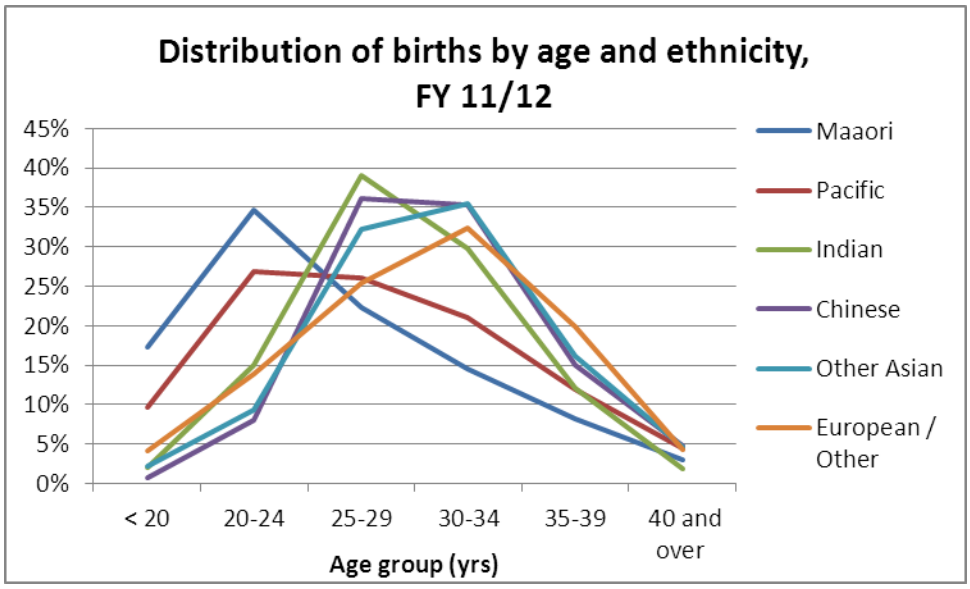
Maternal age is important in relation to diabetes risk, with higher risk in older women, so the distribution of births by age is relevant context for interpreting patterns of prevalence of diabetes in pregnancy. As demonstrated in Table 4 and Figure 3, the distribution of births by age differs by ethnicity across the CMDHB population with 52% of Maaori women delivering in FY 11/12 being under the age of 25 years, compared to 37% of Pacific women, and 9 - 18% for women of Asian and European/Other ethnicities.

Table 4 Distribution of births by age and ethnicity, for CMDHB resident women FY 11/12

Age group as % of total deliveries	< 20	20-24	25-29	30-34	35-39	40 and over	Total
Maaori	17.3%	34.7%	22.3%	14.5%	8.2%	2.9%	100%
Pacific	9.7%	26.9%	26.1%	21.0%	11.9%	4.4%	100%
Indian	2.0%	15.0%	39.1%	29.9%	12.1%	1.9%	100%
Chinese	0.8%	8.1%	36.1%	35.4%	14.9%	4.7%	100%
Other Asian	2.2%	9.3%	32.1%	35.4%	16.2%	4.7%	100%
European / Other	4.2%	13.8%	25.3%	32.4%	19.9%	4.3%	100%
Total	**8.6%**	**22.5%**	**26.8%**	**24.7%**	**13.6%**	**3.9%**	

Source: NMDS, analysed by CMDHB 2012.

Figure 3 Distribution of births by age and ethnicity, for CMDHB resident women FY 11/12



Source: NMDS, analysed by CMDHB 2012.

Deliveries complicated by gestational diabetes

The total number of deliveries for CMDHB women identified with GDM in the NMDS has almost doubled over the last six years (Table 5, Figure 4 & Figure 5) with the biggest proportionate increases being for Chinese and other, non-Indian Asian women. Collectively Indian, Chinese and other Asian women represented 17% of deliveries for CMDHB women in 2011/12 and 31% of those deliveries with GDM (note Asian women represented 25% of GDM deliveries in 2006/07 in the 2008, Smith et al report). However the largest volume of cases continues to be women of Pacific ethnicities.

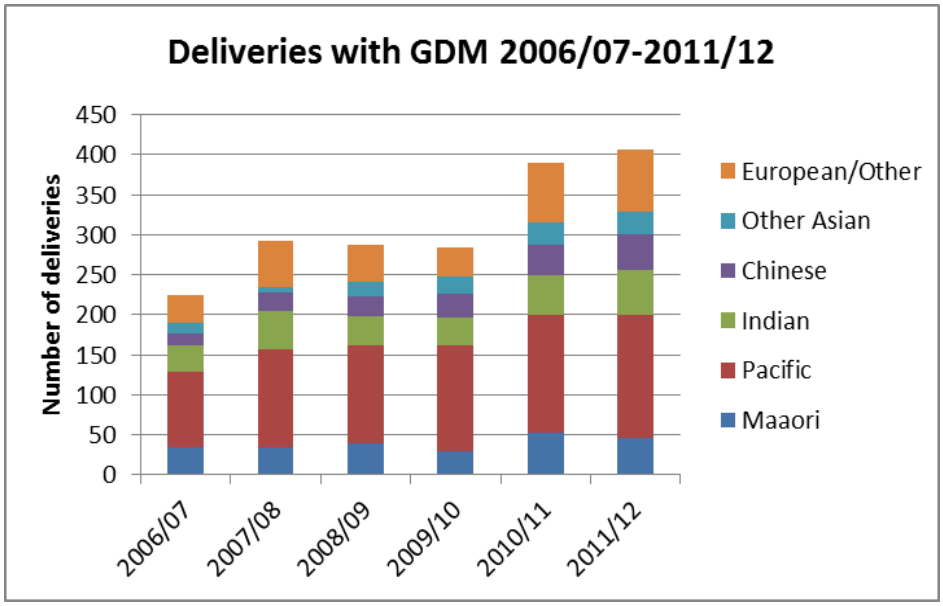
As noted previously, in 2009 the College of Midwives updated their consensus statement about Gestational Diabetes and this is likely to have raised awareness among College members about GDM; this may have contributed to the 'step change' in numbers identified with GDM in 2010. Over time, increasing awareness and resulting changes in clinical practice may also be in part a response to the increasing frequency of working with women with GDM.

Table 5 Deliveries identified with GDM to CMDHB resident women 2006/07 - 2011/12

Deliveries with GDM	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12
Maaori	34	34	40	30	52	46
Pacific	94	122	122	131	148	154
Indian	34	48	36	36	50	56
Chinese	15	23	24	29	38	44
Other Asian	12	7	19	22	27	28
European / Other	36	59	47	36	74	79
Total	**225**	**293**	**288**	**284**	**389**	**407**

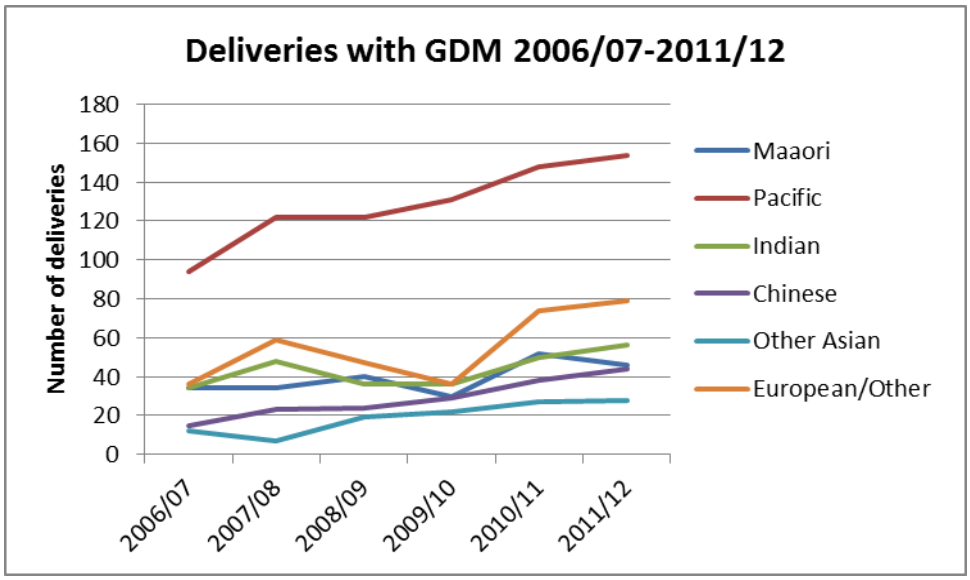
Source: NMDS, analysed by CMDHB 2012.

Figure 4 Deliveries identified with GDM to CMDHB resident women 2006/07 – 2011/12, ethnicity as proportion of total



Source: NMDS, analysed by CMDHB 2012.

Figure 5 Deliveries identified with GDM to CMDHB resident women 2006/07 - 2011/12, trend by ethnicity



Source: NMDS, analysed by CMDHB 2012.

The crude rate of deliveries with GDM for CMDHB women has correspondingly increased from 2.7% to 4.8% with the highest rates being in Indian (9.6%), Chinese (8.6%) and other Asian women (7.7%) (Table 6 & Figure 6). Concern has been expressed that the Maaori rate seems considerably less than might be expected (with an expectation of rates similar to Pacific women) and that this may reflect lack of screening and diagnosis for these women. The rate of polycose screening among Maaori

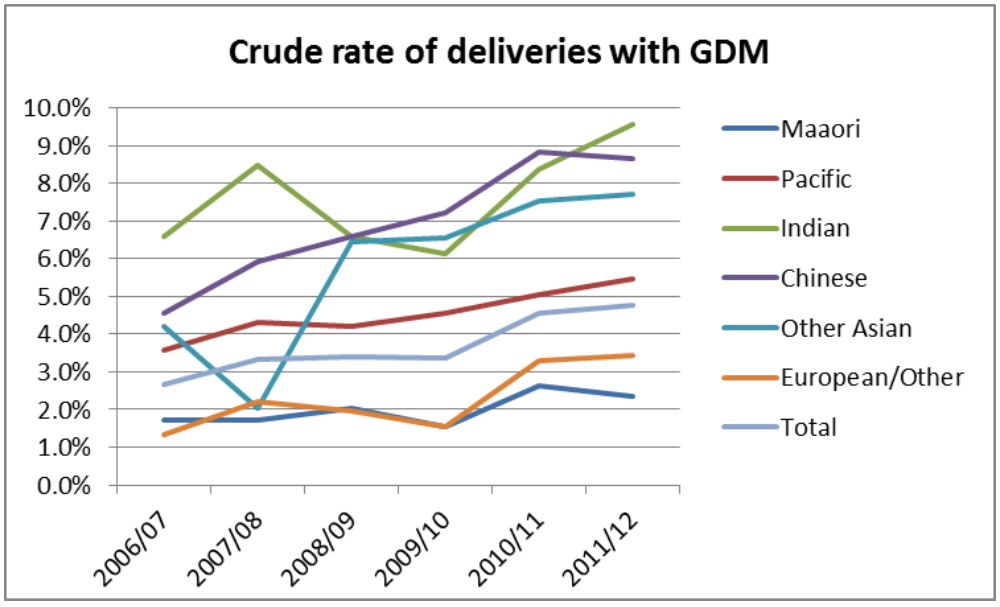
women in CMDHB (and across the region) is lower than other ethnic groups (see P 39-40) and this does need to be addressed, but of note the crude rate of identified diabetes in the overall CMDHB population is consistently higher in Pacific peoples than Maaori (8.6% for Maaori and 11.9% for Pacific peoples in 2011, Winnard et al 2012). This may in part relate to higher obesity rates in Pacific women than Maaori women.

Table 6 Crude rate of deliveries with GDM, CMDHB resident women 2006/07-2011/12

Deliveries with GDM, crude rates	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12
Maaori	1.7%	1.7%	2.0%	1.6%	2.6%	2.4%
Pacific	3.6%	4.3%	4.2%	4.5%	5.0%	5.5%
Indian	6.6%	8.5%	6.6%	6.1%	8.4%	9.6%
Chinese	4.5%	5.9%	6.6%	7.2%	8.8%	8.6%
Other Asian	4.2%	2.0%	6.5%	6.5%	7.5%	7.7%
European / Other	1.3%	2.2%	2.0%	1.6%	3.3%	3.4%
Total	**2.7%**	**3.3%**	**3.4%**	**3.4%**	**4.6%**	**4.8%**

Source: NMDS, analysed by CMDHB 2012.

Figure 6 Crude rate of deliveries with GDM, CMDHB resident women 2006/07-2011/12



Source: NMDS, analysed by CMDHB 2012.

Deliveries complicated by pre-existing diabetes

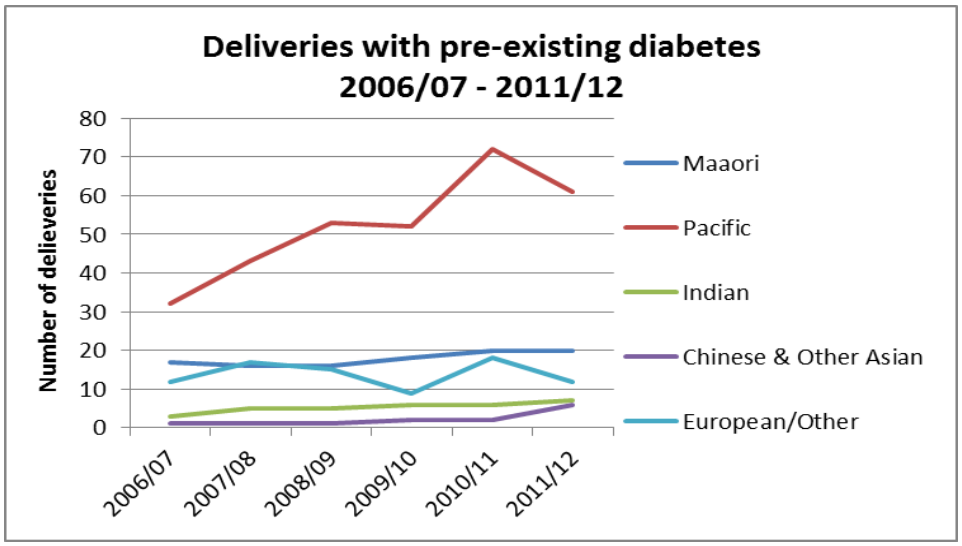
The total number of deliveries with pre-existing diabetes has also increased over the last six years (Table 7 & Figure 7), with the biggest proportionate increases being for Pacific, Indian and other Asian women, although numbers are small for Indian and other Asian groups.

Table 7 Deliveries identified with pre-existing diabetes to CMDHB resident women 2006/07-2011/12

Deliveries with pre-existing diabetes	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12
Maaori	17	16	16	18	20	20
Pacific	32	43	53	52	72	61
Indian	3	5	5	6	6	7
Chinese & Other Asian	1	1	1	2	2	6
European / Other	12	17	15	9	18	12
Total	**65**	**82**	**90**	**87**	**118**	**106**

Source: NMDS, analysed by CMDHB 2012.

Figure 7 Deliveries identified with pre-existing diabetes to CMDHB resident women 2006/07-2011/12



Source: NMDS, analysed by CMDHB 2012.

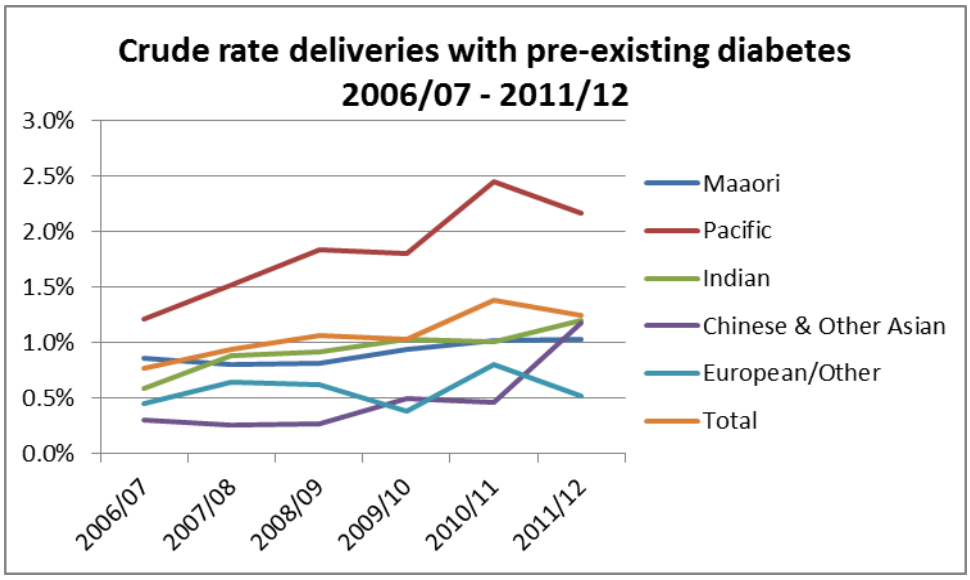
The crude rate of deliveries with pre-existing diabetes has increased from 0.8% to 1.2% with the highest rate being in Pacific woman (2.2%) (Table 8 & Figure 8). The age structure of the birthing populations will also contribute to differing risks of pre-existing diabetes.

Table 8 Crude rate of deliveries with pre-existing diabetes, CMDHB resident women 2006/07-2011/12

Pre-existing diabetes crude rates	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12
Maaori	0.9%	0.8%	0.8%	0.9%	1.0%	1.0%
Pacific	1.2%	1.5%	1.8%	1.8%	2.5%	2.2%
Indian	0.6%	0.9%	0.9%	1.0%	1.0%	1.2%
Chinese & Other Asian	0.3%	0.3%	0.3%	0.5%	0.5%	1.2%
European / Other	0.4%	0.6%	0.6%	0.4%	0.8%	0.5%
Total	**0.8%**	**0.9%**	**1.1%**	**1.0%**	**1.4%**	**1.2%**

Source: NMDS, analysed by CMDHB 2012.

Figure 8 Crude rate of deliveries with pre-existing diabetes, CMDHB resident women 2006/07-2011/12



Source: NMDS, analysed by CMDHB 2012.

Overall deliveries complicated by diabetes

Overall the volume of deliveries complicated by diabetes in 2011/12 was over 500, representing a crude rate of 6% of all deliveries for women resident in CMDHB (Table 9 & Table 10; Figure 9 & Figure 10). This compares with 4.6% in 2009 in Jackson's report, with all ethnic groups being higher in 2011/12 than reported in 2009.

Table 9 Deliveries identified with either GDM or pre-existing diabetes to CMDHB resident women 2006/07-2011/12

Deliveries with GDM or pre-existing diabetes	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12
Maaori	51	50	56	48	72	66
Pacific	126	165	175	183	220	215
Indian	37	53	41	42	56	63
Chinese	16	23	25	31	38	46
Other Asian	12	8	19	22	29	32
European / Other	48	76	62	45	92	91
Total	**290**	**375**	**378**	**371**	**507**	**513**

Source: NMDS, analysed by CMDHB 2012.

Table 10 Crude rate of deliveries identified with either GDM or pre-existing diabetes to CMDHB resident women 2006/07-2011/12

Deliveries with GDM or pre-existing diabetes, crude rates	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12
Maaori	2.6%	2.5%	2.9%	2.5%	3.7%	3.4%
Pacific	4.8%	5.8%	6.1%	6.3%	7.5%	7.6%
Indian	7.2%	9.3%	7.5%	7.2%	9.4%	10.8%
Chinese	4.8%	5.9%	6.9%	7.7%	8.8%	9.0%
Other Asian	4.2%	2.3%	6.5%	6.5%	8.1%	8.8%
European / Other	1.8%	2.9%	2.6%	1.9%	4.1%	4.0%
Total	**3.4%**	**4.3%**	**4.5%**	**4.4%**	**5.9%**	**6.0%**

Figure 9 Deliveries identified with either GDM or pre-existing diabetes to CMDHB resident women 2006/07-2011/12

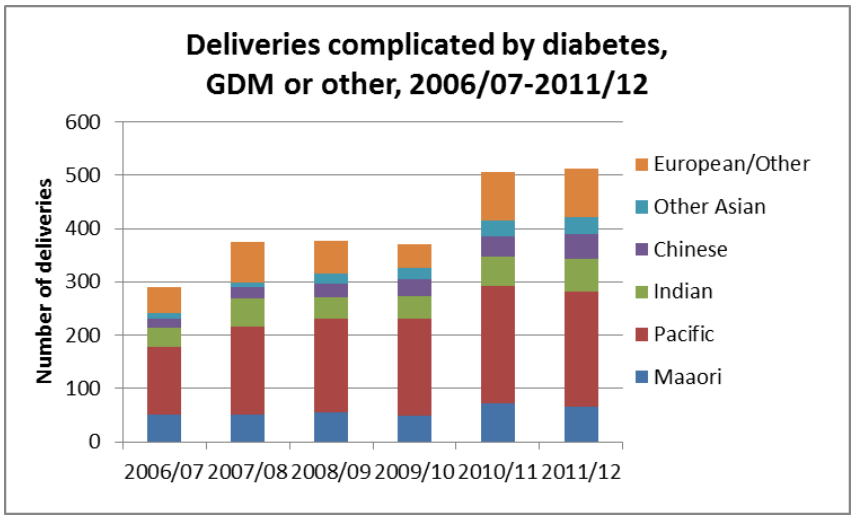
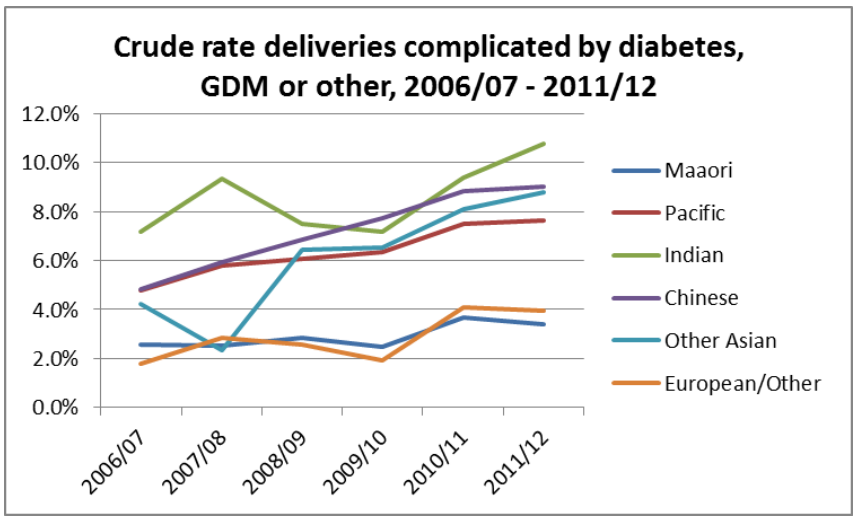


Figure 10 Crude rate of deliveries with either GDM or pre-existing diabetes, CMDHB resident women 2006/07-2011/12



Source: NMDS, analysed by CMDHB 2012.

Projections of future growth for service planning

If the trends of overall rates of diabetes in pregnancy of the past six years continue, with no change in definition of GDM or screening practices, it could be anticipated that overall there will be an average of 0.5% increase each year in the prevalence of deliveries complicated by gestational or pre-existing diabetes for women living in CMDHB. Assuming a stable birth cohort size continues, this would mean an increase of nearly 25% (8% per annum) on 2011/12 volumes of CMDHB women needing to be managed by diabetes in pregnancy services by 2014/15 (Table 11). Note that as per the following 2011 Snapshot analysis, not all of these women will be managed by the CMDHB service.

Table 11 Projected number of CMDHB women with diabetes in pregnancy, assuming 0.5% increase in prevalence per annum but no change in screening practices or diagnostic criteria

Description of projection	2012/13	2013/14	2014/15
Projected volume of CMDHB women with diabetes in pregnancy	550	595	640
% increase on 2011/12 volume (of 513)	8%	16%	24%

In addition, analyses of the implications of implementing the recently developed algorithm for improving screening for pre-existing diabetes in pregnancy (planned for 2013) could add another 170 women with pre-existing diabetes. Potential changes to the diagnostic criteria for GDM in late 2013 could add another 150 women, based on 2010 estimates. Table 11 shows the potential volumes of CMDHB women needing care for DIP if these changes are incorporated and assuming 8% annual growth for these groups as well (Table 12).

Table 12 Projected number of CMDHB women with diabetes in pregnancy, assuming implementation of changes in screening practices and diagnostic criteria, along with 8% increase in rates per annum

Description of projection	2012/13	2013/14	2014/15
Potential volume of CMDHB women with diabetes in pregnancy*	645	860	980
% increase on 2011/12 volume (of 513)	25%	68%	92%

*assuming 170 extra women with pre-existing diabetes are added for 2013 and are spread between the financial years and 150 extra women with GDM are identified in 2014, spread between the financial years, and both groups also grow by 8% yearly.

These projections may overestimate or underestimate future demand depending changes in the ethnic mix of the CMDHB population, the rates of obesity in women of childbearing age and whether rates of growth are consistent across the potential new categories of women requiring care. However the expected changes in all of these drivers are likely to be upward rather than downward. Analysis by facility for 2011 calendar year (2011 snapshot below) suggests about 82% of these women will need to be managed by the CMDHB DIP service, along with a further number of women from other DHBs booked to deliver at CMDHB, bringing the proportion to about 94% of the volume predicted for CMDHB women (Table 13).

Table 13 Potential volume of women with diabetes in pregnancy likely to be referred to CMDHB DIP service 2012/13 – 2014/15

Description of projection	2012/13	2013/14	2014/15
Potential number of women with DIP likely to be referred to CMDHB service	605	810	920
% increase on 2012 calendar year volume (of 551)	10%	47%	68%

2011 Snapshot (based on NMDS)

As previously noted, records were extracted from the NMDS for deliveries recorded in the 2011 calendar year for women resident in CMDHB and were analysed by facility as well as age and ethnicity, to allow an analysis of how many of these women would be expected to be under the care of the Diabetes in Pregnancy Service at CMDHB/ Middlemore Hospital.

Context

There were just over 8,500 deliveries for CMDHB resident women in the 2011 calendar year, and just under three quarters of these took place at Middlemore Hospital. A further 13% took place at the three CMDHB primary birthing units, leaving 13% taking place in facilities beyond CMDHB, mostly Auckland City Hospital. 42% of women were aged 30 and over (Table 14).

Table 14 CMDHB women delivering in the 2011 year by age and facility.

Deliveries in 2011	< 20	20-24	25-29	30-34	35-39	40 and over	Total	Facility as % of total deliveries
Middlemore	593	1565	1663	1420	856	224	**6321**	73.8%
Pukekohe	33	71	87	112	62	9	**374**	4.4%
Papakura	48	137	115	67	22	4	**393**	4.6%
Botany Downs	19	72	115	105	55	6	**372**	4.3%
Auckland City Hospital	19	98	278	315	226	49	**985**	11.5%
Other facilities*	3	29	39	30	9	8	**118**	1.4%
Total	**715**	**1972**	**2297**	**2049**	**1230**	**300**	**8563**	
Age group as % of total	8.3%	23.0%	26.8%	23.9%	14.4%	3.5%		

Source: NMDS, analysed by CMDHB 2012.

*Other facilities category includes Birthcare Parnell (45 births for CMDHB residents in 2011, 0.5% of the total), North Shore (23) and Waitakere (17) also had more than 10 deliveries for CMDHB residents.

Women of Pacific ethnicities formed the largest group of CMDHB residents having a delivery in 2011, 34% of the total (Table 15). Women of Asian ethnicities constituted 17% of those having a delivery.

Table 15 CMDHB women delivering in the 2011 year by age and ethnicity.

Deliveries in 2011	< 20	20-24	25-29	30-34	35-39	40 and over	Total	Ethnicity as % of total deliveries
Maaori	332	664	448	290	177	45	**1956**	22.8%
Pacific	260	812	753	609	365	110	**2909**	34.0%
Indian	11	93	248	175	75	8	**610**	7.1%
Chinese	2	32	180	158	63	20	**455**	5.3%
Other Asian	9	46	115	116	71	17	**374**	4.4%
European / Other	101	325	553	701	479	100	**2259**	26.4%
Total	**715**	**1972**	**2297**	**2049**	**1230**	**300**	**8563**	**100.0%**

Source: NMDS, analysed by CMDHB 2012.

Women with gestational diabetes

Overall Pacific women constituted the largest group of women delivering with GDM (39.5%), with women of Asian ethnic groups the next largest totalling 28% (Table 16).

Table 16 CMDHB women delivering in the 2011 year with GDM by age and ethnicity

Women with GDM in 2011	< 20	20-24	25-29	30-34	35-39	40 and over	Total	Ethnicity as % of total deliveries
Maaori	0	10	11	11	15	3	**50**	12.3%
Pacific	3	15	39	44	45	15	**161**	39.5%
Indian	0	3	16	17	13	2	**51**	12.5%
Chinese	0	0	8	14	9	5	**36**	8.8%
Other Asian	0	2	5	14	7	1	**29**	7.1%
European / Other	3	6	19	28	21	4	**81**	19.9%
Total	**6**	**36**	**98**	**128**	**110**	**30**	**408**	

Source: NMDS, analysed by CMDHB 2012.

As expected, women whose deliveries were complicated by GDM were older than the overall cohort of CMDHB women having deliveries, with those aged 30 and over constituting 66% compared with 42% of overall deliveries and 7.4% of those with GDM were aged 40 or older (Table 17).

For CMDHB women, 98% of deliveries complicated by GDM took place at Middlemore Hospital or Auckland City Hospital. A higher proportion of women with deliveries complicated by GDM delivered at Auckland City Hospital (19.1%) Table 17) than the proportion of all deliveries for CMDHB women that took place at Auckland City Hospital (11.5%).

Table 17 CMDHB women delivering in the 2011 year with GDM by age and facility

Women with GDM in 2011	< 20	20-24	25-29	30-34	35-39	40 and over	Total	Facility as % of total deliveries
Middlemore	6	33	78	100	82	23	**322**	78.9%
Auckland City Hospital	0	2	18	26	25	7	**78**	19.1%
Other facilities*	0	1	2	2	3	0	**8**	2.0%
Total	**6**	**36**	**98**	**128**	**110**	**30**	**408**	
Age group as % of total	1.5%	8.8%	24.0%	31.4%	27.0%	7.4%		

Source: NMDS, analysed by CMDHB 2012.

The proportion of deliveries complicated by GDM delivered at Middlemore and Auckland City Hospitals varied by ethnicity, with a much higher proportion taking place at Auckland Hospital for women of Chinese ethnicity at 64% (although numbers were relatively small). Compared with the overall group with GDM, a higher percentage of women of non-Indian/non-Chinese Asian groups (24%) and European/Other ethnicities (28%) also delivered at Auckland Hospital, whereas over 80% of Maaori, Pacific and Indian women with GDM delivered at Middlemore Hospital (Table 18).

Table 18 CMDHB women delivering in the 2011 year with GDM by ethnicity and facility.

Women with GDM in 2011	Maaori	Pacific	Indian	Chinese	Other Asian	European/ Other	Facility as % of total deliveries
Middlemore	86%	93%	82%	28%	72%	69%	79%
Auckland City Hospital	14%	6%	16%	64%	24%	28%	19%
Other facilities*		1%	2%	8%	3%	3%	2%

Source: NMDS, analysed by CMDHB 2012.

*a few of these women delivered at CMDHB primary birthing units, others at North Shore Hospital or Waikato.

This has implications for the ethnicity mix of those expected to be seen at the CMDHB Diabetes in Pregnancy service (those delivering at any CMDHB facility). Although 29% of CMDHB women with GDM would be Chinese or European/other groups, these groups would be expected to represent 21% of those with GDM attending the CMDHB Diabetes in Pregnancy service. The total group of women of Asian ethnicities with GDM expected to be seen in the CMDHB service would be 23% of the total GDM patients (Table 19).

Table 19 Expected ethnicity of CMDHB women delivering in the 2011 year with GDM by DIP service

Expected ethnicity for women with GDM seen at DIP service	Maaori	Pacific	Indian	Chinese	Other Asian	European/ Other	Total
Number expected for CMDHB service	43	150	43	11	22	58	327
Ethnicity as % of CMDHB service	13%	46%	13%	3%	7%	18%	
Number expected to be seen at ADHB	7	10	8	23	7	23	78
Ethnicity as % of CMDHB women seen at ADHB	9%	13%	10%	29%	9%	29%	
(Number expected to be seen elsewhere)		1		2			3

Source: NMDS, analysed by CMDHB 2012.

Women with pre-existing diabetes

Overall Pacific women constituted the largest group of women delivering in 2011 with pre-existing diabetes (61%) (Table 20).

Table 20 CMDHB women delivering in the 2011 year with pre-existing diabetes by age and ethnicity

Women with pre-existing diabetes	< 20	20-24	25-29	30-34	35-39	40 and over	Total	Ethnicity as % of total deliveries
Maaori	0	3	7	3	5	1	**19**	16.8%
Pacific	1	10	9	19	18	12	**69**	61.1%
Indian	0	0	1	3	1	0	**5**	4.4%
Chinese	0	0	0	1	0	0	**1**	0.9%
Other Asian	0	0	0	0	2	1	**3**	2.7%
European / Other	0	1	2	4	7	2	**16**	14.2%
Total	**1**	**14**	**19**	**30**	**33**	**16**	**113**	**100.0%**

Source: NMDS, analysed by CMDHB 2012.

As expected, women whose deliveries were complicated by pre-existing diabetes were older than the overall cohort of CMDHB women having deliveries and slightly older that those with GDM, with those aged 30 and over constituting 70% compared with 66% with GDM and 42% of overall deliveries, and 14% aged 40 or older (Table 21).

94% of deliveries complicated by pre-existing diabetes for CMDHB women took place at Middlemore Hospital. A lower proportion of women with deliveries complicated by pre-existing diabetes delivered at Auckland City Hospital (6%) (Table 21) than the proportion of all deliveries for CMDHB women that took place at Auckland City Hospital (11.5%); this is in keeping with the ethnicity of the women with pre-existing diabetes with only 3% of all Pacific women from CMDHB who delivered in 2011 doing so at Auckland City Hospital.

Table 21 CMDHB women delivering in the 2011 year with pre-existing diabetes by age and facility

Women with pre-existing diabetes	< 20	20-24	25-29	30-34	35-39	40 and over	Total	Facility as % of total deliveries
Middlemore	1	13	18	30	29	15	**106**	93.8%
Auckland City Hospital	0	1	1	0	4	1	**7**	6.2%
Total	**1**	**14**	**19**	**30**	**33**	**16**	**113**	
Age group as % of total	0.9%	12.4%	16.8%	26.5%	29.2%	14.2%		

Source: NMDS, analysed by CMDHB 2012.

Women with either gestational or pre-existing diabetes

Overall Pacific women constituted the largest group of women delivering with GDM or pre-existing diabetes (44%), with women of Asian ethnic groups the next largest totalling 24% (Table 22). 67% of women with GDM or pre-existing diabetes were aged 30 years or over, and 9% aged 40 or older.

Table 22 CMDHB women delivering in the 2011 year with GDM or pre-existing diabetes by age and ethnicity

Women with GDM or pre-existing diabetes	< 20	20-24	25-29	30-34	35-39	40 and over	Total	Ethnicity as % of total deliveries
Maaori	0	13	18	14	20	4	**69**	13.2%
Pacific	4	25	48	63	63	27	**230**	44.1%
Indian	0	3	17	20	14	2	**56**	10.7%
Chinese	0	0	8	15	9	5	**37**	7.1%
Other Asian	0	2	5	14	9	2	**32**	6.1%
European / Other	3	7	21	32	28	6	**97**	18.6%
Total	**7**	**50**	**117**	**158**	**143**	**46**	**521**	
Age group as % of total	1.3%	9.6%	22.5%	30.3%	27.4%	8.8%		

Source: NMDS, analysed by CMDHB 2012.

Looking at the overall group of women delivering in 2011 with GDM or pre-existing diabetes the percentage delivering at Middlemore was very high for Maaori, Pacific and Indian women, 70% or over for women of European/Other and non-Indian/non-Chinese Asian groups but much lower for Chinese women (30%) (Table 23).

Table 23 CMDHB women delivering in the 2011 year with either GDM or pre-existing diabetes by facility and ethnicity

Women with GDM or pre-existing diabetes	Maaori	Pacific	Indian	Chinese	Other Asian	European/ Other	Facility as % of total deliveries
Middlemore	90%	95%	82%	30%	72%	70%	82%
Auckland City Hospital	10%	5%	16%	62%	25%	28%	16%
Other facilities*			2%	8%	3%	2%	2%

Source: NMDS, analysed by CMDHB 2012.

*a few of these women delivered at CMDHB primary birthing units, others at North Shore Hospital or Waikato.

Based on this NMDS analysis, overall it would be expected that 50% of women seen at the CMDHB Diabetes in Pregnancy service (those delivering at any CMDHB facility) would be of Pacific ethnicity (Table 24). Although 26% of CMDHB women with GDM or pre-existing diabetes would be Chinese or European/other groups, these groups would be expected to represent 19% of those attending the CMDHB Diabetes in Pregnancy service because of the proportion delivering at Auckland City Hospital.

Table 24 Expected ethnicity for CMDHB women delivering in the 2011 year with either GDM or pre-existing diabetes by facility

Expected ethnicity for women with GDM or pre-existing diabetes seen at DIP service	Maaori	Pacific	Indian	Chinese	Other Asian	European/ Other	Total
Number expected for CMDHB service	62	218	47	12	24	70	433
Ethnicity as % of CMDHB service	14%	50%	11%	3%	6%	16%	
Number expected to be seen at ADHB	7	11	9	23	8	27	85
Ethnicity as % of CMDHB women seen at ADHB	8%	13%	11%	27%	9%	32%	
(Number expected to be seen elsewhere)		1		2			3

Source: NMDS, analysed by CMDHB 2012.

Comparison with data from the CMDHB Diabetes in Pregnancy service database

As noted previously, the Diabetes in Pregnancy (DIP) service data is stored by Expected Date of Delivery (EDD) at referral. This means data extracted for a calendar year not be a matching group to those who deliver in that year. However with a stable birth cohort number overall, it is likely that a similar number will deliver outside of the year in which their EDD is each year so figures are likely to be roughly comparable.

As noted, data extracted for 2012 includes bookings up until early Oct which means the majority of those who have an EDD in 2012 would be identified, but there will be some further cases referred so the 2012 data in Table 25 is incomplete. A further 6 cases have been referred since the data was extracted and another two or so cases could be expected based on previous years referrals (personal communication, Lesley MacLennan); this would bring the 2012 total to approximately 551.

Overall patient numbers for the DIP service, representing both women with GDM and pre-existing diabetes show an increase of similar magnitude to the NMDS data (using 551 for 2012 and bearing in mind that the denominator definitions are different on a number of parameters) (Figure 11).

Figure 11 Women seen by the Diabetes in Pregnancy service at CMDHB, with an EED in the years 2008-11

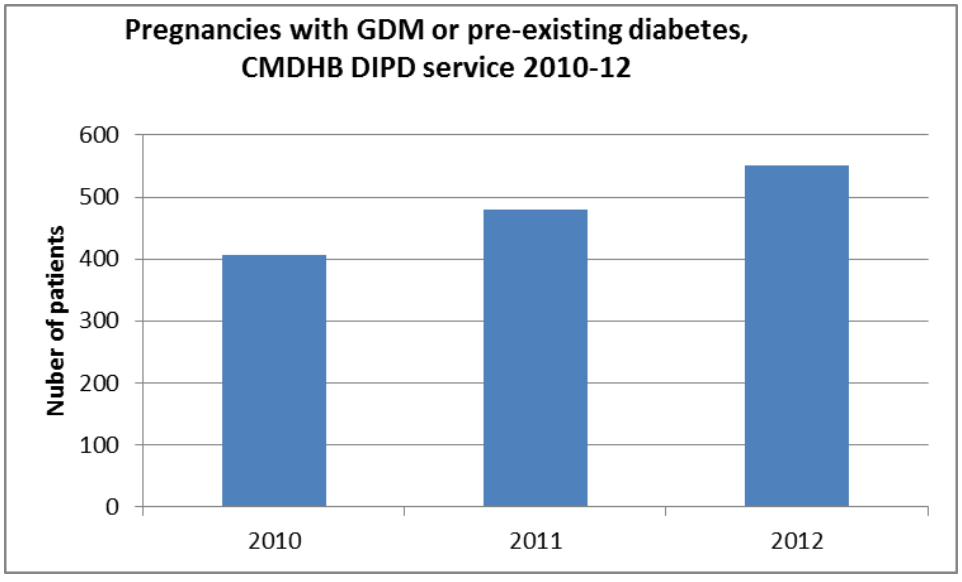


Table 25 Women seen by the DIP service, CMDHB, 2010 – 2012, by type of diabetes

Type of diabetes	2010		2011		2012 (until 9th Oct)	
	N	% of total DIP patients	N	% of total DIP patients	N	% of total DIP patients
GDM	272	66.8%	354	73.8%	404	74.4%
Pre-existing diabetes	135	33.2%	126	26.3%	139	25.6%
Total	**407**		**480**		**543**	

Source: DIP service data, analysed by CMDHB 2012.

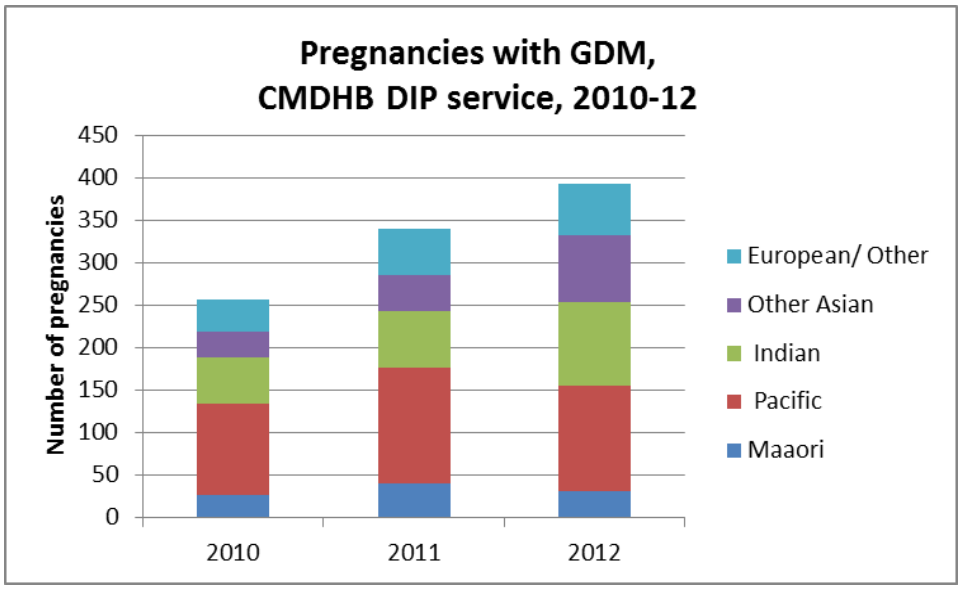
Ethnicity recording in the DIP service database prior to 2010 is not comparable with current data so this analysis considers 2010 – 2012, noting the 2012 figures are incomplete. Like the NMDS data, there is an increase in pregnancies identified as complicated by GDM (Table 26 & Figure 12). The biggest proportionate increases have been for women of Indian and Other Asian ethnicities (Table 26) although women of Pacific ethnicities remain the largest volume of cases.

Table 26 Women seen by the DIP service, CMDHB, 2010 – 2012, with GDM by ethnicity

GDM	Maaori	Pacific	Indian	Other Asian	European/ Other	Total
2010	27	107	55	31	52	272
2011	40	137	67	42	68	354
2012	31	125	98	79	71	404

Source: DIP service data, analysed by CMDHB 2012.

Figure 12 Women seen by the DIP service, CMDHB, 2010 – 2012, with GDM by ethnicity



Source: DIP service data, analysed by CMDHB 2012.

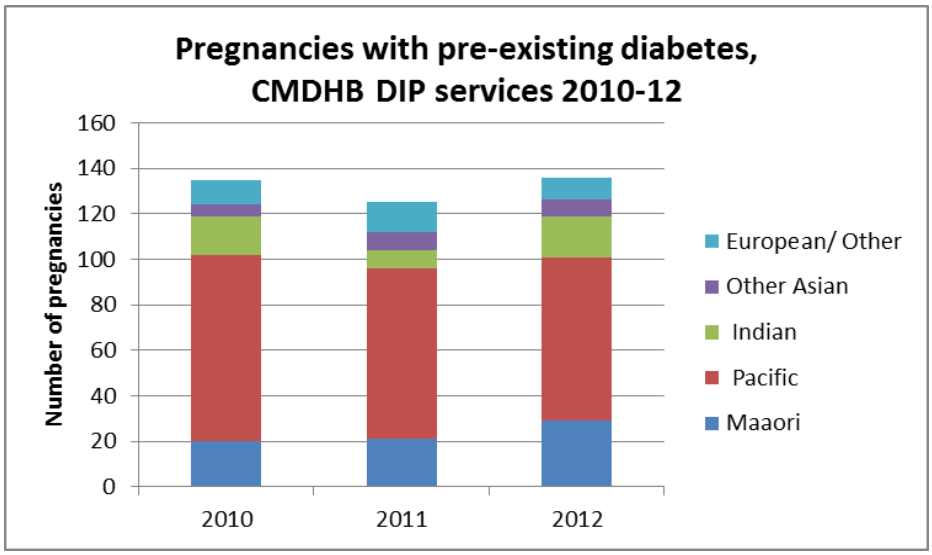
Numbers of women referred to the DIP service identified as having pre-existing diabetes has been relatively stable over the period 2010-2012 in the DIP data, noting that the 2012 is likely to be incomplete (Table 27 & Figure 13)

Table 27 Women seen by the DIP service, CMDHB, 2010 – 2012, with pre-existing diabetes by ethnicity

Pre-existing diabetes	Maaori	Pacific	Indian	Other Asian	European/ Other	Total
2010	20	82	17	5	11	135
2011	21	75	8	8	14	126
2012	29	72	19	8	11	139

Source: DIP service data, analysed by CMDHB 2012.

Figure 13 Women seen by the DIP service, CMDHB, 2010 – 2012, with pre-existing diabetes by ethnicity



Source: DIP service data, analysed by CMDHB 2012.

Of those women with pre-existing diabetes, 80-90% had Type 2 diabetes (Table 28)

Table 28 Women with Type 1 Pre-existing diabetes by ethnicity

Type 1 Pre-existing diabetes	Maaori	Pacific	Indian	Other Asian	European/ Other	Total (% of pre-existing)
2010	1	5	-	-	7	13 (9.6%)
2011	2	9	-	-	7	18 (14.3%)
2012	3	2	1	1	3	10 (7.2%)

Source: DIP service data, analysed by CMDHB 2012.

Table 29 Women with Type 2 Pre-existing diabetes by ethnicity

Type 2 Pre-existing diabetes	Maaori	Pacific	Indian	Other Asian	European/ Other	Total
2010	19	77	17	5	4	122
2011	19	66	8	8	7	108
2012	26	70	18	7	8	129

Source: DIP service data, analysed by CMDHB 2012.

The total group of women seen in the CMDHB DIP service by ethnicity is described in Table 30. The figures for 2011 can be compared with the number and percentage expected to be seen at the CMDHB DIP service from analysis of the NMDS, although NMDS is women who actually delivered in 2011 and the DIP data is women with an EDD at referral for 2011.

This initial comparison suggested there were about 50 more women referred with diabetes in pregnancy, booked to deliver at a CMDHB facility in 2011, than there were CMDHB women recorded in the NMDS as having diabetes in pregnancy and delivering at a CMDHB facility (Table 30 &Table 31).

Table 30 Total group of women seen in the CMDHB DIP service by ethnicity (with incomplete 2012 data)

GDM or Pre-existing diabetes	Maaori	Pacific	Indian	Other Asian	European/ Other	Total
2010	47	189	72	36	63	407
2011	61	212	75	50	82	480
2012	60	197	117	87	82	543

Source: DIP service data, analysed by CMDHB 2012.

Table 31 Number and percentage by ethnicity expected to be seen at the CMDHB DIP service from analysis of the NMDS

Expected ethnicity for women with GDM or pre-existing diabetes seen at DIP service	Maaori	Pacific	Indian	Chinese	Other Asian	European/ Other	Total
Number expected for CMDHB service	62	218	47	12	24	70	433
Ethnicity as % of CMDHB service	14%	50%	11%	3%	6%	16%	
Number expected to be seen at ADHB	7	11	9	23	8	27	85
Ethnicity as % of CMDHB women seen at ADHB	8%	13%	11%	27%	9%	32%	
(Number expected to be seen elsewhere)		1		2			3

Source: DIP service data, analysed by CMDHB 2012.

However after this comparison was undertaken, data was extracted from NMDS regarding women delivering at CMDHB facilities who were resident in other DHBs, as women with diabetes from this group will also be seen by the CMDHB Diabetes in Pregnancy service. DIP service records were also reviewed to determine what proportion of women referred to the service do not subsequently deliver at CMDHB.

In 2011 there were 36 women from other DHBs who delivered at CMDHB facilities who were identified as having diabetes in pregnancy. 72% of these women were of Pacific or Indian ethnicity and 55% were from Otahuhu (Table 32). This would take the number of women expected to be seen by the CMDHB DIP service in 2011 to 469 based on NMDS records.

Table 32 Women from other DHBs with diabetes in pregnancy delivering at CMDHB in 2011

	Either GDM or pre-existing diabetes	GDM	Pre-existing
CMDHB women delivered at CMDHB	433	327	106
ADHB women delivered at CMDHB – Otahuhu	20 (14 Pacific, 3 Indian)	15	5
Other ADHB women delivered at CM	10 (7 Pacific, 2 Indian)	9	1
Women from other DHBs delivered at CMDHB	6 (3 Maaori)	3	3

Source: NMDS, analysed by CMDHB 2012.

Review of DIP service records identified that in 2011 there were 28 women who for various reasons were initially referred to the CMDHB DIP service but who did not deliver at CMDHB (Table 33). This would take the number of women referred to the DIP service at CMDHB and expected to deliver at CMDHB in 2011 to 452.

Table 33 Women initially referred to the CMDH DIP service who did not deliver at CMDHB, 2011

Reason for not delivering at CMDHB	Number
Miscarried after being referred to the service with pre-existing diabetes	12
Transferred to the care of the Auckland service after detection of fetal anomalies	3
Chose LMC care with a provider who had an access agreement at another DHB	4
Moved home during the pregnancy and transferred to the DHB of their new residence	9
Total	**28**

Source: DIP service data, analysed by CMDHB 2012.

Given the differences between denominators of the NMDS and DIP service data, these analyses suggest there is reasonable alignment between data drawn from the two sources which is useful knowledge for future analyses. From January 2013 the CMDHB Diabetes in Pregnancy Service has changed data collection to categorising by month of referral, to help with future service planning, as well as recording EDD.

Clinical parameters of women seen at the CMDHB Diabetes in Pregnancy service

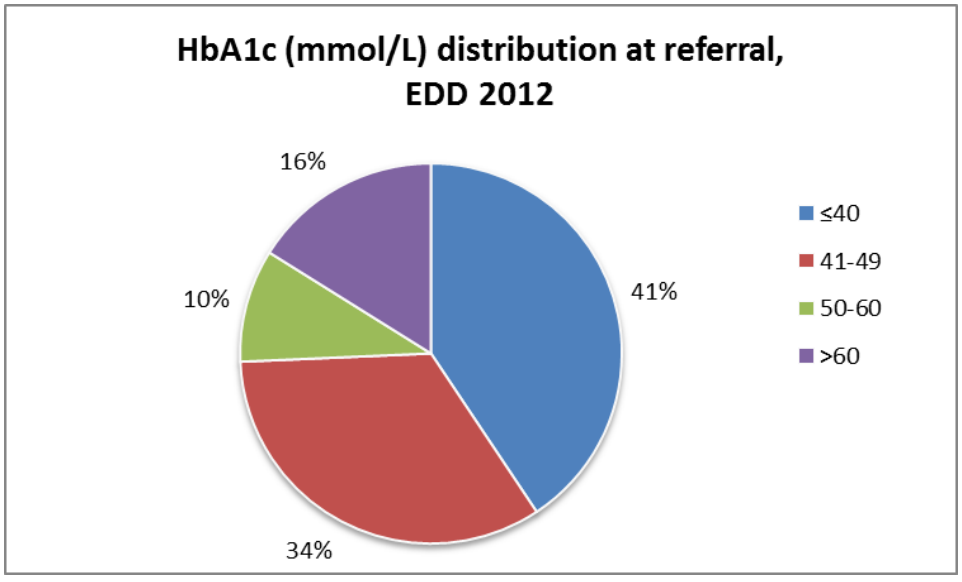
HbA1c levels at referral

Elevation of blood glucose in the peri-conceptual period is associated with increased risk of fetal anomaly and hyperglycaemia during pregnancy is associated with adverse pregnancy and neonatal outcomes (Bell et al, 2012).

Analysis of DIP service HbA1c data shows that for women referred in 2012, at referral a quarter of women had an HbA1c over 50 mmol/L and nearly two thirds of those had an HbA1c over 60 (Figure 14). A level over 60 is considered high risk. A dozen women had a level over 100.

Many women with pre-existing diabetes have an HbA1c of less than 50 at referral. The fact that a quarter of women had an HbA1c of 50 or more at referral suggests that some of those referred with gestational diabetes actually have unrecognised pre-existing diabetes. There may also be a considerable number who have impaired glucose tolerance prior to their diagnosis of gestational diabetes. This will be impacting on the in-utero environment for their babies.

Figure 14 HbA1c at referral, women referred to the CMDHB DIP service, EDD 2012



Source: DIP service data, analysed by DIP, CMDHB 2012.

In addition, data on a cohort of women booked in 2011 who had diabetes clinic visits was available for analysis[2] with relatively complete information on BMI, nature of delivery and infant birth weight. Data was available for 297 women with GDM and 104 with pre-existing diabetes.

[2] This was not a specific data request for this paper but material that had been extracted previously in relation to a query regarding clinic patients

BMIs

As context, Jackson found that for the period she examined (2007-2009), 35% of CMDHB women who delivered in a CMDHB facility had a BMI in the normal range, 27% were overweight, and 38% were obese. Body size at booking varied by ethnicity, age group, deprivation and residential suburb, with the greatest variation being by ethnic group. Pacific women had the highest median BMI at 32, followed by Maaori (27) and European/Other (27) women, and Asian women had the lowest median BMI (23).

For women booked in 20011 who had diabetes clinic visits, BMI information was available electronically for 267 out of 297 women with GDM (90%). As demonstrated in Table 34 & Table 35 and Figure 15, distribution of BMI was bimodal with Indian, Other Asian and European/Other/ Unknown groups having a peak under 30 and Maaori and Pacific women peaking in the 35-39 category. It is recognised that people of Asian ethnicities have higher body fat levels at the same BMIs as European people along with increasing rates of metabolic syndrome (Scragg, 2010), and this is reflected in the GDM data for women attending the DIP service. However it is also noteworthy that 26% of women of European/Other/Unknown ethnicities with GDM also had BMIs within the 'normal' range (Table 35).

Table 34 BMI for women with GDM booked in 2011 and seen at DIP clinics by ethnicity

Women with GDM	**< 19**	**20-24**	**25-29**	**30-34**	**35-39**	40-44	**45-49**	**50& over**	**No data**	**Total**
Maaori		2	5	6	8	2	1		7	**31**
Pacific	1	7	15	23	37	21	9	7	16	**136**
Indian	3	12	17	8	3	1	0	0	2	**46**
Other Asian	2	15	12	3	0	0	0	0	2	**34**
European / Other/ unknown	0	13	9	8	5	6	3	3	3	**50**
Total	**6**	**49**	**58**	**48**	**53**	**30**	**13**	**10**	**30**	**297**

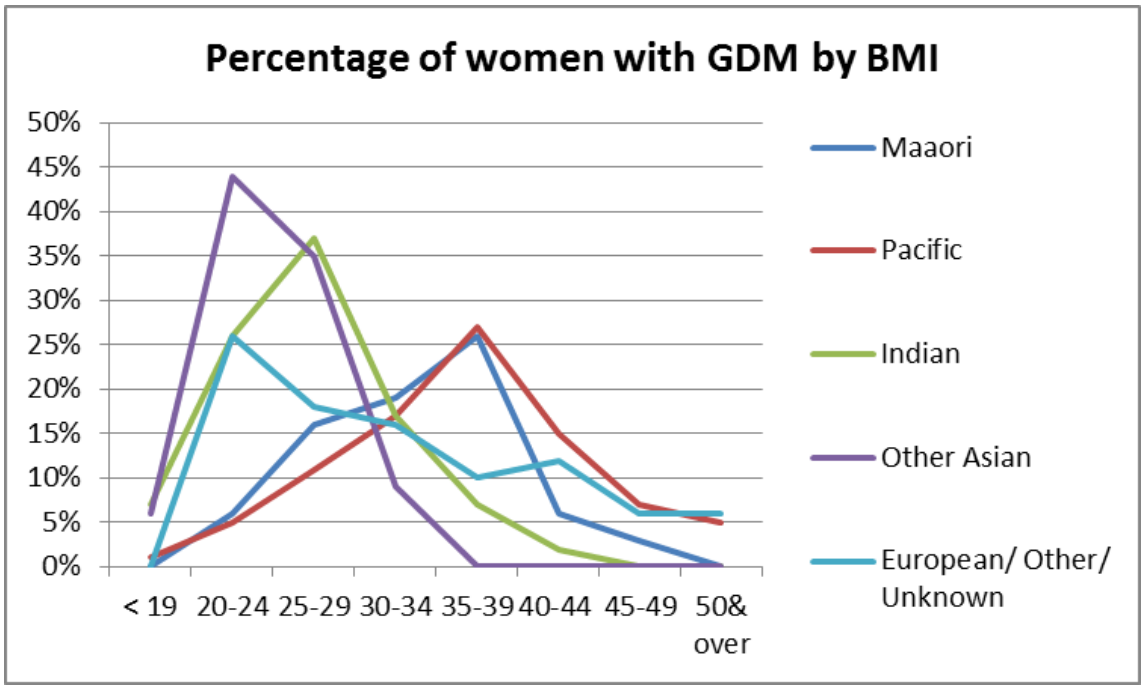
Source: DIP service data, analysed by CMDHB 2012.

Table 35 Distribution of BMI for women with GDM booked in 2011 and seen at DIP clinics by ethnicity

Women with GDM	**<25**	**BMI 25-29**	**BMI 30 -39**	**BMI 40 or over**	**No data**
Maaori	6%	16%	45%	9%	23%
Pacific	6%	11%	44%	27%	12%
Indian	33%	37%	24%	2%	4%
Other Asian	50%	35%	9%	0%	6%
European / Other/ unknown	26%	18%	26%	24%	6%
Total	**18%**	**20%**	**34%**	**17%**	**10%**

Source: DIP service data, analysed by CMDHB 2012.

Figure 15 Distribution of BMI for women with GDM booked in 2011 and seen at DIP clinics by ethnicity



Source: DIP service data, analysed by CMDHB 2012.

BMI information was available for 87 women with pre-existing diabetes out of 104 (84%). As demonstrated in Table 36 & Table 37 and Figure 16, essentially there was a similar distribution of BMI as for those with GDM, with Indian, Other Asian and European/Other/Unknown groups having a peak of BMIs under 30 and Maaori and Pacific women peaking in the 30-39 category. However this pattern could be distorted by women with Type 1 diabetes who would be expected to have lower BMIs than women with Type 2 diabetes. Analysis with women with Type 1 diabetes excluded is described further below (Table 38), although numbers are very small for some ethnic groups.

Table 36 BMI for women with pre-existing diabetes booked in 2011 and seen at DIP clinics by ethnicity

Women with Pre-existing diabetes	**< 19**	**20-24**	**25-29**	**30-34**	**35-39**	**40-44**	**45-49**	**50& over**	**No data**	**Total**
Maaori			2	6	6	1	1	1	3	**20**
Pacific		3	7	8	14	9	4	3	9	**57**
Indian	1	3	1	1	2					**8**
Other Asian	1	3						1		**5**
European / Other/ unknown		3	2	1	2	1	1	0	4	**14**
Total	**0**	**8**	**17**	**16**	**23**	**13**	**6**	**4**	**17**	**104**

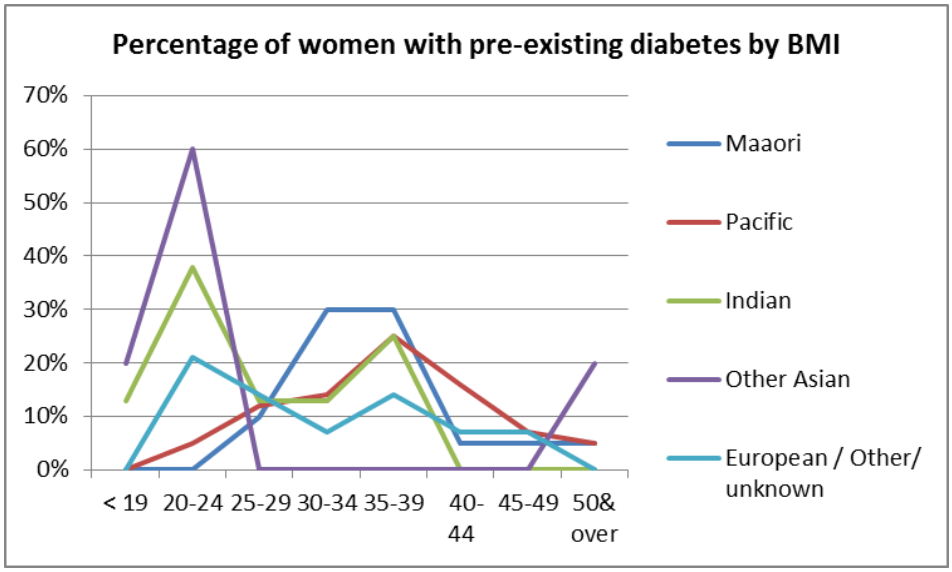
Source: DIP service data, analysed by CMDHB 2012.

Table 37 Distribution of BMI for women with pre-existing diabetes booked in 2011 and seen at DIP clinics by ethnicity

Women with pre-existing diabetes	BMI <25	BMI 25-29	BMI 30 -39	BMI 40 or over	No data
Maaori	-	10%	60%	15%	15%
Pacific	5%	12%	39%	28%	16%
Indian	51%	13%	38%	0%	0%
Other Asian	80%			20% (1 person)	0%
European / Other/ unknown	21%	14%	21%	14%	29%
Percentage of Total	**8%**	**16%**	**37%**	**23%**	**16%**

Source: DIP service data, analysed by CMDHB 2012.

Figure 16 Distribution of BMI for women with pre-existing diabetes booked in 2011 and seen at DIP clinics by ethnicity



Source: DIP service data, analysed by CMDHB 2012.

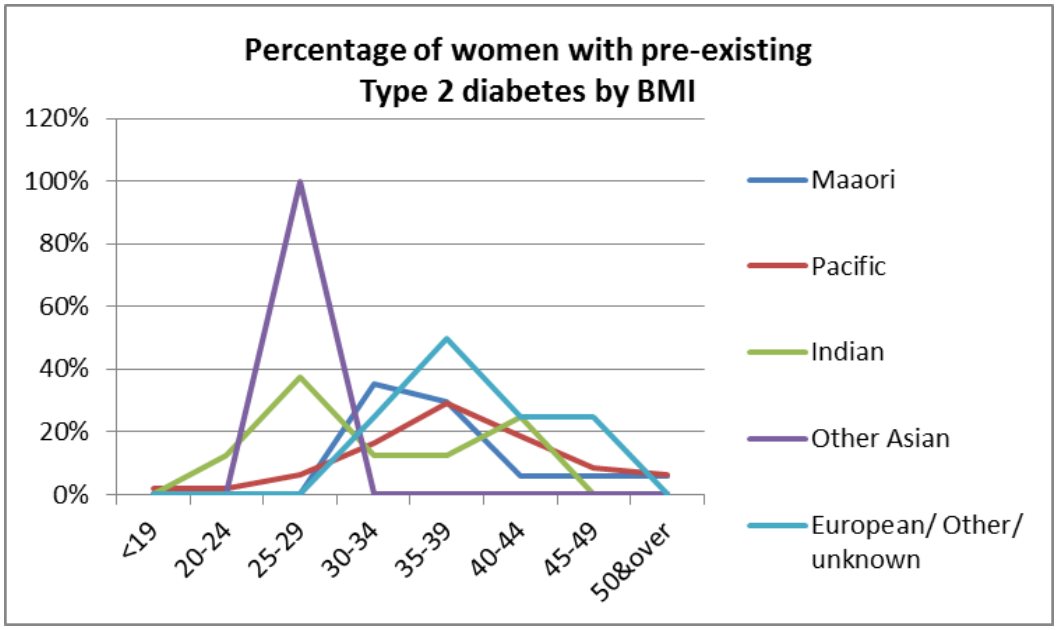
When women with Type 1 diabetes were excluded from the analysis for women with pre-existing diabetes, only women of Indian and other Asian ethnicities have a peak of BMIs below 30, with Maaori, Pacific and European/Other/unknown groups having a peak in the 30-39 range (Table 38 and Figure 17).

Table 38 Distribution of BMI for women with pre-existing Type 2 diabetes booked in 2011 and seen at DIP clinics

Women with Type 2 pre-existing diabetes	BMI <25	BMI 25-29	BMI 30 -39	BMI 40 or over	No data
Percentage of total	4%	11%	46%	28%	12%

Source: DIP service data, analysed by CMDHB 2012.

Figure 17 Distribution of BMI for women with pre-existing Type 2 diabetes booked in 2011 and seen at DIP clinics by ethnicity



Source: DIP service data, analysed by CMDHB 2012.

Mode of delivery

Diabetes in pregnancy is associated with increased rates of operative delivery (Wijayaratna, 2011). This is borne out by the data from women booked with the CMDHB DIP service for 2011. Data was available for 284 of 297 women with GDM (96%). 28% of the total group had a Caesarean Section and 5% an operative vaginal delivery (Table 39). For women with pre-existing diabetes, data was available for 86% of women. 36% of the total group were identified as having a Caesarean section and 4% an operative vaginal delivery (Table 40).

These figures may be an underestimate depending on the outcomes of those for whom no data was available. They compare with a C-Section rate of 20% for CMDHB overall, but are much lower that figures from Australia - a 2010 Australian Institute of Health and Welfare (AIHW) report found that 71% of women with type 1 diabetes underwent a caesarean section, while 56% of women with type 2 diabetes and 38% of women with GDM had Caesareans, compared to a Caesarean delivery rate of 30% in the non-diabetics population (cited in Wijayaratna, 2011).

Table 39 Mode of delivery for women with GDM booked in 2011 and seen at DIP clinics by ethnicity

GDM	Elective CS	Emergency CS	Operative vag	Normal Vag	No data	Total
Maaori	6	4		20	1	**31**
Pacific	12	24	6	89	5	**136**
Indian	6	10	2	26	2	**46**
Other Asian	4	6	4	17	3	**34**
E/O/U	4	6	4	34	2	**50**
Total	**32**	**50**	**16**	**186**	**13**	**297**
	11%	**17%**	**5%**	**63%**	**4%**	

Source: DIP service data, analysed by CMDHB 2012.

Table 40 Mode of delivery for women with pre-existing diabetes booked in 2011 and seen at DIP clinics by ethnicity

Pre-existing	Elective CS	Emergency CS	Operative vag	Normal Vag	No data	Total
Maaori	4	2		9	5	**20**
Pacific	5	17	2	26	7	**57**
Indian	1	3		4		**8**
Other Asian		2	2	1		**5**
E/O/U	1	2		7	4	**14**
Grand Total	11	26	4	47	15	**104**
	11%	**25%**	**4%**	**45%**	**14%**	**100%**

Source: DIP service data, analysed by CMDHB 2012.

Birth weight

Diabetes in pregnancy is associated with macrosomia, internationally defined as a birth weight over 4kg or >90% for gestational age[3], secondary to maternal and fetal hyperinsulinaemia. Rates of macrosomia have been described as high as 40-50% of pregnancies complicated by diabetes (Lim et al, 2009).

Infant birth weight information was available for 285 women with GDM out of 297 (96%). For infants born to mothers with GDM who were booked at the CMDHB DIP service and seen at clinic in 2011, 20% of those for whom birth weight data was available weighed 4000 gm or over (Table 41)**.** Two thirds of Indian infants weighed between 2500 and 3500 gm; for infants of Other Asian ethnicities a similar percentage was spread between 2500 and 4000 gm. For Maaori infants 61% weighed 3000-4000 gm and for Pacific infants 72% were in the range 3000-4500 gm. Infants of mothers of European/Other/Unknown ethnicities were more spread across the range 2500-4500 gm (Figure 18).

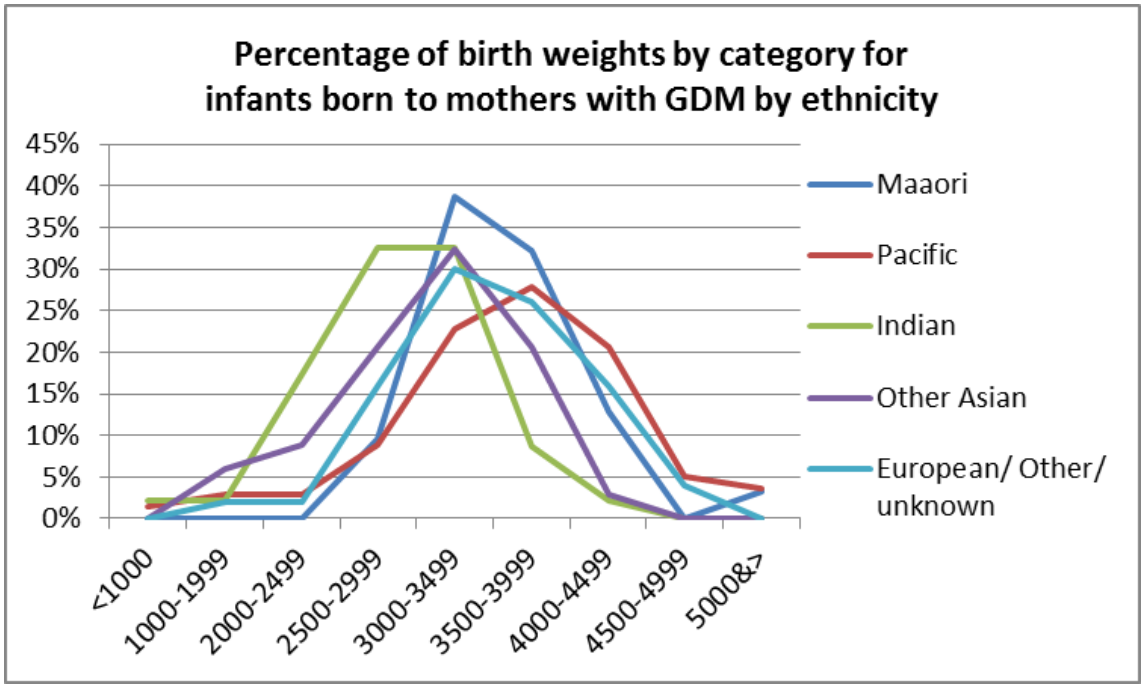
Table 41 Number of infants by category of birth weight for infants born to mothers with GDM, booked in 2011 and seen at DIP clinics, by ethnicity

Birth weight (g)	<1000	1000-1999	2000-2499	2500-2999	3000-3499	3500-3499	4000-4499	4500-4999	5000>	No data	Total
Maaori				3	12	10	4		1	1	31
Pacific	2	4	4	12	31	38	28	7	5	5	136
Indian	1	1	8	15	15	4	1			1	46
Other Asian		2	3	7	11	7	1			3	34
European/ Other/ unknown		1	1	8	15	13	8	2		2	50
Total	**3**	**8**	**16**	**45**	**84**	**72**	**42**	**9**	**6**	**12**	**297**
	1%	**3%**	**5%**	**15%**	**28%**	**24%**	**14%**	**3%**	**2%**	**4%**	**100%**

Source: DIP service data, analysed by CMDHB 2012.

[3] Using customised growth charts for the CMDHB population would give a variety of infant weight cut-offs for macrosomia depending on mother's ethnicity, BMI and age at booking

Figure 18 Percentage of infants by category of birth weight for infants born to mothers with GDM, booked in 2011 and seen at DIP clinics, by ethnicity



Source: DIP service data, analysed by CMDHB 2012.

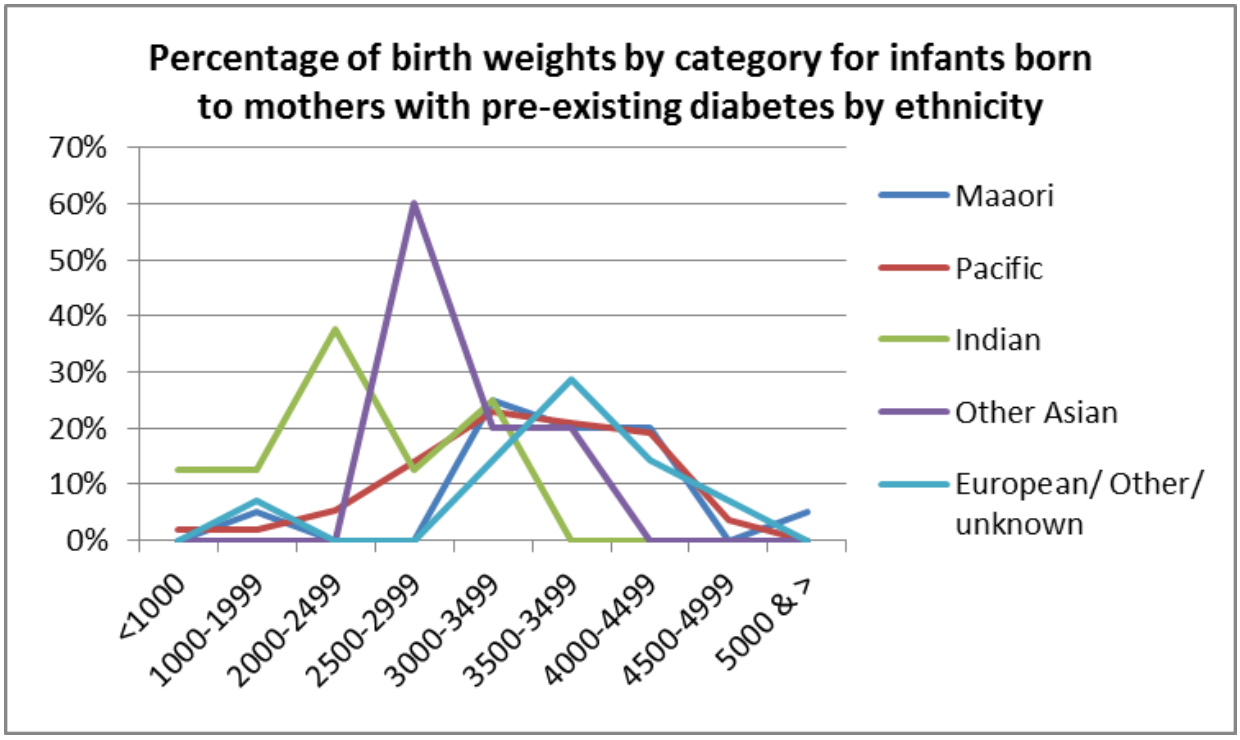
Infant birth weight information was available for 89 women with pre-existing diabetes out of 104 (85%). For infants born to mothers with pre-existing diabetes who were booked at the CMDHB DIP service and seen at clinic in 2011, 24% of those for whom birth weight data was available weighed 4000 gm or over – there were small numbers for Indian and Other Asian ethnicities (Table 42). 75% of Indian infants weighed less than 3500 gm with a peak at 2000-2500 gm; 60% of infants of Other Asian ethnicities weighed between 2500 and 3000 gm. Two thirds of Maaori infants weighed 3000-4500 gm and for Pacific infants three quarters were in the range 2500-4500 gm. Two thirds of Infants of European/Other/Unknown ethnicities were between 3000-4500 gm (Figure 19).

Table 42 Number of infants by category of birth weight for infants born to mothers with pre-existing diabetes, booked in 2011 and seen at DIP clinics, by ethnicity

Birth weight (g)	<1000	1000-1999	2000-2499	2500-2999	3000-3499	3500-3499	4000-4499	4500-4999	5000>	No data	Total
Maaori		1			5	4	4		1	5	**20**
Pacific	1	1	3	8	13	12	11	2		6	**57**
Indian	1	1	3	1	2						**8**
Other Asian				3	1	1					**5**
European/ Other/ unknown		1			2	4	2	1		4	**14**
Total	**2**	**4**	**6**	**12**	**23**	**21**	**17**	**3**	**1**	**15**	**104**
	2%	**4%**	**6%**	**12%**	**22%**	**20%**	**16%**	**3%**	**1%**	**14%**	**100%**

Source: DIP service data, analysed by CMDHB 2012.

Figure 19 Percentage of infants by category of birth weight for infants born to mothers with pre-existing diabetes, booked in 2011 and seen at DIP clinics, by ethnicity



Source: DIP service data, analysed by CMDHB 2012.

Screening for GDM

As part of a recent Ministry of Health contract on health literacy in relation to diabetes in pregnancy CMDHB primary care nurse specialist Christine Lynch was seconded to work with Workbase (the principle agency involved in the health literacy project) in CMDHB. The focus population was Maaori women up to age 24 years because nationally their screening rates for GDM are 30% compared to 70% for non-Maaori (note the analysis below indicates a screening rate of 61-63% for pregnant Maaori women aged 15-24 resident in CMDHB who don't have pre-existing diabetes). This work included exploring factors in relation to screening for gestational diabetes. It found that women were not necessarily offered screening, depending on the LMC/provider attitude regarding the importance of screening, and also that whaanau members such as mothers, aunts and grandmothers may not understand the relevance of screening and therefore may be dismissive of it (personal communication, Christine Lynch, December 2012).

Subsequent to this feedback from Christine further analysis was undertaken to see if an estimate of screening rates could be obtained by linkage of NMDS with Laboratory testing data. The Laboratory data identifies whether a test was actually undertaken but not the results. Information was extracted for the metro Auckland region, both by residence of woman, and DHB of delivery for those women with a birth event in 2011.

For women delivering in 2011, the percentage of women who did not have pre-existing diabetes, who had a polycose test in the six months prior to delivery is described in Table 43. As demonstrated overall close to three quarters of CMDHB woman without pre-existing diabetes were screened with a polycose test for GDM, this being very similar to the proportion screened for women resident in the other two metro Auckland DHBs. Of note, Maaori women have the lowest rate of screening in all three DHBs, at 61-63% and European/Others the highest at 78-82%. Pacific, Indian, and non-Chinese other Asian women living in CMDHB were screened with a polycose test more commonly than women of the same ethnicity resident in the other two DHBs.

Table 43 Percentage of women without pre-existing diabetes who had a polycose test in the 6 months prior to their delivery, by ethnicity and DHB of residence in 2011

Ethnicity	CMDHB resident women	ADHB resident women	WDHB resident women
Maaori	61%	63%	62%
Pacific	72%	61%	68%
Indian	83%	69%	73%
Chinese	81%	79%	74%
Other Asian	80%	75%	74%
European/Other	78%	82%	79%
Total	**73%**	**74%**	**75%**

Source: NMDS, analysed by CMDHB 2012.

If the polycose screening results are analysed by DHB of delivery, the figures are very similar for CMDHB, but with some variance for the other DHBs (Table 44).

Table 44 Percentage of women without pre-existing diabetes who had a polycose test in the 6 months prior to their delivery, by ethnicity and DHB of delivery in 2011

Ethnicity	Delivered at CMDHB facility	Delivered at ADHB facility	Delivered at WDHB facility
Maaori	61%	60%	64%
Pacific	72%	55%	71%
Indian	83%	66%	79%
Chinese	81%	79%	75%
Other Asian	81%	73%	76%
European/Other	77%	81%	80%
Total	**72%**	**74%**	**76%**

Source: NMDS, analysed by CMDHB 2012.

Analysis by age (not shown) demonstrates that although GDM is more common in older women, polycose testing in CMDHB resident women was most common in the 25-29 year age group (75%), but with little difference from the proportion screened among 15—24 year olds (about 70%) and those aged 35 and over (about 72%). In ADHB the highest proportion screened with a polycose test was in the 35-39 year age group (79%) and in WDHB the 30-39 year age group (77%). This may reflect the fact that people see ethnicity as a bigger driver of the risk of GDM than age in CMDHB, but even in those of European/Other ethnicities in CMDHB there was little difference in polycose screening rates across the age groups (76-78% in the 15-24 year age group and 78-79% in the 35 and over age groups).

It is important to note that the age of the population delivering at ADHB is substantially older that CMDHB resident mothers, and those delivering at CMDHB. In 2011 30.4% of women delivering at ADHB were aged 35 and over[4] compared with17.5% for CMDHB resident women giving birth in 2011/12.

Where there was quite a difference between DHBs was the proportion of women who had a GTT in the six months prior to delivery (Table 45). For women resident in all three DHBs, approximately 20% who had a polycose also had a GTT (presumably subsequently because of an abnormal polycose screen). However of the approximately 25% of women who did not have a polycose, of CMDHB resident women only 28% had a GTT, compared with 41% from WDHB and 49% from ADHB. Presumably this reflects use of demographic markers of risk of GDM (such as maternal age and/or ethnicity) as a 'screening' tool, or markers such as glycosuria, and proceeding straight to GTT. The differences between CMDHB and ADHB are even more marked when considering the populations delivering at the DHBs (Table 45).

[4] Pot M, Sadler L, McDougall J, Harilall M, Battin J (2012) National Women's Annual Clinical Report 2011. Auckland: Auckland District Health Board

Table 45 Percentage of women being screened by polycose and/or GTT by DHB of residence and delivery

	CMDHB residents	ADHB residents	WDHB residents	Women delivering at CMDHB facilities	Women delivering at ADHB facilities	Women delivering at WDHB facilities
Had polycose	73%	74%	75%	72%	74%	76%
Had polycose, also had GTT	20%	22%	21%	19%	25%	20%
Didn't have polycose, had GTT	28%	49%	41%	25%	53%	37%

Source: NMDS, analysed by CMDHB 2012

This means while 80% of CMDHB women who did not have pre-existing diabetes were screened and/or tested for GDM (by polycose or GTT), approximately 1,650 women were not tested. If the women who weren't tested had the same GDM rates as those who were, there may have been approximately 70 women and infants in 2011 (based on current practice) whose outcomes could have been impacted by undiagnosed GDM.

Postnatal Follow-up

Improving postnatal screening for underlying diabetes in women with GDM has been an area of significant attention in recent years in CMHDB. Appointments for postnatal GTTs are sent to the affected women by the DIP service, with follow up by a Women's Health Community Liaison Coordinator if results are not received in the expected timeframe. From 2012 HbA1c at 3 months has been used as an alternative screening test for those women who have not had an OGTT, with subsequent follow up by a community worker from the PHO the woman is enrolled with. If the PHO doesn't have a CHW, a practice nurse from the relevant practice is asked to follow up. Experience suggests the CHWs are more successful in achieving a follow up test than practice nurses.

In 2011, 119 women were referred for to the Women's Health Community Liaison Co-ordinator for further follow up, 39 of whom eventually got their test done. Of those 39, 18 were abnormal, identifying the woman as having diabetes or Impaired Glucose Tolerance. Ethnicity of the women referred and those completing follow-up is described in Table 46.

Table 46 Follow up outcomes of women referred to Women's Health Community Liaison Coordinator for postnatal follow up by ethnicity, 2011

Ethnicity	Women referred for further follow up	Women completing their GTT
Maaori	12	1
Pacific	56	16
Indian	21	10
European/Other Asian/ Other	30	12

Source: Donna Harvey, Women's Health Community Liaison Co-ordinator

To get further information on post natal follow up, NMDS was linked with the Laboratory Testing data (which indicates whether or not a test has been done, not the result) for those women with a birth event in 2011. Information was extracted for the metro Auckland region, both by residence of woman, and DHB of delivery.

For women delivering in 2011 identified as having GDM, the percentage of women who had a GGT or an HbA1c in the six months after delivery is described in Table 47. This data identifies 63% of CMDHB resident women identified with GDM having had a GGT or HbA1c within six months of delivery. The results are not dissimilar for ADHB and WDHB women.

Table 47 Postnatal follow-up for women identified with GDM for women resident in each of the three Auckland region DHBs

Ethnicity	CMDHB resident women		ADHB resident women		WDHB resident women	
	GTT	HbA1c if no GTT	GTT	HbA1c if no GTT	GTT	HbA1c if no GTT
Maaori	43% (21)	6% (3)	29% (7)	0	33% (13)	8% (3)
Pacific	51% (81)	6% (9)	39% (44)	5% (6)	25% (14)	9% (5)
Indian	68% (34)	4% (2)	72% (53)	0	71% (29)	5% (2)
Chinese	83% (30)	0	84% (54)	2% (1)	72% (42)	2% (1)
Other Asian	69% (20)	0	76% (42)	2% (1)	66% (27)	5% (2)
European/Other	63% (51)	4% (3)	69% (70)	6% (6)	55% (86)	4% (7)
Total	**59% (237)**	**4% (17)**	**63% (270)**	**3% (14)**	**54% (211)**	**5% (20)**

Source: NMDS, analysed by CMDHB 2012

If the results are broken down by DHB of delivery, ADHB clearly provide services to a much larger cohort of women with GDM (approximately 37[5]% of whom were from WDHB), and the proportion of women undergoing postnatal follow up appears to be considerably lower for women delivering at WDHB facilities (48% compared with 65% for ADHB and 62% for CMDHB) (Table 48).

Table 48 Postnatal follow-up for women identified with GDM for women delivering at each of the three Auckland region DHBs

Ethnicity	Women delivering at CMDHB facilities		Women delivering at ADHB facilities		Women delivering at WDHB facilities	
	GTT	HbA1c if no GTT	GTT	HbA1c if no GTT	GTT	HbA1c if no GTT
Maaori	44% (20)	7% (3)	32% (17)	6% (3)	27% (4)	0%
Pacific	51% (86)	7% (11)	34% (52)	6% (9)	0%	0%
Indian	64% (29)	4% (2)	74% (87)	2% (2)	0%	0%
Chinese	91% (10)	0%	82% (99)	1% (1)	63% (17)	4% (1)
Other Asian	68% (15)	0%	76% (70)	2% (2)	36% (4)	9% (1)
European/Other	65% (39)	0%	63% (144)	7% (15)	48% (25)	2% (1)
Total	**57% (199)**	**5% (16)**	**61% (469)**	**4% (32)**	**45% (50)**	**3% (3)**

Source: NMDS, analysed by CMDHB 2012

Of note, the way this data is reported it measures adequacy of follow up. If it is considered in reverse – the number not being screened postnatally - it gives an indication of the number of women with high risk of future diabetes, both gestational and type II, who are not receiving adequate follow up to help them reduce their future risk.

I.e. available data suggests 38% of women delivering at CMDHB facilities did not receive adequate follow up to help reduce future risk.

[5] Compared with 16% of the total population delivering at ADHB being WDHB residents

Other comparisons

National Women's Hospital Annual Report

The National Women's Hospital Annual Report for 2011 was available for comparison. Data for the report was drawn from the National Women's Healthware clinical database. The HealthWare data for non-NW LMCs is entered by a specific administrator for women delivering at ADHB, and so is considerably more complete that CMDHB HealthWare data, while NW clerks and midwives enter the data for NW patients. Data is cleaned in various ways to improve data quality.

The report describes a total number of 7493 women birthing at National Women's in 2011 and a further 33 birthing before arrival (giving a total of 7523 birth outcomes). The Caesarean rate was 32.5% and 11% were operative vaginal deliveries. 30.4% of mothers were aged 35 or more and 6.1% were aged 40 or more. The percentage aged 35 or more was significantly greater than the mean for Women's Hospitals Australasia[6] of 23.4%. 69% of women delivering at NW were ADHB residents. In 2011, 7.9% of mothers giving birth at NW were prioritised as Maaori, 13.5% Pacific, 7.3% Indian, 20.3% Chinese and Other Asian, 50.9% European/Other.

In 2011 approximately 11% of women who birthed at NW were reported as diagnosed with GDM and 1.3% with pre-existing diabetes. The GDM rate had gone up considerably from previous years - rates for 2008-2010 were 6-7%. Discussion with CMDHB clinicians suggests this may coincide with increased use of HbA1c screening in early pregnancy in ADHB from late 2010.

The Caesarean Section rate for women with GDM was approximately 36% and operative vaginal delivery approximately 11%. 58% of women were reported to have a postnatal GTT (480 women). This was a decrease from previous levels of testing of 67-68% for 2008-2010, and 72-78% for 2003-2007. 78% of the GTTs in 2011 were normal and 3.1% diabetic.

Further unpublished analysis of GDM rates by ethnicity demonstrated considerable differences by ethnicity – 5.5% for European mothers, 10.2% Maaori, 16.% Pacific and 22% Indian (personal communication Lesley McCowan).

National Women's population compared with the population delivering at CMDHB

The population of CMDHB women giving birth in 2011 was very much younger than the population delivering at NW – only 17.5% of women were aged 35 or more and 3.9% aged 40 or more. The ethnicity mix is quite different with much higher proportions of Maaori and Pacific women in CMHDB. These factors are important in interpreting GDM rates.

The metro Auckland NMDS extract undertaken for this paper to consider GDM screening and postnatal follow-up has GDM rates for ADHB facilities consistent with the Healthware derived rates in the NW Annual report – 10.4% overall, 6% European/Other, 9.1% for Maaori, 15.5% for Pacific, 21.8% for Indian. These GDM rates are considerably higher than the rates for the CMDHB population and the population delivering at CMDHB facilities, especially the rates for non-European/Other women. To explore how much of this difference was due to the difference between the age

[6] Benchmarking group for contributing New Zealand and Australian maternity units with level 3 neonatal ICUs

structure of the ADHB delivery population compared to the CMDHB delivery population, further analysis was undertaken to examine age specific rates by ethnicity.

As in Table 49 & Table 50 below, it appears the difference in identified GDM prevalence between CMDHB and ADHB is not due to the difference in the age structure of the delivery populations. Although some caution is needed because of small numbers in some categories, the prevalence of GDM based on NMDS data appears to be substantially higher for all age groups across all ethnicities in the population delivering at ADHB facilities.

This suggests a definitional difference in identifying/classifying women as having GDM, and discussion with CMDHB clinicians suggests this may be due to the introduction in ADHB of the screening algorithm which uses HbA1c at booking for women identified by screening on the basis of demographic factors, as at high risk of diabetes or GDM. Women with abnormal HBA1c may then be identified as having diabetes 'arising in pregnancy', because it has not been diagnosed previously, even though in reality it is likely to represent pre-existing diabetes. Either way, control of abnormal glucose metabolism is important in these women to protect their own health and the health of their infants.

This apparent definitional difference needs to be further discussed with CMDHB and ADHB diabetes in pregnancy clinicians as it has significant implications for work and/or research which extends across the region.

Table 49 Percentage of women delivering at CMDHB facilities identified as having GDM by age and ethnicity

Age group (yrs)	15-19	20-24	25-29	30-34	35-39	40 and over	Total
Maaori	0.0%	1.2%	2.5%	3.7%	7.9%	2.4%	**2.3%**
Pacific	1.1%	1.7%	5.0%	6.8%	12.6%	13.6%	**5.4%**
Indian	0%	3.5%	5.3%	9.1%	17.6%	33.3%	**7.7%**
Chinese	0%	0%	0%	9.2%	9.7%	16.7%	**6.4%**
Other Asian	0%	4.4%	3.8%	11.8%	5.1%	8.3%	**6.7%**
European/Other	3.1%	2.3%	3.1%	3.5%	3.8%	4.2%	**3.2%**
Total	**0.8%**	**1.8%**	**3.9%**	**5.9%**	**8.8%**	**9.6%**	**4.4%**

Source: NMDS, analysed by CMDHB 2012

Table 50 Percentage of women delivering at ADHB facilities identified as having GDM by age and ethnicity

Age group (yrs)	15-19	20-24	25-29	30-34	35-39	40 and over	Total
Maaori	0%	7.3%	10.1%	11.5%	11.5%	20.0%	**9.1%**
Pacific	1.2%	9.2%	13.0%	22.8%	20.3%	38.5%	**15.8%**
Indian	0%	14.6%	19.2%	21.5%	29.2%	45.0%	**21.8%**
Chinese	0%	3.7%	9.2%	12.6%	20.0%	27.9%	**12.4%**
Other Asian	0.0%	8.2%	15.9%	15.1%	21.2%	32.4%	**17.1%**
European/Other	2.4%	7.1%	5.3%	5.7%	6.0%	9.7%	**6.1%**
Total	**1.0%**	**8.1%**	**10.3%**	**10.5%**	**10.2%**	**18.8%**	**10.4%**

Source: NMDS, analysed by CMDHB 2012

Discussion

Data pulled together for this paper has highlighted a number of key issues for the Diabetes in Pregnancy service at CMDHB and for the wider work to strengthen the CMDHB population health approach which includes prioritising interventions that can improve outcomes related to the 'First 2000 Days' (from peri-conception to age five years).

1. While the number of births per year for the CMDHB resident population has remained relatively stable in recent years, the crude prevalence of diabetes in pregnancy, both gestational and pre-existing diabetes has increased. This is likely due to the changing ethnicity mix of the population and high obesity rates. Assuming a stable birth cohort size continues, if these increases continue, this would mean an increase of nearly 25% (8% per annum) on 2011/12 volumes of CMDHB women needing to be managed by diabetes in pregnancy services by 2014/15. Although not all of these women will be managed by the CMDHB service, there are also women from other DHBs who deliver at CMDHB and require care under the CMDHB DIP service.

A change to the algorithm for screening for pre-existing diabetes in early pregnancy, and potential changes to the diagnostic criteria for GDM would further increase the potential volumes for the DIP service. The potential extra volumes suggest that by 2014/15 there could be up to 80% more women needing to be seen than the numbers referred to the service in the 2011/12 financial year. This has major implications for the multidisciplinary work force involved in the Diabetes in Pregnancy service and model of care planning.

2. Data about the rates of polycose and GTT testing suggest that approximately 20% of pregnant CMDHB resident women are not currently being tested for GDM by either method. Rates of polycose testing are lowest for Maaori women. In 2011 overall this potentially resulted in approximately 70 women and their infants whose outcomes could have been impacted by undiagnosed GDM.

In addition, GDM rates based on NMDS coding are considerably higher for the population delivering at ADHB than the rates for the CMDHB resident population and the population delivering at CMDHB facilities, especially the rates for non-European/Other women. Age specific rates by ethnicity, although needing to be interpreted with caution because of small numbers in some categories, suggest this is not just due to the much older cohort of women delivering at ADHB, as rates were higher for the ADHB population across all age groups. This suggests a definitional difference and discussion with CMDHB clinicians suggests this may be due to the introduction in ADHB of the screening algorithm which uses HbA1c at booking for women at high risk of diabetes or GDM.

Further discussion with regional clinicians may be useful to ensure common understanding of the interpretation of HbA1c in pregnancy. It would seem likely that a significant proportion of those being detected by HbA1c actually have pre-existing diabetes rather than GDM, although current practice in Australasia is to identify this situation as GDM (Nankervis et al, 2013). This needs to be further discussed with diabetes in pregnancy clinicians as it has significant implications for work and/or research which extends across the region.

There is also a perception among CMDHB midwifery and obstetric staff that polycose screening, which is not weight-adjusted and seems a relatively small carbohydrate load compared with normal consumption for many women in CMDHB, may not be an adequate screening test in the CMDHB population. It would be helpful to review the sensitivity and specificity of polycose as a screening test and how adequately it has been validated for populations such as that of CMDHB. Of note the recently released Australasian Diabetes In Pregnancy Society (ADIPS) guidelines for testing and diagnosis of GDM in Australia recommends the use of OGTT rather than polycose, stating 'the glucose challenge test lacks both sensitivity and specificity and is no longer part of the diagnostic algorithm' (Nankervis et al, 2013). Presumably this recommendation will considered by the group working on the New Zealand guidelines.

3. To provide continuity of primary maternity care and address capacity issues for the DIP service, it is important that LMCs and general practice teams involved in shared care are equipped to provide high quality primary maternity care for women with diabetes in pregnancy, in collaboration with the specialised care provided by the DIP service. The interface of the DIP service with these groups is an area where the service sees significant opportunity for improvement. To address safety concerns for primary care providers there needs to be a clear framework for accountability and information sharing; this relates to both to referral to the service and communication between various members of the service team and primary providers when women are under the care of the service.

There is also a need for consistent messages about nutrition and self-care across LMCs and the Diabetes in Pregnancy service team members. For example while obesity and excess gestational weight gain are significant issues for the CMDHB population, anecdotally women from some cultural backgrounds may 'starve themselves' or restrict their diets to very low carbohydrate intake for fear of taking medication in pregnancy (personal communication, Elaine Chong, dietitian for the DIP service). The potential negative impacts of this kind of nutrition on the baby developing in utero are recognised and communicated during antenatal visits but could be further reinforced by all health professionals involved in the care of women with diabetes in pregnancy.

4. Dietetic services are an important component of the Diabetes in Pregnancy service model of care. Over the years of increasing patient numbers through the service there has not been any increase in dietitian time dedicated to the service but use of resources has been maximised by initiating group education sessions to complement individual sessions with the dietitian, and a triaging system. The group sessions have been well received patients and feedback from other members of the Diabetes in Pregnancy team who see the women subsequently suggests they are effective at engaging women in increased self-care of the diabetes and overall nutrition (Chong, 2008). This is consistent with experience of group education in smoking cessation support, where group education has been shown to be more effective than on-on-one intervention (Brose et al, 2011).

5. The biggest increases in the prevalence of diabetes in pregnancy in recent years for women resident in CMDHB have been in women of Indian and other Asian ethnicities. However for the DIP

service at CMDHB, this increase has been masked to some extent because for various reasons only 30% of CMDHB Chinese women with diabetes in pregnancy deliver at CMDHB facilities; most of the rest deliver at ADHB.

Indian women have the highest prevalence of diabetes in pregnancy at just under 11% in 2011/12. Under the protocol for the collection and use of ethnicity data for the health sector (Ministry of Health, 2004) Fijian Indian women are classified as Indian. However experience from working with these women in the DIP service suggests that many of them have a culture related to nutrition and physical activity that is more like their Pacific neighbours than traditional Indian patterns. If possible, it would be useful to explore the numbers of women identified as Fijian Indian among CMDHB residents identified as having DIP as well as those from other DHBs under the care of CMDHB, so as to plan appropriate management and preventive services for them. If this data is not currently available, efforts could be made over the next year to improve identification of this group to support service planning.

6. The risk of gestational diabetes increases with increasing body weight. However it is noteworthy that from data from the CMDHB DIP service, 26% of women referred to the service who were of European/Other/Unknown ethnicities with GDM had BMIs within the 'normal' range (<25) (assuming accurate ethnicity coding). This has implications for the use of risk factor criteria for GDM screening which relate to body weight.

7. While women with GDM represent 75% of those referred to the DIP service at CMDHB, issues related to pre-existing diabetes in pregnancy are of principle concern for staff of the DIP service. In their experience young women with diabetes frequently seem to have very limited understanding of the risks to their pregnancy and the future health of their child from poorly controlled, pre-existing diabetes. This is important information to feed back to the primary care community in CMDHB. DIP staff observe that some of these women may live in extended family situations and have limited influence over the food and drink available to themselves and the household. Hence a whole household/family approach, which is culturally tailored, is important to try to effect change. Poverty and the easy accessibility of cheap, high fat, high energy foods are also seen as important factors.

Many pregnancies are unplanned – there is no data on this in relation to women with diabetes specifically but the Growing Up in New Zealand study found that 50% of pregnancies to CMDHB women in their cohort were unplanned (Morton et al, 2010). Together these factors result in lost opportunities to improve the peri-conceptual environment by optimising diabetes control prior to pregnancy. This is an area where improvements could be made by working with primary care providers and the communities of CMDHB. Localities developments give the opportunity to link DIP specialist midwives to general practice clusters to support training and availability for advice.

8. Women with GDM have a significant risk of future Type 2 diabetes, with a Lancet review concluding that women with GDM have a seven fold increase in developing Type 2 diabetes

compared with women who are normoglycaemic in pregnancy (Bellamy et al, 2009). There have been recent regional discussions about using HbA1c at 12 weeks postpartum as an alternative to the currently recommended 75gm OGTT at six weeks for post-partum diabetes screening. This would align with the use of HbA1c instead of the OGTT in the general population, and as it is much easier for women to do this test than an OGTT, it is anticipated this change would improve postnatal screening rates.

Currently available data suggests 38% of women delivering in CMDHB facilities are not getting adequate follow up postnatally to optimally help them manage their future risk. There are important opportunities to prevent future gestational and non-gestational diabetes in working with women with gestational diabetes and their families, and a current project exploring this is underway, funded from the previous 'HEHA' funding. This area needs further review as part of the development of the 'First 2000 Days' population health approach. Again a whole of household/family approach will be key and has potential to maximise impacts.

9. There is regional interest in developing a registry for women with gestational diabetes to improve follow up and be able to track outcomes. At present this would need manual registration, but there is potential in the future for some degree of automation using the TestSafe database. Use of TestSafe would also offer potential to explore how to intervene in a more systematic manner postnatally and to evaluate interventions trialled.

10. It is recognised that poor health literacy is a major barrier to improving health outcomes for the CMDHB population (Winnard et al, 2012). The DIP service has attempted to use innovative methods to support health education for women with diabetes in pregnancy, implementing group education and revision of nutrition information to better reflect population food preferences. The service would also be keen to explore use of social media such as You-tube, nutrition related applications for Smartphones and web-based technologies as means to improve community understanding about diabetes in pregnancy but it would be important to understand which groups in our community this would actually reach so as not to increase rather than decrease inequalities.

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Appendix One: Current screening and diagnostic criteria for Diabetes in Pregnancy, as used in CMDHB (from November 2010)

At booking

If high risk of gestational diabetes:

- Obesity
- Past history of GDM or glucose intolerance
- Previous baby over 4.5kg or for an Asian woman 4.0kg
- Family history of diabetes
- Age > 30 yrs
- Past adverse pregnancy outcomes
- High risk ethnic group

THEN do 75g oral GTT.

Test is positive if fasting glucose >=5.5 or 2 hr >= 9.0
If oral GTT positive, then GDM (or overt DM) is diagnosed; refer to DIP clinic.
If oral GTT negative, repeat GTT at 26 weeks gestation.

At 26 weeks gestation

Polycose screen (for women not previously diagnosed with diabetes)
If >=7.8, do 75g oral GTT. If >=11.1 refer to DIP clinic.
If Gtt shows FPG >=5.5 or 2 hr>= 9.0 refer to DIP clinic
If GTT negative but clinical or ultrasound suspicion of fetal macrosomia, repeat GTT after 4 weeks.

At this time HbA1c is not part of screening for gestational diabetes for CMDHB. If for some reason HbA1c has been measured and it is >=6.5 or a fasting glucose is >=5.5 then the woman should be referred directly to the diabetes in pregnancy service. Women with an HbA1c of >=6.0 but <=6.5 should have a GTT and only be referred if that is abnormal. Women with borderline results and ultrasound evidence for macrosomia should be referred to a general obstetric clinic.

Appendix Two: ICD codes for diabetes in pregnancy

Table 51 ICD codes for Gestational Diabetes

ICD code	Description
O2441 (ICD v 3)	Diabetes mellitus arising in pregnancy non-insulin treated
O2442 (ICD v 3, ICD v6)	Diabetes mellitus arising during pregnancy, insulin treated
O2443 (ICD v6)	Diabetes mellitus arising during pregnancy, oral hypoglycaemic therapy
O2444 (ICD v6)	Diabetes mellitus arising during pregnancy, other
O2449 (ICD v6)	Diabetes mellitus arising during pregnancy, unspecified

Table 52 ICD codes for diabetes in pregnancy of unspecified onset

ICD code	Description
O2491	Diabetes mellitus in pregnancy, unspecified onset, noninsulin treated
O2492	Diabetes mellitus in pregnancy, unspecified onset, insulin treated
O2493	Diabetes mellitus in pregnancy, unspecified onset, oral hypoglycaemic therapy
O2494	Diabetes mellitus in pregnancy, unspecified onset, other
O2499	Diabetes mellitus in pregnancy, unspecified onset, unspecified

Table 53 ICD codes for pregnancy with pre-existing diabetes

ICD code	Description
O240	Pre-existing diabetes mellitus, Type 1, in pregnancy
O2411	Pre-exist diabetes mellitus, Type 2, in pregnancy noninsulin treated
O2412	Pre-existing diabetes mellitus, Type 2, in pregnancy, insulin treated
O2413	Pre-existing diabetes mellitus, Type 2, in pregnancy, oral hypoglycaemic therapy
O2414	Pre-existing diabetes mellitus, Type 2, in pregnancy, other
O2419	Pre-existing diabetes mellitus, Type 2, in pregnancy, unspecified
O2421	Pre-exist diabetes mellitus, other specified type, in pregnancy, noninsulin treated
O2422	Pre-existing diabetes mellitus, other specified type, in pregnancy, insulin treated
O2423	Pre-existing diabetes mellitus, other specified type, in pregnancy, oral hypoglycaemic therapy
O2424	Pre-existing diabetes mellitus, other specified type, in pregnancy, other
O2429	Pre-existing diabetes mellitus, other specified type, in pregnancy, unspecified
O2431	Pre-exist diabetes mellitus unspecified, in pregnancy, noninsulin treated
O2432	Pre-existing diabetes mellitus, unspecified, in pregnancy, insulin treated
O2433	Pre-existing diabetes mellitus, unspecified type, in pregnancy, oral hypoglycaemic therapy
O2434	Pre-existing diabetes mellitus, unspecified type, in pregnancy, other
O2439	Pre-existing diabetes mellitus, unspecified, in pregnancy, unspecified
E10	Insulin-dependent diabetes mellitus
E11	Non-insulin-dependent diabetes mellitus
E12	Malnutrition-related diabetes mellitus
E13	Other specified diabetes mellitus
E14	Unspecified diabetes mellitus