

**Compliance to Gestational Diabetes
Mellitus Screening Guidelines
among Healthcare Professionals in
Primary Healthcare Institutions in
Oman**

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Abstract

Background: In Oman, gestational diabetes mellitus is an increasingly common complication of pregnancy, with the prevalence estimated to have risen from 5.7% in 2013 to 18.3% in 2018. Gestational diabetes mellitus is associated with an increased risk of adverse perinatal outcomes such as macrosomia which is associated with birth trauma. Guidelines for the screening and diagnosis of gestational diabetes mellitus were available at all Omani healthcare institutions since 2010 and revised in 2015. This high prevalence of GDM suggested a need to explore the implementation of GDM screening guidelines in a primary healthcare setting in Oman and propose recommendations for increasing compliance.

Method: This was a mixed-methods study, with two phases:

Phase 1: A retrospective review of gestational diabetes mellitus screening in Oman, utilising routinely collected data (case records). The sample for this study comprised the records of all pregnant women who registered for ante-natal care at primary and secondary healthcare centres in Muscat in 2014.

Phase 2: Face-to-face interviews with healthcare professionals working in two antenatal clinics in Muscat, to explore practice in screening and diagnosis of gestational diabetes mellitus in these two institutions. Also, to identify barriers and facilitators of compliance with GDM screening guidelines in these two primary healthcare centres.

Results: The retrospective review of notes and records revealed poor compliance with gestational diabetes mellitus screening guidelines. A particular weakness was the lack of consistency with which an oral glucose challenge test and/or oral glucose tolerance test was offered to appropriate women. All women underwent a random blood sugar

test when registering their pregnancy, and the guideline determined the screening pathway women with a normal or abnormal result should follow.

A proportion of women, who before registration had a normal), or abnormally high glucose results were not subsequently offered the appropriate screening(28.1% and (25.6%) respectively.

Of 942 women who completed a random blood sugar test before registration at the antenatal clinic, 91.3% (n = 860) had a normal result and 8.7% (n = 82) had abnormally high blood glucose. Amongst the 860 women with a normal screening result at registration, only 28.9% (n = 248) received follow-up screening in line with the guidelines using the oral glucose challenge test. 51.6% (n = 444) were administered an oral glucose tolerance test.

Ten face-to-face interviews were conducted to explore barriers faced by healthcare professionals in two primary healthcare institutions when implementing the screening guidance. Thematic analysis indicated three themes. These were: organisational barriers; poor inter-professional communication that were evident in both clinics, and confusion and lack of understanding that was evident in one clinic. These barriers presented challenges to the accurate implementation of the gestational diabetes mellitus guidelines. However, facilitators were also evident, including utilisation of the available resources, working experiences, and professional teamwork.

Study Outcomes and Impact: The study has made a unique contribution to the body of knowledge on how to best utilise the facilitators available within the healthcare system to improve the implementation of GDM screening in Oman. This study found a discrepancy in the implementation of GDM guidelines between two PHC institutions in Muscat. There is a lack of clarity around the job descriptions of nurses and midwives, the consequences of staff rotation within different clinics in the health centre that has a direct effect on the continuity of care provided for pregnant women. There is the

potential for improving compliance with GDM guidelines implementation by HCPs if they are provided with a clear interpretation of these same guidelines. This thesis offers recommendations to improve the gestational diabetes mellitus screening services for pregnant women in Oman. Improved implementation of the guidelines may be achieved by encouraging life-long learning training and keeping healthcare professionals up-to-date with current trends in screening for gestational diabetes mellitus, monitoring, and evaluation.

Abbreviations

ACOG	American College of Obstetricians and Gynaecologists
ADA	American Diabetes Association
ADIPS	Australian Diabetes in Pregnancy Society
ANC	Antenatal care
BMI	Body Mass Index
CASP	Critical Appraisal Skills Programme
CDR	Crude Death Rate
CINAHL	Cumulative Index to Nursing and Allied Health Literature
CS	Caesarean Section
EASD	European Association for the Study of Diabetes
FBS	Fasting Blood Sugar
G	gram
GDM	Gestational Diabetes Mellitus
GP	General Practitioner
HAPO	Hyperglycaemia and Adverse Pregnancy Outcomes
HbA1c	Glycosylated haemoglobin
HCP's	Healthcare professionals
HREC	Human Research Ethics Committee
IADPSG	The International Association of Diabetes and Pregnancy Study Groups
IGT	Impaired glucose tolerance

IFG	Impaired fasting glycaemia
MBRRACE-UK	Mothers and Babies: Reducing Risk through Audits and Confidential Enquires across the UK
MDC	Midwives' data collection
MDG	Millennium development goal
MMR	Maternal mortality ratio
MoH	Ministry of Health
NCD	Non-communicable diseases
NDDG	National Diabetes Data Group
NICE	National Institute for Health and Clinical Excellence
OECD	Organisation for Economic Co-operation and Development
OGCT	Oral glucose challenging test
OGTT	Oral glucose tolerance test
OR	Odd ratio
PHC	Primary Health Care
RBS	Random Blood Sugar
UN	United Nations

Operational definition of terms

Screening of GDM refers to the laboratory investigations or tests that are undertaken to screen women for GDM.

Diagnosis of GDM refers to the presence of at least one abnormal blood glucose value after a 75 g oral glucose tolerance test (OGTT): 5.1 mmol/l or above or (≥ 92 mg/dl) for fasting, and/or a two-hour plasma glucose concentration ≥ 8.5 mmol/l.

Oral glucose challenges test (OGCT) is a short version of the OGTT, used to check pregnant women for signs of gestational diabetes. It can be done at any time of day, not on an empty stomach. The test involves 50g of glucose, with a reading taken after one hour.

Oral glucose tolerance test (OGTT) is used to check pregnant women for signs of gestational diabetes. 75 g of glucose load was given to the women after fasting for eight hours. Venous plasma glucose concentration is measured before the glucose load (fasting) and two hours after glucose load. Gestational diabetes was diagnosed if the women had fasting value ≥ 5.3 mmol/l or post glucose 2 hours value ≥ 8.5 mmol/l (Chan et al. 2002).

Sensitivity is “the ability of a test to give a positive finding when the person tested truly has the disease under study” (Morabia and Zhang 2004).

Specificity is “the ability of the test to give a negative finding when the person tested is free of the disease under study” (Morabia and Zhang 2004).

Macrosomia is defined variously as birthweight above the 90th percentile for gestational age or birthweight greater than 4000 g.

Adherence/ compliance is defined as “a person’s ability and willingness to follow recommended health practices” (Brannon et al. 2014)

Nurses who work in PHC institutions in Oman and have either qualified with a Diploma in nursing or bachelor’s degree in nursing.

Midwives in Oman have a Diploma in Midwifery as a “post basic” programme and already have a diploma or bachelor’s degree in nursing.

General Practitioners are qualified medical officers who completed a bachelor’s degree in medicine from a school of medicine at a university.

Midwife educators in Oman are qualified midwives with a post basic diploma in midwifery who have completed a master's degree and have a minimum of 2 years' experience in teaching.

Health educators in Oman are qualified health care providers with a diploma certificate in health education but with some knowledge of maternity care.

A **health centre in Oman** is defined as "a health institution that provides primary healthcare to the people in the surrounding catchment area" (MoH 2015). They do not have in-patient services, although antenatal care is provided by health centres, all deliveries are conducted in hospitals because there are no maternity beds in the health centres (MoH, 2017).

Extended Health Centre: "A health centre that provides primary healthcare services and in addition has some specialised outpatient clinics in different specialties. They serve people within their catchment areas" (MoH 2017).

Wilayat Hospital "A hospital that provides both primary and secondary health care to inhabitants of the Wilayat in which it is located and those of nearby Wilayats" (MoH 2017).

Governorate Hospital "A hospital that provides secondary and tertiary cares to inhabitants of the health governorate in which it is located. It is usually built in the centre of a health governorate and is considered as a referral hospital for critical cases from other hospitals and health centres of the health governorate. Governorate hospitals of the Muscat" (MoH 2017).

Muscat is the capital of Sultanate of Oman.

Clinical practice guidelines are "systematically developed statements to assist practitioner and patient decisions about appropriate health care for specific clinical circumstances." (Field and Lohr 1990).

A barrier was defined as any factor that limits or restricts the healthcare professionals to the GDM screening guidelines.

A facilitator was defined as any factor that promotes an effective implementation of GDM guidelines amongst healthcare professionals.

Compliance refers to the processes of following rules, regulations, and laws that relate to healthcare practices such as guidelines, patient safety, and patient's privacy.

Chapter 1. Introduction

1.1. Introduction to the thesis

The purpose of this study was to explore the implementation of gestational diabetes mellitus (GDM) screening guidelines within primary healthcare institutions (PHCs) in Oman. It was extremely important to conduct this study because most previous studies exploring and examining the implementation of GDM guidelines have been undertaken in other countries including Australia, United Arab Emirates (UAE), United States of America (USA) and the United Kingdom (UK) (Flack and Ross 2016; Agarwal et al. 2015; Mersereau et al. 2011; Murphy et al. 2016) but none have been thus far conducted in Oman. The only previous study identified which examined nurses' practices, attitudes, knowledge/skills, and perceived barriers in relation to evidence-based practice (EBP) in Oman (Ammouri et al. 2014), was not related to GDM screening. The Sultanate of Oman is a high-income country and has recently gone through rapid economic development, which has meant considerable changes in lifestyles (Al-Lawati et al. 2008). GDM guidelines were established in Oman in 2010 and revised in 2015. Since 2010, universal GDM screening has been recommended in Oman. However, health care professionals lack both knowledge and experience when it comes to the implementation of GDM guidelines in PHC's. The current study made use of the World Health Organisation (WHO) (2013) and National Institute for Health and Clinical Excellence (NICE) (2015) GDM a guideline as 'the gold standard' against which, the implementation of GDM guidelines in Oman was compared. This chapter presents the research problem, the aims and objectives of the study and the research questions.

1.2. Research statement

The Directorate of Information and Statistics of reported that the proportion of women who develop GDM in Oman steadily increased from 4.8% in 2012 through to 5.7% in 2013, 7.2% in 2014, 11.3% in 2015 and 18.3% in 2018 (MoH 2019). The healthcare system in Oman has undergone tremendous changes to improve both healthcare services and the health of individuals.

The Ministry of Health (MoH) first developed GDM guidelines in 2010 and distributed these to all healthcare institutions in the same year. However, the extent to which these guidelines have since been implemented is unclear. There is a paucity of literature regarding the evaluation of the implementation of the 2010 GDM guidelines in PHC institutions in Oman. It is far easier and cheaper to conduct the screening test as described in the guidelines, compared with the cost of managing women with adverse pregnancy outcomes, such as macrosomic babies and unexplained stillbirths (Huhn et al. 2016). For the present study, it was possible to examine the literature on the implementation of GDM guidelines among healthcare professionals (HCPs) from the United Arab Emirates (Agarwal et al. 2015) but, as stated, none from Oman.

1.3. Personal reflection

From my personal experience as a midwifery educator actively involved in designing the midwifery curriculum in Oman, GDM is part of the curriculum of an at-risk pregnancy course. The midwifery students should learn the “complexities in midwifery practice course” in their second semester in which the management and care for GDM women would be taught (Midwifery curriculum, 2014). As a midwife working in primary health care institutions, during my clinical placements in antenatal clinic, I observed that the implementation of GDM guidelines differed from one health institution to another. For example, a health centre managed by a qualified midwife and a GP

(general practitioner) might fully implement the guidelines. Conversely, when midwives input was lacking at some health centres, these guidelines were poorly implemented. Midwives work closely with other obstetric nurses/ dieticians in the maternity units and, as such, maybe more aware of any updates to the guidelines than nurses without midwifery qualifications.

Furthermore, midwives are posted to work in antenatal clinics every day, whereas nurses who work in antenatal clinics may do so for only two days a month. This greater antenatal care (ANC) experience amongst midwives may contribute to their increased knowledge and skills around the implementation of GDM guidelines compared to that of nurses. However, the number of trained midwives working in PHCs is limited, meaning that nurses working in these units must often assist in managing antenatal clinics. For this study, clinical compliance is defined as the ability of the HCPs to comply with the recommended MoH GDM screening guidelines to detect women with GDM in early pregnancy and monitor them accordingly. The anecdotal evidence reported in this section, together with the apparent gap in the literature regarding barriers and facilitators of implementing the GDM guidelines in Oman, indicated a pressing need for further research. Therefore, this study seeks to explore the implementation of the 2010 GDM guidelines within PHC institutions.

1.4. Research Questions

- a. What is the level of clinical compliance with GDM guidelines in Oman?
- b. What barriers do healthcare professionals face that may limit the implementation of GDM screening guidelines?
- c. What facilitators do healthcare professionals have that may improve the implementation of GDM screening guidelines?

1.5. Aim of this study.

The study aimed to determine compliance with GDM guidelines in PHC institutions in Oman and explore any barriers and facilitators to their implementation.

1.6. Main Objectives of the study were:

- To explore practice in screening for and diagnosis of GDM
- To compare practice in Oman with evidence-based recommendations.
- To explore the challenges involved in implementing GDM guidelines in Oman.
- To develop recommendations for healthcare professionals in primary healthcare, in relation to screening for GDM.
- To explore the facilitators that may contribute towards improvement of the implementation of GDM guidelines.

1.7. Research design

Mixed-methods research is an approach to inquiry, which involves data collection and analysis for both quantitative and qualitative data. In this study, a pragmatism paradigm was identified as the best paradigm to investigate the research questions. The data are merged using distinct designs that may involve philosophical assumptions and theoretical frameworks. Pragmatism advocates the use of mixed-methods in research and focuses on 'what works' as the key to solving the research problem (Tashakkori and Teddlie 2016). According to Creswell (2015), when it comes to answering different parts of a complex research question, the mixed-methods approach offers researchers the ability to use the strengths of both qualitative and quantitative research designs. Many scholars (Halcomb and Hickman 2015; Kettles et al. 2011) recognise that mixed-method research is currently widely advocated within the field of health research. It allows healthcare professionals to explore complex

phenomenon within the healthcare system. According to Miller et al. (2013), mixed-method research helps researchers capture the complete experiences, emotions and motivations of health care providers and receivers. Further details on the choice of a mixed research design and pragmatic philosophy are discussed in Chapter 4.

For the purpose of this thesis, the convergent design, as outlined by (Creswell 2014), is a more familiar approach to researchers (Gray et al. 2017). Data were collected by taking a retrospective review of gestational diabetes mellitus screening in Oman, utilising routinely collected data (case records) as well as face-to-face interviews with healthcare professionals working in two antenatal clinics in Muscat (see Chapter 4, section 4.4). The quantitative descriptive data of the research were analysed using the Statistical Package for Social Sciences (SPSS) version 23. Quantitative statistical analysis used in this study is further described in Chapter 5. The analyses of qualitative data findings using thematic analysis are provided in Chapter 6 and 7.

1.8. Significance of the study

The outcome of the study will provide potential benefits to pregnant women, nurses, midwives, and GPs. The potential benefits are outlined as follows:

1.8.1. Pregnant women

Pregnant women should be aware of gestational diabetes. Women with GDM require education around the importance of laboratory glucose tests, ultrasonography, and follow-up visits to the antenatal clinic. All pregnant women should understand the procedure of screening for GDM and the potential complications of GDM for both mother and foetus. They should be aware of the consequences of not doing the glucose test include the possibility of delay in the diagnosis of GDM, fetal macrosomia, and the expectation of birth trauma such as in the case of shoulder dystocia. The

findings of the current study may enable pregnant women to understand the importance of GDM screening during pregnancy. This can be achieved by encouraging healthcare professionals to provide them with up-to-date general information about GDM and screening.

1.8.2. Nurses and Midwives

Nurses and midwives are the first line carers for pregnant women in antenatal clinics (ANCs). No evaluation has previously been undertaken to determine the extent to which healthcare providers implement the Oman GDM guidelines. Healthcare professionals in primary healthcare institutions in Oman may be able to use the findings of this research to improve screening for GDM and its diagnosis in ANCs. Healthcare professionals might adopt the current research as a base for future research in this field and explore the importance of the implementation of GDM guidelines when it comes to improving the screening for GDM. The recommendations of this study may contribute positively to a change in the attitudes and behaviours of healthcare professionals towards the implementation of effective GDM guidelines.

1.8.3. Maternal healthcare services

The findings of this research may encourage decision makers in the MoH to provide a series of workshops or training courses aiming to enable healthcare professionals to implement GDM screening more effectively. The “women and child health theme” is among the ‘Health Research Priorities’ listed by the MoH of Oman (MoH 2014). Thus, the findings of this research may create awareness of the importance of GDM screening among healthcare professionals and reduce the cost-effectiveness of healthcare organisation.

1.8.4. Researcher

The researcher's background is as a midwifery educator in Oman, so the results of this study can directly furnish the body of knowledge held by midwifery services in Oman. In the future, the researcher will collaborate with nursing educational services in Oman, seeking to influence the content of training for nurses in order to improve their knowledge and skills in screening for women with GDM, in PHC settings. Also, to explore the importance of the nurses' compliance with the GDM guidelines in the antenatal clinic.

1.9. Summary

Gestational diabetes mellitus is a public health issue that has generated ongoing discussions in MoH Oman. These discussions seek to identify ways to detect the number of cases early on in pregnancy by ensuring that clinical GDM guidelines are implemented by healthcare professionals in PHC. Universal screening for GDM began in 2010 and was revised in 2015. The MoH has included universal screening for GDM as a central component of strategic five-year plans for health development in Oman, aiming to reduce the chances of adverse pregnancy outcomes arising from GDM, including macrosomia, shoulder dystocia and Erb's palsy. Despite the efforts of the MoH in distributing updated GDM guidelines, the way HCPs implement these guidelines needed to be explored. In this chapter, the rationale for the study and the researcher's interest in the study topic is presented. Chapter 2, part 2, provides detailed background on GDM and describes the healthcare system in Oman.

Chapter 2. Background

2.1. Introduction

This chapter presents the epidemiology of obesity in Oman and its consequences for maternal and birth outcomes. It provides information on the epidemiology of obesity and GDM; prevalence, screening, and diagnostic criteria of GDM globally and in Oman and highlights the advantages and disadvantages of GDM screening.

2.2. Epidemiology and prevalence of obesity

In recent decades, lifestyles have changed in developed and developing countries (Sassi et al. 2009). Obesity is now considered to be one of the most significant public health challenges in the world (Hammond 2009) and is a major contributor to the increased prevalence of several non-communicable diseases, including diabetes mellitus type 2 (DM2) (Awad et al. 2015). In Oman, rapid cultural and social changes since 1970 have resulted in an increase of a wide range of non-communicable diseases (Al-Riyami and Afifi 2003; Al-Moosa et al. 2006). These negative changes have included increased both unhealthy food consumption and poor physical activity. This has led to increased weight gain, obesity (Al-Lawati and Jousilahti 2004; Samaranayake et al. 2012) and other associated medical health conditions such as heart diseases, hypertension, and cancer.

Over the past four decades in Oman, there have been significant developments in socio-economic status. Consequently, this has resulted in changes in the standard of living caused by a sedentary lifestyle and cultural changes, including increased car ownership, reduced physical activities, and changes in dietary intakes, such as the increased consumption of sugar and salt. These changes are also found in other gulf countries that border Oman, including the United Arab Emirates (UAE), Kingdom of Saudi Arabia (KSA), Bahrain, Qatar, and Kuwait. Due to socio-cultural factors and

lifestyles across these countries, women are unable to participate in public physical activities because of cultural or religious barriers (Kanter and Caballero 2012). The lifestyle changes in Oman have, in turn, led to an increase in the prevalence of non-communicable diseases such as coronary heart diseases, hypertension, and diabetes due to obesity (Ganguly et al 2009; Al Meqbali et al 2013; Al-Lawati et al. 2015).

Obesity is defined as:

*“Abnormal or excessive fat accumulation that presents risk to health”
(WHO 2015, p 1).*

Body mass index (BMI) has been used as a proxy for obesity which was proposed first in the mid-1990s (Lee et al. 1995; Ashwell et al. 2012). BMI is calculated by measuring an individual's weight in kilogrammes and dividing this by the square of their height in metres. In 2016, it was estimated by WHO that more than over 650 million worldwide were obese, and more than 1.9 billion were overweight (WHO 2016). Maitland et al. (2014), considered obesity to be the sixth most important determinant of adverse health and reduced adult life expectancy globally. Oman Health Vision 2050 (2014) states that 24.1% of Omani adults are obese, while 29.5% of Omani adults are overweight (MoH 2014a). This is ostensible because of poor dietary habits and lack of knowledge around maintaining a balanced diet (MoH 2014). Out of 5,006 new cases of DM2 in 2011, 51.5% were female (MoH 2012). A survey was conducted in Oman, by Al Riyami et al. (2012) assessing the national prevalence of obesity in adults aged 18 and above. The survey was conducted as a part of the World Health Survey (WHS) in the first half of 2008. The rationale for these surveys was to obtain good quality data and evidence that would form the basis of health reform in the country, against the background of increased chronic diseases due to changes in lifestyles and behaviour change. The studies found that the prevalence of obesity is high in Oman and has increased predominantly among women. The mean BMI among women (overweight 25- < 30 kg/m²) was 28.0, and the mean BMI among (obese ≥ 30 kg/m²) was 26.1.

Moreover, approximately 54% of Omani women were critically obese compared to 20 % of Omani men. Obesity in Gulf countries may well continue to rise in nations that already suffer from a relatively high prevalence of diabetes and hypertension.

Although the report by (Al-Lawati and Jousilahti 2004; Al Riyami et al. 2012) included women, there were no specifications about obesity in pregnant women in Oman. However, in KSA, the prevalence of obesity in pregnant women is high; in 2009, it was found to be 23.9%, and the prevalence of extreme obesity in this group was 4.7% (El-Gilany and El-Wehady 2009). One reason for the high prevalence of obesity in women living in Gulf countries is that people often travel mainly by car in, because of the high outdoor temperatures. Also, most Arabic women prefer to remain indoors, the majority of Arabic women prefer to remain indoors, this might be due that having a good income eventually improved the standard of living and allowed a luxurious lifestyle, this is including employing housekeepers who take care of household chores. All these factors combined lead to a sedentary lifestyle, which in turn leads to obesity.

A cross-sectional study was conducted by Al-Habsi and Kilani (2015) in Oman between May and June 2013 over five out of eleven governorates. The study included 277 Omani women who were classified according to age as young adults or adults (18–29 or 30–48 years old, respectively. The participants completed two questionnaires, assessing their level of physical activity and sedentary behaviour. Of the 277 participants, only 229 provided complete responses to the questionnaire. The result showed that about 34% of women reported participation in high activity levels, and a similar percentage reported participation in low levels of physical activity. Women reported that 80 minutes per week had vigorous physical activity . Married women reported more moderate physical activity or walking than single women ($p \leq 0.03$). There were significant differences in sitting time spent watching television ($z = -3.6$; $P < 0.001$) during a working day between age groups, with adults reporting more

time spent sitting watching television than young adults. In contrast, young adults reported spending significantly more time using the computer ($p \leq 0.01$).

Traditionally, after a woman gives birth (almost always in a hospital), the woman and her new-born baby stay with her parents, along with any other children, she may already have. For the next 40 days, the postpartum woman is not involved in any physical activities. She is expected to relax in a bedroom or sitting room. Her meals are brought to her, and the care of her other children is undertaken by her parents. This type of postpartum inactivity is very strongly culturally ingrained. If friends and neighbours see a woman who has recently given birth walking around, they will scold her and remind her that she should not walk around or even sit up too much during the first 40 days. This means that weight gained during pregnancy is unlikely to be lost during the early postnatal period, and during the first 40 days, women are likely to gain more weight. After the end of the 40 days, the woman returns to her usual lifestyle, but as this is likely to be relatively sedentary, weight is unlikely to be lost. Therefore, multiple pregnancies, each with 40 days of inactivity, tend to result in cumulative weight gain. This tends to be 4.5 kg or more per pregnancy (Al-Nohair 2014).

There is no current literature estimating the number of pregnant women who are obese in any Gulf countries. The prevalence of obesity in Arab countries increased because of a change in lifestyles due to increased socio-economic status. The WHO and International Diabetes Federation Statistics (IDFS) (2010) have released a report on the prevalence of obesity and diabetes in Arab countries. Obesity levels amongst women in some of these countries are as follows; Kuwait 55%, Egypt 48%, UAE 42%, Bahrain, and Jourdan 38%, KSA 36% and Qatar 32% (Al zaman and Ali 2016).

2.3. Diabetes Mellitus

Diabetes mellitus is a chronic, non-communicable disease, which has a significant impact on almost all aspects of everyday life (Fraser and Cooper 2009). The

International Diabetes Federation (2006) predicts that in 2025, the prevalence of diabetes will be 308 million people worldwide. Diabetes mellitus is defined as:

'A metabolic disorder of multiple aetiology characterised by chronic hyperglycaemia with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action or both'
(WHO 1999, p.2)

Diabetes mellitus (DM) is classified into the following types: type 1 (DM1), type 2 (DM2); impaired glucose tolerance (IGT); impaired fasting glycaemia (IFG); and GDM (WHO 1999). DM1 occurs due to deficiency of insulin production because of permanent damage to the pancreas and requires lifelong treatment with insulin therapy (WHO 2016). DM2 results from insulin resistance because the pancreas no longer produces enough insulin to overcome the cells' resistance and it is often initially managed with diet and exercise; as the disease progresses, effective management usually includes pharmacological treatment such as insulin (WHO 2016). Risk factors for DM2 include a previous history of GDM and people with hypertension and/or obesity (WHO 1999).

2.4. Epidemiology of GDM

Gestational diabetes (GDM) is defined as:

"Carbohydrate intolerance resulting in hyperglycaemia of variable severity with onset or first recognition during pregnancy".

(WHO 1999, p.19)

This definition highlights that GDM develops in women without pre-existing DM type 1 or 2. It is diagnosed through prenatal screening rather than reported symptoms (WHO 2016). In 1824 Bennewitz submitted the case of a 22 year old woman from Berlin for his doctoral presentation, who was diagnosed with diabetes in pregnancy during her fifth pregnancy. The woman complained of unquenchable thirst, polyuria, and glycosuria. She stated that she drank six measures of beer or spring water in one day. The urine she passed was rain-coloured and cloudy, which tested for the presence of

glucose. During delivery, the woman could not push the baby out because the shoulders were stuck in the uterus. The obstetrician could not rotate the baby and save his life resulting in the stillbirth of a 12 Pound baby boy (Hadden 1998). In 1882, Mathews Duncan delivered a review at the Obstetrical Society of London about complications arising during 22 pregnancies amongst 15 women with diabetes. The foetus died in at least 13 out of 19 registered pregnancies amongst these 15 diabetic mothers, and in nine of the cases, the mother herself died of diabetes within a year. (Hadden 1998). Farrar et al. (2015) stated that the incidence of GDM is increasing worldwide; factors associated with this rise include increasing rates of obesity and reduced levels of exercise.

In the United States of America, more than 200,000 pregnant women (approximately 7%) have their pregnancies complicated by GDM annually (American Diabetes Association 2004). However, the prevalence ranges from 1% to 14%, depending on the population studied within the USA and the diagnostic tests employed (Bottalico 2007; Landon et al. 2009). In Oman, the reported prevalence of GDM (20.2%) was similar to that reported from the UAE (20.6%) and Qatar (19.0%), but higher than that reported from Bahrain (13.5%) and Saudi Arabia (12.5%) (Al-Lawati et al. 2015). MoH Oman in 2012 indicated that 5% of all pregnant women are diagnosed with GDM (Al-Lawati et al. 2015).

2.5. Risk factors for GDM

Risk factors for GDM include previous GDM, BMI \geq 30 Kg/m², previous macrosomia, and a family history of diabetes (WHO 2013; NICE 2015).

2.5.1. Previous gestational diabetes

Kwak et al. (2008) conducted a retrospective study of women in Korea who were diagnosed with GDM between 1993 and 2001 and who had a subsequent pregnancy by 2003. They found that almost half of the women (45%) had recurrent GDM during a subsequent pregnancy.

Another retrospective cohort study, conducted in the USA by Getahun et al. (2010), aimed to examine the likelihood of a recurrence of GDM. They found that women who developed GDM during their first pregnancy were at a higher risk of GDM in their second pregnancy (OR, 13.2; 95% CI, 12.0–14.6) compared to women who did not have GDM during their first pregnancy. Women with pregnancies complicated by GDM during their first but not second pregnancies were at 6.3-fold (95% CI, 4.5–9.0) increased risk of developing GDM during their third pregnancy.

2.5.2. BMI ≥ 30 kg/m²

Raised BMI is one of the maternal risk factors for gestational diabetes mellitus. BMI is the measure most commonly used to estimate whether adults are overweight or obese (WHO 2015). This measure is currently used in ante-natal clinics (Herring and Oken 2011; Linne 2004). BMI is categorised into five groups (Bhattacharya et al. 2007):

Classification	BMI (kg/m ²)
Underweight	≤ 19.9 Kg/m ²
Normal	20 to 24.9 Kg/m ²
Overweight	25 to 29.9 Kg/m ²
Obese	30 to 34.9 Kg/m ²
Morbidly obese	≥ 35 Kg/m ²

Obesity in pregnancy carries significant maternal and foetal risks (Krishnamoorthy et al. 2006). According to MBRRACE-UK (2017), in the UK, there was no change in the maternal death rate between 2010-12 and 2013-15, which remained at 8.76 per 100,000 maternities (95% CI 7.59 – 10.05) (Knight et al. 2017). Maternal risk factors include pre-eclampsia (RR 1.99, 95% CI 0.96–4.92) and thromboembolism in pregnancy (RR 1.94, 95% CI 1.43–2.63). In the UK, from 2012 to 2014, obesity was associated with a higher maternal death rate (MBRRACE-UK 2016) with direct contributions to medical comorbidities (Nair et al. 2015; Knight et al. 2016). A report on MBRRACE-UK by Knight et al. (2017) identified that 33% of women who died in 2012–2014 were obese, and 18% were overweight.

A review conducted by Evans (2009) reported that pregnant women with BMI ≥ 30 Kg/m² are three times more likely to develop GDM than healthy pregnant women with a BMI between 18.9 and 24.9. Obesity can also have a major impact on pregnancy outcomes, including foetal growth retardation, Odds Ratio (OR) of 1.9 (95% CI 1.6, 2.2, $p < 0.05$) and macrosomia (birth weight ≥ 4 kgs) 2.1 (95% CI 1.3, 3.2, $p < 0.05$) respectively. Compared to women with a normal BMI, obese women are at increased risk of stillbirth OR of 1.8 (95% CI 1.1–2.9, $p < 0.05$) and 1.1(95% CI 0.3–4.1) and neonatal death (Bhattacharya et al. 2007; Krishnamoorthy et al. 2006).

A population-based cohort study examined the effect of increased BMI on pregnancy outcomes for nulliparous women delivering singleton babies. This data was added to the Aberdeen Maternity and Neonatal Databank (AMND) (Bhattacharya et al. 2007). All primigravidae women (24,241) delivering singleton babies after 24 weeks of gestation in Aberdeen city and district between 1976 and 2005 were included in the study. Of 24,241 women 2,842 (11.7%) were underweight, 14,076 (58.1%) had normal BMI, 5,308 (21.9%) were overweight, 1,858 (7.7%) were obese and 157 (0.6%) were morbidly obese. Macrosomia (birth weight > 400 g) was common in the obese 13.7% ($n = 255$) and morbidly obese ($n = 157$) groups with OR of 1.9 (95% CI 1.6, 2.2) and

2.1 (95% CI 1.3, 3.2) respectively, compared with the normal BMI group 7.6% (n = 1072). In addition, stillbirth rates were significantly higher in the obese and morbidly obese groups 1.9% (n = 35) and 2.5% (n = 4) respectively, compared to 0.9% (n = 131) in the 14,076 normal BMI group. Bhattacharya et al. (2007) concluded from the study that maternal rates of BMI are closely associated with pregnancy complications and outcomes.

2.5.3. Previous macrosomic baby weighing 4 kgs or above.

The risk of macrosomia increases with poor glycaemic control and maternal obesity (Ali and Dornhorst 2011). A reduction of hyperglycaemia in women minimises the likelihood of foetal macrosomia. A case-control study was conducted in Iran by Mohammadbeigi et al. (2013), amongst the 420 consecutive births occurring in public and private hospitals, from October 2006 to March 2007. The study found that gestational diabetes OR 11.9 (95% CI, 4.6-30.3), macrosomic birth history OR 3.8 (95% CI, 1.1-13.2), and preeclampsia OR 3.3 (95% CI, 1.04-1.04) could increase the likelihood of macrosomic new-borns.

Earlier studies in Oman found that the risk of macrosomia increased amongst women aged 35 years and above and were obese and with high parity (Barakat et al. 2010). The rate of macrosomia differed across the studies because of differences in the characteristics of the population studied. In Barakat et al's. retrospective review, the rate of macrosomia among Omani women was (6.7%) higher than among the multi-ethnic population in the United Arab Emirates.

2.5.4. Family history of diabetes (first-degree relative with diabetes)

Pregnant women with a family history of DM occurring in either their mother, father, sister, or brother are at greater risk of developing GDM. According to Chan et al.

(2002), the incidence of glucose intolerance in women with such a family history is 23.5%. Family history was recognized as a significant risk factor by Davey and Hamblin (2001), who conducted a case study to examine whether selective screening for GDM is a practicable alternative to universal screening. They used a case-control study to compare the likelihood of four risk factors criteria: older age, obesity, family history of DM and racial susceptibility (with differences in culture and lifestyles) amongst women both with and without GDM. They found that selective screening for GDM using the above four criteria, which are common to the American Diabetes Association (ADA) and Australian Diabetes in Pregnancy Society (ADIPS) list of risk factors, would have missed two of 313 cases (0.6%) and could have saved screening up to 1025 women without GDM (17% of all women. Out of 313 women who were identified by the screening process as having GDM, 39.9% were found to have a family history of GDM OR 7.1 (95% CI, 5.6-8.9).

A recent study conducted by Moosa-Zadeh et al. (2016) conducted a meta-analysis of papers published between 2002-2015 to determine the relationship between GDM and a family history of diabetes among pregnant Iranian women. There were 33 articles included in the meta-analysis: five case-control studies, eight cohort studies and twenty cross-sectional studies. The authors concluded that a family history of diabetes is a strong predictor for GDM OR 3.46 (95% CI, 2.80-4.27).

2.6. GDM screening

Screening is an essential element in preventing illness. Healthcare professionals use screening tests as valuable tools to detect communicable and non-communicable diseases and to instigate preventative measures (Morabia and Zhang 2004; Edelman and Kudzma 2018). Historically, the initial motivation for GDM screening using blood tests and glucose loading was to provide a more sensitive screening process than risk

factor screening alone (O'Sullivan 1973). O'Sullivan and Mohan (1964) from Boston presented their landmark study on using the Oral Glucose Tolerance Test (OGTT) during pregnancy to predict future risk of DM2, at the 23rd annual meeting of ADA. They firstly proposed screening criteria for GDM by using a two-step approach and used whole blood glucose in diagnosis. The screening criteria were aimed at detecting women at risk of developing diabetes subsequent to pregnancy and were not designed for women at increased risk for adverse perinatal outcomes (Mishra et al. 2016). They started with two steps a 1 hour 50 g Oral Glucose Challenging Test (OGCT) and 3 hours 100 g OGTT. The 50 g 1-hour OGCT had 87% specificity and 79% sensitivity in a population with a 2.5% prevalence of GDM (Pintaudi et al. 2016; Naylor et al. 1997). In 1979, the national diabetes data group recommended measurement of plasma glucose rather than whole blood because glucose levels in whole blood were 15% lower than in plasma. In 1982, Carpenter and Coustan recommended measuring plasma glucose using the glucose oxidase method and were able to diagnose 30-50% more women with GDM. Between 1990 and 2005, there was a proliferation of competing international criteria, many based on a one-step method using a 75-g OGTT, with published guidelines from the European Association for the Study of Diabetes (EASD) (1996) ADIPS (1998), WHO (1999), NICE (2008), IADPSG (2012) and many others (Brown and Wyckoff 2017).

Over 50 years, there have been many studies worldwide that have sought to provide appropriate diagnostic criteria for GDM. However, there is still no consensus on which one should be followed internationally (Agarwal et al. 2015; Brown and Wyckoff 2017). For example, in Oman, the two-step screening method using 50 g 1-hour OGCT followed by 75 g 2 hours OGTT was adopted until February 2015. In March 2015, new GDM guidelines were introduced in which the screening method used 75 g 2 hours only and stopped 50 g 1 hour.

2.7. Worldwide GDM screening guidelines

Morabia and Zhang (2004) provided a history of screening in the USA and Canada, including screening for DM. The mass screening was used to detect DM because of an increase in diabetes-related deaths in 1946-1947. Blood and urine were used for screening for DM; however, it was found that the urine test was unreliable because of its poor sensitivity, which is estimated to be 16.7% for fasting values and 72.7% for two-hour post-load values. Whereas the blood glucose test, whether fasting or random, has shown high sensitivity and specificity of 64.3% and 96.9%, respectively. Later the OGTT was developed. False positives in screening for GDM may result in serious consequences, including causing unnecessary stress and anxiety for women (Morabia and Zhang 2004). Screening tests ideally identify the disease in its early stage, so before beginning the screening process, it is important to have the following four conditions: the presence of a sample for the test; the availability of the equipment for screening; the availability of treatment; and the wide access to health care (Morabia and Zhang 2004). There is no universal agreement on how pregnant women should be screened for GDM (Minsart 2009).

NICE in 2008 recommended selective GDM screening, using risk factors to identify women who required further laboratory investigations. NICE guidelines were updated in 2015, including emerging evidence that resulted from the HAPO (Hyperglycaemia and Adverse Pregnancy Outcomes) study, which was published in 2008. The HAPO study provided consensus guidance on the definition of GDM, which was adopted by WHO (2013) and The IADPSG (2012), which was a positive contributory factor in the effectiveness of GDM screening improving neonatal outcomes (Brown and Wyckoff 2017).

A retrospective study was conducted in Edinburgh (UK) by Ryan et al. (2018) hypothesised that early identification and treatment of GDM would improve pregnancy outcomes, compared to previous standards of care. They enrolled (n = 576) women

who were diagnosed with early GDM using early screening (n = 241) and previous routine screening (n = 335). Most of these women were multiparous, had previously given birth to a macrosomic baby and had a first-degree relative with DM2. The study outcomes comprised of primary and secondary composite outcomes based on HAPO outcomes. The primary outcomes included macrosomia (weight > 4000g), emergency CS and neonatal hypoglycaemia. The secondary outcomes included preterm delivery (< 37 weeks gestation), low birth weight (< 2500 g), congenital malformation and polyhydramnios. The authors found that early screening of GDM increased the proportion of women diagnosed before 24 weeks of gestation (n= 59 /335, 17.6% vs n = 103/241, 42.7%, $p < 0.001$). There was a significant reduction in the primary composite outcome in women who were diagnosed using early screening 30.3% (n = 73/241) compared to women who used previous routine screening 41.2% (n = 138/335), adjusted OR 0.62 (95%CI 0.43-0.91, $p < 0.001$).

Falavigna et al. (2012) conducted a systematic review including seven trials involving 3,157 women to evaluate the effectiveness of GDM treatment compared to usual antenatal care in the prevention of adverse pregnancy outcomes which had been conducted in Australia, Canada, Hong Kong, UK, and USA. The review found there was an improvement in neonatal outcomes with the treatment of GDM, including a statistically significant decrease in the relative risks of macrosomia (RR= 0.47; 95% CI 0.34– 0.65), being large for gestational age (RR= 0.57; 95%; CI 0.47–0.71) and shoulder dystocia (RR= 0.41; 95% CI 0.22–0.76).

2.8. Omani Guidelines for screening and diagnosis of DGM

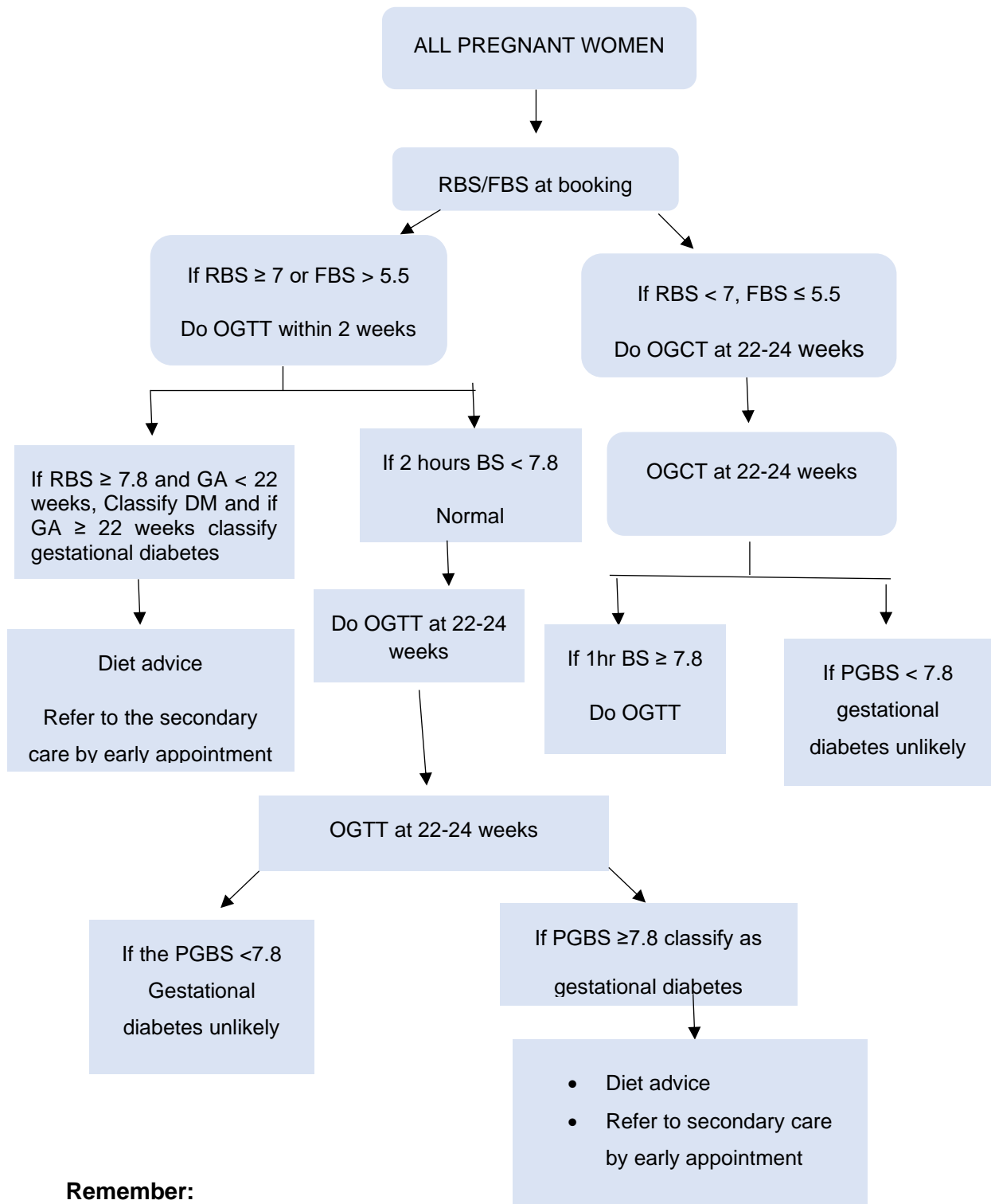
The 2010 GDM guidelines in Oman included universal screening for all pregnant women. The risk factors for GDM, such as close relatives having a history of DM2 and BMI $\geq 30\text{kgs/m}^2$, were included in the screening for GDM, as a local expected

standard. The other GDM risk factors, including previous GDM, previous macrosomic baby, previous stillbirth, and neonatal death, were not considered a priority for OGTT screening. However, as the numbers of women with GDM were increasing every year, new GDM guidelines were proposed by MoH (in 2015) in which the risk factors of GDM were considered. Details of both screening guidelines are presented in the following two sections.

2.8.1. GDM guidelines 2010

Screening for gestational diabetes in Oman has been part of routine antenatal care since 2010. In 2010, the Department of Family and Community Health at the MoH published “Pregnancy and Childbirth Management Guidelines: A Guide for Nurses, Midwives, and Doctors,” for all healthcare institutions in Oman, including guidelines on screening for gestational diabetes (as shown in Figure 2-1 below). The screening for GDM in 2010 included laboratory tests, including the OGCT and the OGTT.

The guidelines stated that every woman, with no history of DM or GDM, should have an estimation of either her random blood sugar (RBS) or fasting blood sugar (FBS) at the point of registration. If results were abnormal with an RBS ≥ 7 or an FBS of > 5.5 , an OGTT should be offered within two weeks of registration to an ante-natal clinic (ANC). If RBS was < 7 or FBS was ≤ 5.5 the woman had to have an OGCT at 22 to 24 weeks. Individual risk factors were not considered as a part of the 2010 screening criteria. In 2010 women were given an appointment for early registration during the first trimester of pregnancy. Women were given a verbal explanation about the procedures before the ANC appointment. The national standards of 2010 GDM screening guidelines are explored in more detail in chapter 5.



Remember:

- When performing OGTT, if FBS is ≥ 7 mmol/l, proceed with the 2 hours test without giving the glucose.

Figure 2-1 Screening guidelines for GDM in Oman in 2010 adapted from Department of planning 2010.

In 2014, when the retrospective review of case notes was undertaken, it was not compulsory in MoH institutions to screen all pregnant women using OGTT to diagnose GDM. Instead, an OGCT was the recommended test for women who had normal RBS results.

The data collection for Phase One in this study involved all those women who registered their pregnancies in a primary and secondary healthcare institution in Muscat Governate from January to December 2014 and were screened for GDM using the GDM guidelines of 2010. By Phase Two of the study, the 2015 guidelines had been published and therefore, compliance with the new guidelines informed the discussions.

2.8.2. GDM guidelines 2015

Updated GDM guidelines in Oman were formulated in March 2015 by a collaborative effort between the Department of Family and Community Health, Department of Non-communicable Diseases, the National Diabetic Centre, and the Department of Obstetrics & Gynaecology at Royal Hospital (a large, tertiary-level hospital in the MoH) and were entitled 'The National Policy in Screening and Management of Diabetes in Pregnancy'. A list of risk factors for developing GDM was included: first degree relative with diabetes (such as mother, father, sisters and brothers), women with a history of a baby weighing ≥ 4 kgs, being previously diagnosed with GDM, history of previous unexplained stillbirth or neonatal death as well as women who had suffered from polycystic ovary syndrome, HbA1C $\geq 5.7\%$, IGT, or IFG in the past or any other clinical conditions associated with insulin resistance (e.g., obesity ≥ 30 kgs/m²). Furthermore, exercises, glucose monitoring and insulin therapy were provided for GDM women when there were no medical or obstetrical contraindications to physical activity. The GDM pathway in the guidelines was based on the FBS and RBS readings taken at registration.

Concerning the management of GDM, the guidelines included the allotment of calories based on ideal body weight and the current weight of the pregnant woman, using a BMI calculation (see Table 2-1).

Table 2-1: The suggested caloric intake is approximately adapted from Diabetes Mellitus Management Guidelines, 2015

Approximate suggested caloric intake	Calculate the pregnant woman's weight per day	BMI calculation
40 kcal per kg	(Current weight) per day of pregnant women	BMI <22
30 kcal per kg	(Current weight) per day of pregnant women	BMI 22 to 25.
24 kcal per kg	(Current weight) per day of overweight pregnant women	BMI 26 to 29.
12 to 15 kcal per kg	(Current weight) per day of obese pregnant women	BMI >30

2.8.3. Screening methods for GDM (2015)

The following is a description of the process used for screening for GDM in 2015, including the use of the blood glucose tests FBS, or RBS and OGTT (data were based on Oman GDM screening guidelines 2015).

- If **FBS < 5.1 mmol/l** or **RBS < 7.0 mmol/l** and the woman was at **low risk** of GDM, offer an OGTT at 22-24 weeks of gestation.
- If **FBS < 5.1 mmol/l** or **RBS < 7.0 mmol/l** and the woman was **at risk or high risk** for GDM, offer an OGTT within two weeks of the registration.
- If **FBS ≥ 5.1 mmol/l** woman is considered **at risk** of developing GDM at registration, she should be referred to the dietician and family physician. Offer an OGTT at registration if the results are abnormally high for glucose and physician should start oral antidiabetic medication (Metformin).
- If **RBS ≥ 7.0 mmol/l**, offer an OGTT immediately.
- If **FBS ≥ 7.0 mmol/l** or **RBS ≥ 11.1 mmol/l**, the woman is positive GDM and her pregnancy is at more than 12 weeks of gestation, the GP should take the following actions:
 - If the blood glucose level was not controlled, the woman should be offered insulin therapy to monitor diabetes in pregnancy.
 - Referral to an obstetrician and diabetologists

2.8.4. Oral glucose tolerance test

In the event of an OGTT result of $FBS \leq 5.1$ mmol/l or 2 hours plasma glucose (PG) ≥ 8.5 mmol/l, women were diagnosed with GDM. Women were referred to the obstetrician and dietician for treatment. If $FBS < 5.1$ mmol/l or 2 hours PG < 8.5

mmol/l, women should be asked to repeat OGTT at 22-24 weeks of gestation. All blood tests should be collected directly from the veins to assess the plasma glucose level in the blood. If the blood test was made via pricking the finger, the target capillary blood glucose values:

- Pre-prandial: ≤ 5.3 mmol/l
- 2 hours post-Prandial: ≥ 6.7 mmol/l

2.9. Diagnosis criteria of GDM

Oman GDM guidelines (2015) stated that the diagnostic criteria for positive OGTT for diagnosis of GDM are as follows:

- FBS ≥ 5.1 mmol/l
- 2 hours post-prandial ≥ 8.5 mmol/l

Women who presented with these results should be referred to a dietician and specialist in the obstetric unit to monitor their blood glucose and put a plan of oral antidiabetic medication, or insulin therapy should be put in place.

A flow chart (Figure 2-2) has been adapted from Oman GDM guidelines 2015 to provide details of the screening for diabetes in pregnancy. All registered women should be offered FBS or RBS at registration and subsequently screened as follows:

Diagnostic criteria for positive OGTT for diagnosis of GDM:

- FBS ≥ 5.1 mmol/l
- Two hours ≥ 8.5 mmol/l

Risk factors for GDM:

- BMI ≥ 30
- First degree relatives
- Previous history of macrosomia (birth wt. > 4.0 kgs).
- History of previous unexplained stillbirth or neonatal death.
- Past history of PCOS or if on steroid therapy.

Screening for diabetes in pregnancy

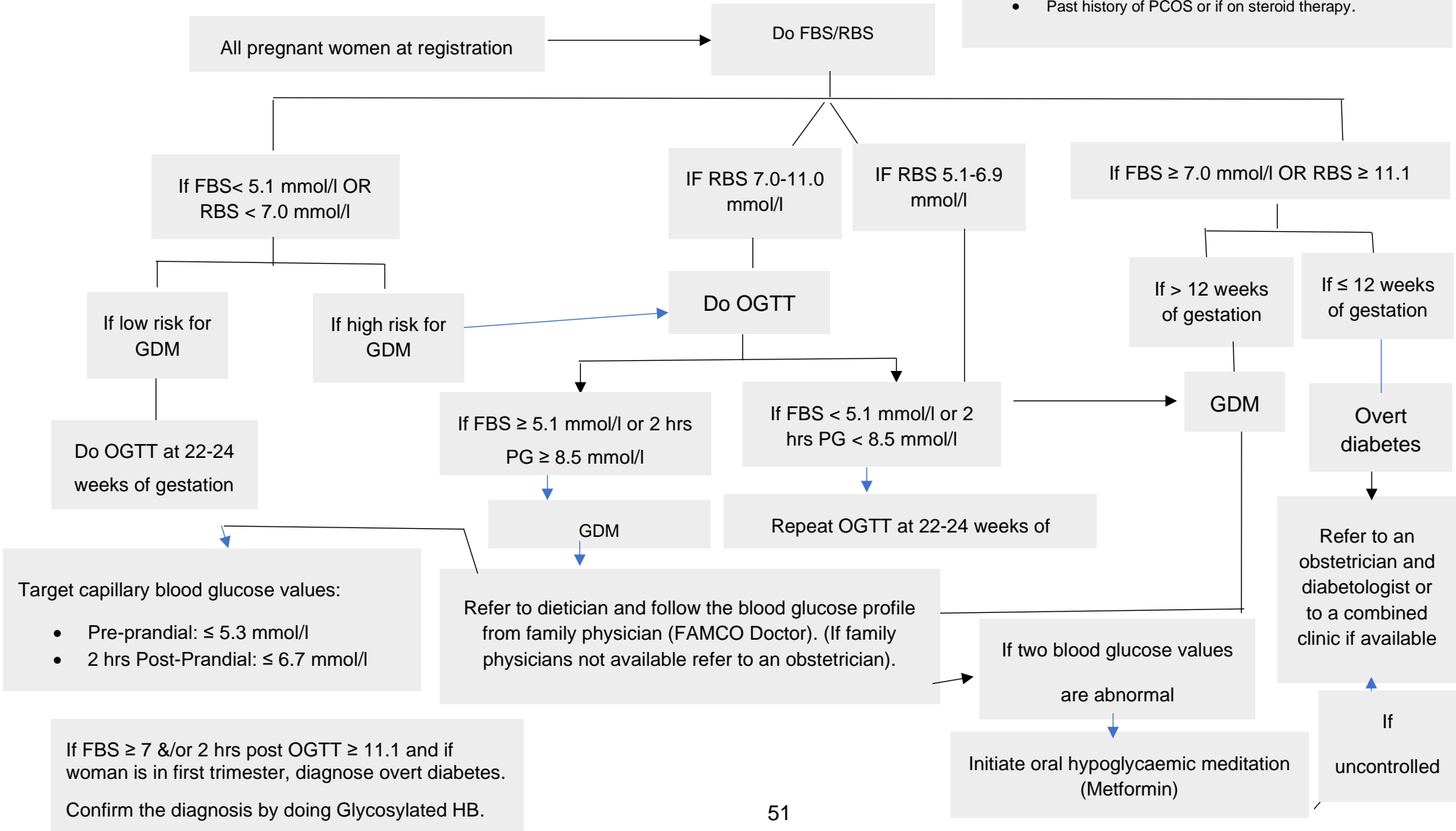


Figure 2-2 Flow chart of GDM guidelines 2015 adapted from MoH, diabetes mellitus: management guidelines, 2015, p.49

Dieticians and family physicians were included to follow the blood glucose profile and advise the pregnant women on the best way(s) to control their blood glucose. If the blood glucose value was abnormal, the family physician would start hypoglycaemic medication or insulin therapy. If it remained uncontrolled, women would be referred to obstetricians for further management. There were no written guidelines that details using this figure and no structured courses advised for the healthcare professionals in PHC.

2.10. Diagnosis of GDM in worldwide guidelines

In 2013, WHO published recommendations on the diagnostic criteria and classification of hyperglycaemia detected during pregnancy (WHO 2013). WHO (2013) recommended improving access to essential technologies for both diagnosis and monitoring of GDM? It is possible to use the measurement of plasma glucose values for screening and diagnosis of any hyperglycaemic state. Implementing a GDM screening programme should be determined by the health services in individual countries, taking into consideration the prevalence of glucose intolerance in the population. In 2015, in the UK, NICE published updated screening, diagnosis and management guidelines for diabetes in pregnancy that covered management of diabetes and its complications, from preconception to the postnatal period.

Diagnostic criteria and follow up as recommended by NICE guidelines (2015) are as follows:

- Use the 2-hour 75 g OGTT to test for gestational diabetes in women with risk factors (a positive result being a fasting plasma glucose level of 5.6 mmol/litre or above or a 2-hour plasma glucose level 7.8 mmol/litre or above).
- Offer women with a diagnosis of gestational diabetes a review with joint diabetes and antenatal clinic within one week.

- Inform the primary healthcare team when a woman is diagnosed with gestational diabetes.

The following table 2.1 presents the recommended screening and diagnosis criteria for gestational diabetes according to Oman's GDM guidelines (2010; 2015), NICE guidelines (2015), and WHO guidelines.

Table 2-2: The recommended screening and diagnosis criteria for gestational diabetes according to Oman's GDM guidelines (2010, 2015), NICE guidelines

Diagnostic criteria	Oman guidelines (2010)	Oman Guidelines (2015)	NICE guidelines (2015)	WHO guidelines (2013)
Diagnostic criteria for positive OGTT and diagnosis of GDM	Fasting plasma glucose \geq 5.5 mmol/l, 2-hour post 75 g oral glucose load \geq 7.8 mmol/l	OGTT: FBS \geq 5.1mmol/l 2-hour PG \geq 8.5mmol/l	OGTT: FBS \geq 5.6 mmol/l or 2-hour PG \geq 7.8 mmol/l	OGTT: FBS \geq 5.1-6.9 mmol/l 2-hour PG \geq 8.5 mmol/l
Risk factors included in guideline	No risk factors included in screening.	BMI $>$ 30 kg/m ²	BMI $>$ 30 kg/m ²	BMI $>$ 30 kg/m ²
		Past history of GDM	Past history of GDM or glucose intolerance	Past history of GDM or glucose intolerance
		First degree relative with diabetes	A family history of type II diabetes in first degree relatives with diabetes	A family history of type II diabetes in first degree relatives with diabetes
		Previous history of macrosomia (birth weight $>$ 4.0 kg)	Previous macrosomia baby weighing \geq 4.5 kg	Previous macrosomia baby weighing \geq 4.0 kg
		History of previous unexplained still birth or neonatal death	Previous adverse pregnancy outcome	Previous adverse pregnancy outcome

(2015) and WHO guidelines (2013)

2.11. Effects of GDM on maternal and birth outcome complications

GDM is considered a major cause for pregnancy-related maternal and perinatal morbidity and mortality (Teh et al. 2011; Gabbe and Graves 2003). Bener et al. (2011) conducted a prospective cohort study in Qatar where they compared the maternal–neonatal complications among women with GDM and women without GDM. The findings of their study identified an increased risk of macrosomia (10.3% Vs 5.9%; $p = 0.01$), preterm birth (12.6% vs 8.3%; $p = 0.03$) and birth trauma (8% vs 3%; $p < 0.001$) among the GDM mothers. Compared with the non-GDM women, GDM women had significantly higher levels of maternal complications including pregnancy-induced hypertension (19.1% vs 10.3%; $p < 0.001$), pre-eclampsia (7.3% vs 3.8%; $p = 0.012$), antepartum haemorrhage (19.2% vs 14.6%; $p = 0.05$) and caesarean section (27.9% vs 12.4%; $p < 0.001$). Universal screening has the advantage of being available to all women and improving sensitivity for detecting GDM. However, in contrast, selective screening identifies the women at high risk of GDM but could miss some of the women who are not highly predisposed to have GDM, meaning they are less likely to have maternal and child complications (Mialhe et al. 2015).

2.12. Conclusion

This chapter has described the prevalence of obesity and GDM amongst pregnant women in the Gulf countries, including Oman. It described the historical context of screening for GDM and the development of screening processes by different health organisations, such as WHO and NICE. Part two of this chapter will focus on the healthcare system in Oman and the current practice of screening and diagnosis of GDM.

2.13. Background Part 2: An Overview of Oman and its Healthcare System

2.13.1. Introduction

This section presents information about the Sultanate of Oman and its healthcare system, from before 1970 up to the present day. Maternal and child morbidity and mortality rates are provided. Information about the provision of maternal healthcare is presented in this chapter. In addition, details about improvements in care for maternal and child health are discussed, including the current recommendations for GDM screening and diagnostic tests.

2.13.2. Overview of the Sultanate of Oman

Oman is an Arab country known officially as the Sultanate of Oman, led by his Majesty the Sultan Qaboos Bin Said Al-Said since the 23rd of July 1970. It is situated on the south-eastern coast of the Arabian Peninsula. A map of Oman showing its major cities' location, including the capital, Muscat, is shown in Figure 2-3.



Figure 2-3 Map of the Sultanate of Oman, from https://www.welt-atlas.de/map_of_oman 4-421

2.13.3. Healthcare system in Oman

Before the Renaissance, which began in 1970, the healthcare system was poor because of a lack of well-equipped hospitals, qualified healthcare professionals, and limited budgets allocated to this sector. As hospitals were not widely available in many areas within Oman and with almost absent maternity healthcare services, women gave birth at home in most cases. These home births were typically attended by traditional unqualified midwives who took this role employing the learning by practice approach. At that time, only two hospitals were serving the entire Omani nation, and both were located in the Muscat governorate. These are the Knox Memorial Hospital, opened in 1935 by the American Arabian Mission and located in Matrah Wilayat and the Al Rahma Hospital, opened in 1948 and located in Muscat Wilaya (Alshishtawy 2010). Currently, there were only 13 expatriate physicians (British and American) working in these two hospitals, serving the entire nation with no Omani physicians' presence. In 1948, this equated to a ratio of 1: 50,000 populations. With the absence of transport

infrastructures and accessible means of transports, people had to travel for up to four days to reach a hospital and see one of these physicians. Morbidity and mortality rates were high; in 1970, more than 118/1000 infants died before reaching their first year (MoH 2002).

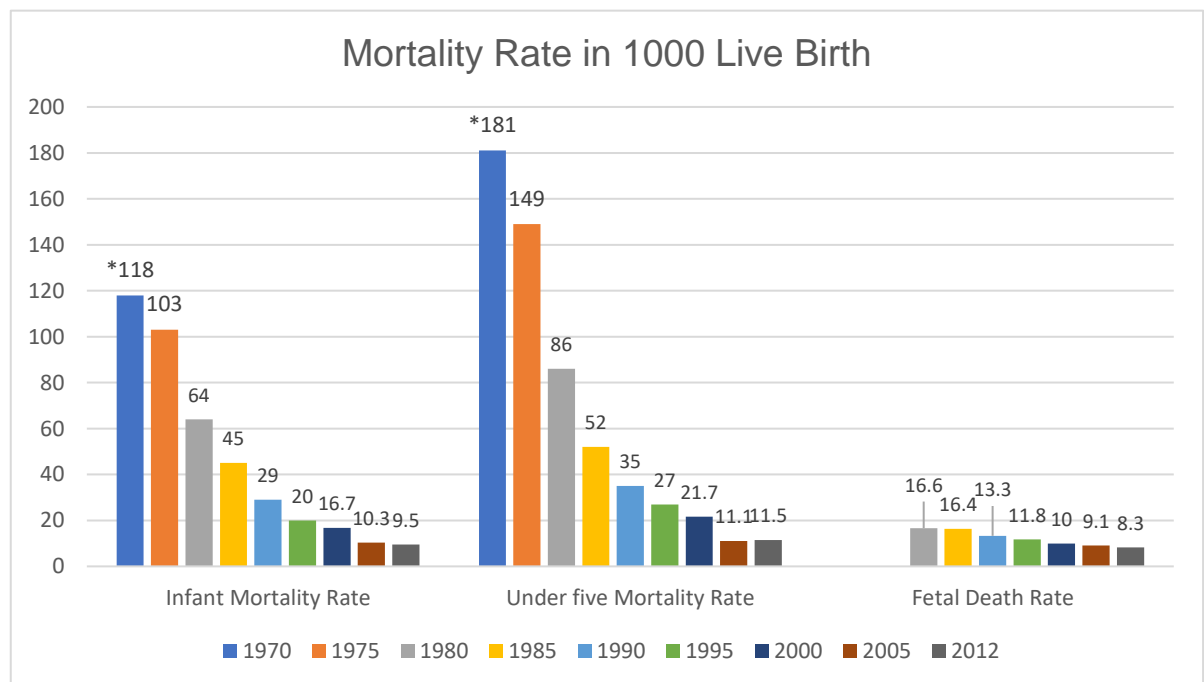
In 1970, the total population of Oman was 723,850, and the life expectancy was 49.3 years. In 2013, Oman's total population had risen to 3,855,206 and life expectancy went up to 72.6 years (MoH 2014). In contrast to these old days, the MoH currently runs 49 hospitals and 195 health centres (MoH 2017). In addition to four hospitals that are not run by the MoH, including the Armed Forces Hospital, Sultan Qaboos University Hospital, Diwan Hospital, and the Royal Oman Police Hospital. In addition, there are more than 1000 private healthcare institutions (MoH 2017). Expansion of primary healthcare began after the year 2000 (WHO 2008).

Over the past four decades, Oman's healthcare system has faced many challenges in treating non-communicable diseases such as diabetes and hypertension (Al-Shookri et al. 2011). Al-Shookri et al. (2011) conducted a review to increase the understanding of the need for type 2 diabetes management in Oman. In this review, they emphasised the importance of improving health promotion and preventing chronic diseases amongst Omani individuals to improve their health. Unfortunately, within primary healthcare institutions in Oman, most GPs, nurses, and midwives are not educated beyond their basic training, so they cannot deal with common complex diseases, such as DM and Hypertension (Al-Shookri et al. 2011). However, according to the diabetes management guidelines (2015; p 59) at MoH, the role of the primary health care physician is "to elucidate symptoms of diabetes mellitus, screen high-risk groups, diagnose the condition, order appropriate investigations at his disposal, initiate treatment, follow-up patients and refer them as needed". Management of complicated cases of diabetes is referred to secondary or tertiary healthcare institutions (MoH 2015). Abdulhadi et al. (2013) conducted semi-structured interviews for 26 healthcare

professionals in Oman. The findings revealed that one of the main barriers faced by healthcare professionals is the lack of diabetes nurse specialists and the shortage in the number of dieticians and health educators.

2.13.4. Mortality and Morbidity Rate

Mortality and morbidity rates have dropped sharply and show clear signs of the onset of a health transition in Oman, similar to developed countries (WHO 2010). Figure 2-4, shows the mortality rate per 1000 births, adapted from the Omani health vision 2050 (MoH 2014a). The infant mortality rate dropped to less than one-thirteenth of its pre-Renaissance level (from 118 to 9.5 / 1,000 live births) between the early 1970s and 2012, and the under-five mortality rate to one-sixteenth during the same period (MoH 2014a).



- *Data used for 1972 because 1970 data were missing.*

Figure 2-4 Mortality rate per 1000 births based on data from Oman health vision 2050 (MoH 2014a)

Over the past 47 years, the Sultanate of Oman has made remarkable progress in health development, as illustrated by the reduction in mortality, especially childhood mortality and control of communicable diseases (MoH 2014a).

2.13.5. Maternal Mortality rate indicators

Many causes of maternal mortality are avoidable (WHO 2016). Globally, leading causes of maternal death include infection, post-partum haemorrhage, pre-eclampsia, and eclampsia, ruptured uterus, and unsafe abortions. Together, these causes accounted for 75% of all maternal deaths between 1990 and 2015 (Say et al. 2014; WHO 2016). The United Nations (UN) Sustainable Millennium Development Goals (MDG) were revised in 2015 (UN 2015). There were 17 Sustainable Development Goals and 169 targets announced on 25 September 2015. “Goal 3. Ensure healthy lives and promote well-being for all at all ages” (UN 2015); clause number 3.1 stated that by 2030, the goal is to reduce the global maternal mortality ratio to less than 70 per 100,000 live births (UN 2015). Globally, between 1990 and 2015, the maternal mortality ratio (MMR) (the number of maternal deaths per 100,000 live births) declined by 2.3% per year (WHO 2016).

In Oman, mortality registration started in 2004, after a Royal Decree (No. 66/99) (Health Vision 2050) (MoH 2014a). Before 2007, the mortality rate indicators were collected from socio-demographic surveys. The CDR declined from 13.3 per 1000 population in 1980 to 2.9 in 2013. United Nations Children’s Fund (UNICEF) (1993) ranked Oman as first in the Middle East and North Africa Region (MENA) and second globally, concerning the ability of the country to manage the percentage of reduction (two-thirds reduction) of the Under Fives Mortality Rate (U5MR) in only ten years, between 1981 and 1991 (MoH 2014a).

The maternal mortality rate has been fluctuating over the years; however, it increased from 22 per 100,000 live births in 1995 to 26.4 per 100,000 live births in 2010. MMR

was 13.2 (per 100,000 live births) in 2012. However, it declined to 12.3 in 2013 (MoH 2016). According to Health Vision 2050 (MoH 2014a), fluctuations in maternal mortality can be explained by the low numbers of maternal deaths over the years (1995-2012), the relatively low numbers of live births in Oman and the calculation of MMR using 100,000 live births as the denominator. WHO (2014) reported that Oman is among the 19 countries that had achieved the MDG by 2013? Figure 2.5 presents data from a study by (Hogan et al. 2010) showing the improvement in maternal mortality rates among six countries in the Middle East (Oman, United Arab Emirates, Qatar, Bahrain, Kingdom of Saudi Arabia, and Kuwait). All these countries showed an overall decline in maternal mortality rate from 1980 to 2008. Oman showed a decline in the rate of maternal deaths from 174 (per 100,000 live births) in 1980 to 24 (per 100,000 live births) in 2008 (Hogan et al. 2010).

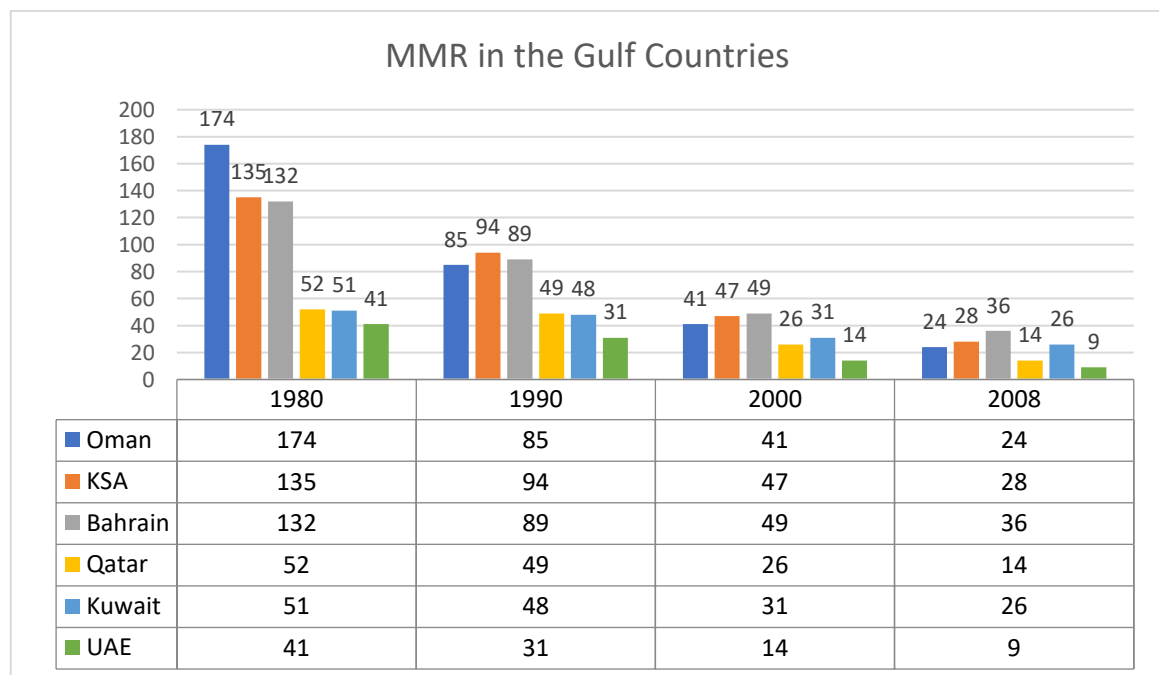


Figure 2-5 Maternal Mortality Rate in Middle Eastern countries (1980-2008) based on data from Hogan et al. (2010)

2.13.6. Maternal and child health services

The maternal and child health service was implemented in Oman in August 1987 to promote mothers and babies' health by providing comprehensive care and reducing morbidity and mortality in both groups (MoH 2014). Pregnant women were encouraged to register their pregnancy at their nearest primary healthcare institution to enable the provision of antenatal care. The total antenatal care coverage by 2013 was more than 99% (MoH 2014). The service is free of charge and provided by nurses and midwives. The number of recommended ANC visits in Oman is six during the pregnancy period unless there is a complication, which is in line with WHO recommendations (WHO 2013). Morbidity associated with pregnancy, including anaemia, diabetes, and hypertension, are all monitored.

In 2014, the MoH provided care to more than 99% of all pregnant women via health centre services (MoH 2014). Of 87,658 women that registered their pregnancies in Oman, 63.9% visited antenatal clinics for registration in the first trimester in 2014. In 2007, the recommended number of routine antenatal care visits within health centres in Oman was four, plus two for anomaly scans, during the entire pregnancy period, in line with WHO recommendations. The average number of antenatal care visits per pregnancy was estimated to be 5.8 in 2014 (MoH 2015). Out of the total number of women who delivered in 2014, about 71.7% of women had visited ANCs four times or more during their pregnancy, 55.6% were assessed medically at least once during the last four weeks of their pregnancy, and about 1% of women had never visited an antenatal clinic. It was estimated that each pregnant woman visited a postnatal care clinic at least once after her delivery during 2014, compared to only 80% of pregnant mothers visiting postnatal care clinics after their deliveries in 1991 (MoH 2015).

There were 68,293 deliveries during 2014, of which 68,026 were in MoH institutions. In 2014, the caesarean section (CS) rate was 19.25%, 28.05% of which were elective procedures. The stillbirth rate declined to 7.1 per 1,000 births in 2014 compared to

13.3 per 1,000 births in 1990. In 2014, 12.1% of women with pregnancies ending in foetal death did not receive antenatal care during the last four weeks of their pregnancy. In 70 cases of foetal death, the foetus was congenitally malformed (nearly 15.6% of cases), and almost 25.1% of cases showed a history of positive consanguinity (MoH 2015).

2.13.7. Staffing

In Muscat Governorate, there are 32 health centres run by 715 HCPs serving pregnant women in their catchment areas (MoH 2014). Staff nurses and general practitioners run the ANC(s) within these health centres. However, in other governorates, midwives run the ANC(s) and refer women to general practitioners if there are any deviations from a normal pregnancy. This practice is due primarily to the shortage of midwives in Muscat, who are distributed throughout the maternity hospitals to staff the delivery suites. Additionally, Muscat has two main tertiary hospitals with large maternity units, as well as a local hospital with a maternity ward. However, other governorates have one secondary hospital and a few extended health centres.

Currently, nurses, midwives and general practitioners run ANC(s) within PHC institutions. From my knowledge and experience, practices differ from one health centre to another and within an antenatal clinic the role of a midwife is different from that of a nurse. For example, in an antenatal clinic that is run by a nurse, the general practitioner manages the pregnant women, and the nurse's role is to register the women, do routine check-ups, including checking blood pressure and measuring height and weight and then send the women to the general practitioner for physical and abdominal palpation. However, this practice is different in clinics that have midwives who perform the physical examination and abdominal palpation, besides the routine care and registration. They also refer the women to the general practitioner in cases that requires clinical consultation or anomaly scans.

Chapter One highlighted the increased number of women in Oman developing GDM annually, associated with increased rates of maternal obesity. The behaviour of policymakers and healthcare professionals is critical in promoting and delivering healthcare to the people (Michie et al. 2017).

2.14. Implementation science

Interventions might contain components that would be effective in changing the behaviour of healthcare professionals, or they may contain components with which to overcome the barriers preventing a change of a particular behaviour (Eccles et al. 2006).

Klein and Sorra (1996) defined implementation as,

“A process of gaining targeted employees’ appropriate and committed use of an intervention” p. 1055.

According to the National Implementation Research Network (2015) in the USA, implementation science is the study of factors that influence the full and effective use of innovations in practice. The purpose of implementation science is to determine what is required (Metz 2015).

2.14.1. Presenting a change in the clinical settings

It is important to have clear and transparent clinical guidelines that allow healthcare professionals to understand and implement guidance accurately to improve patient outcomes (Chen et al. 2016). Grol and Grimshaw (2003) stated that before introducing any change, it is essential to carefully design interventions to transfer the change into the clinical practice. Many strategies can be used to make a change happen. These include continuous education through conferences and workshops, audit of the practice, feedback, and team-work. In Oman, MoH put a five-year strategic plan, the

“Five Years Health Development Plan.” The aim of this plan was to evaluate and update current health policies and clinical guidelines (MoH 2014). Thus, the GDM guidelines are updated every five years, although; there was no clear process to evaluate uptake and implementation.

2.14.2. Behavioural change amongst health professionals

A systematic review conducted by Eccles et al. (2006) explored the relationship between intention and behaviour in clinicians. One of the advantages of using theory in designing interventions to change the behaviour of health professionals is that it offers a generalisable framework within which to work. It was found that constructing theory-based interventions, outcomes, or self-reported behaviours led to useful proxies for actual behaviour (Eccles et al. 2006). Three studies within the review did not find a significant correlation between intention and behaviour (Lambert et al. 1997; Bernaix 2000; Quinn 1996).

2.15. Theoretical framework

To change a behaviour in an individual or organisation, there are several theoretical change approaches. Three of the most commonly used models are the health belief model (Hochbaum et al. 1950s), the theory of planned behaviour (Ajzen 1985) and the trans-theoretical model/ stages of change model (Prochaska 1979). Evidence-based frameworks can help when designing and evaluating health interventions. Although theories might provide the basis for designing interventions to change behaviour, some of these theories do not offer guidance on how to implement change (Michie et al. 2008). To ensure the improvement in implementation of evidence-based practice in health settings including public healthcare, one suggested approach is behavioural change theory (Michie et al. 2011).

Michie et al. (2011) stressed that the critical roles of impulsivity, habit, self-discipline, associative learning, and emotional processing were not addressed by the Theory of Planned Behaviour and Health Belief Model. The study aims to determine the current behaviour of healthcare professionals in PHC towards the accurate implementation of GDM guidelines. Therefore, the researcher used the Capability, Opportunity, and Motivation-Behaviour (COM-B) model by Michie et al. (2011) to frame the study. This is because it enables the researcher to identify the needs for HCPs' behaviour change in the PHC through an in-depth understanding of the behaviour.

2.15.1. The COM-B model

Michie et al. (2011) introduced a behavioural change wheel theory (BCW) which is “a synthesis of 19 frameworks of behaviour change identified in a systematic literature review” (Michie et al. 2014; Michie, et al. 2011). According to Michie et al. 2011, the frameworks were not comprehensive, and few of them were linked clearly to a model of behavioural change. The behavioural change wheel was designed to support the designer of the intervention to move from a behavioural analysis using COM-B to intervention design, using the evidence-base (Michie et al. 2011; Barker et al. 2015). The BCW consists of three layers: the outer layer (the rim of the wheel) contains seven types of policy that can be used to deliver the interventions. The middle layer identifies nine interventions to be used to address the deficits in one or more COM-B model. The inner layer is considered the heart of the wheel and consists of a COM-B model. COM-B is intended as a starting point from which to choose interventions that are most likely to be effective, and specific interventions to address each component have been suggested (Michie et al. 2011). The model hypothesises that interaction between three components, Capability, Opportunity, and Motivation (COM), causes the performance of Behaviour (B) and hence can provide explanations for why a recommended behaviour is not engaged in (Jackson et al. 2014). According to the model, to change

behaviour requires the presence of three conditions: (C) capability to perform the necessary actions, (O) opportunity that includes “the factors which lie outside the individual to make the behaviour possible” (Michie and West 2013) and overcoming barriers. The third condition is to increase the (M) motivational aspects for a person. Then, the person can adopt the new behaviour that influences the above three conditions and to find the reasons behind failure to engage in recommended behaviour (Michie et al. 2011d; Michie and West 2013). The arrows represent the potential for unplanned implication. For example, the single-headed arrows represent the influence between opportunity and motivation and the influence between capability and motivation. The double-headed arrows represent enacting a behaviour that can alter capability, motivation, and opportunity (Michie et al. 2011; see Figure 3-1). This means increased motivation is likely to increase capability, and more motivated individuals will be instrumental in seeking out greater opportunities in support of their change.

The source behaviour is divided into capability, including physical (i.e., physical skills, physical strength) and psychological (i.e., psychological resources and skills, knowledge, the capacity of understanding). Motivation comprises being reflective (awareness, planning, analysis, and decision-making) and automatic (emotional reactions, drives and habits). Opportunity is the ability to differentiate between the physical environment (physical barriers, facilitators) and social environment (concepts, exposure to ideas) (Michie and West 2013).

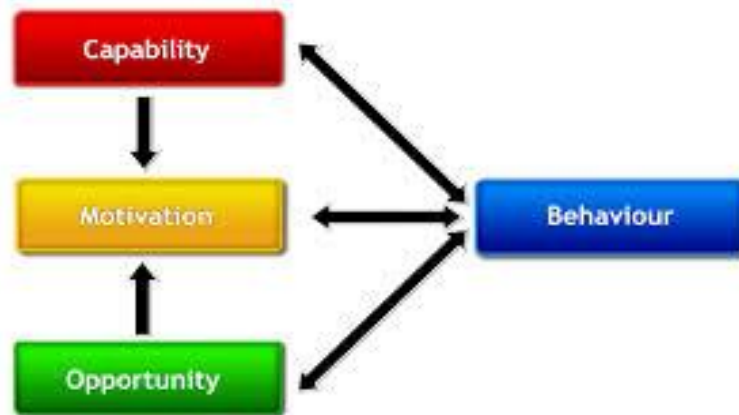


Figure 2-6 COM-B model exactly reproduced from Michie et al. (2011)

The model proposes that each of the three components has subdomains, including physical and psychological capability to achieve the behaviour, the physical and social opportunity to comprise the behaviour and to be well motivated using reflective such as intention and choice and automatic motivation, including emotional reactions, desires (wants and needs), such as habit and impulses motivation (Michie et al. 2011d; Michie et al. 2014b). To change the behaviour of a person, one needs to understand the required interaction conditions. These interactions between the three elements in the model can occur when the people have a particular capability (i.e., physical, and psychological) that may aid in performing the behaviour, have the opportunity to engage in the behaviour (physical and social) and have the internal and external motivation (automatic and reflective) to establish the behaviour (Michie et al. 2011d; Michie et al. 2014b). For example, the nurses have the physical capability to offer the women GDM screening at registration. They also have the psychological capabilities to understand the guidelines.

2.15.2. Conclusion

Since 1970, the healthcare system in Oman has been through tremendous changes that have resulted in improved the healthcare provided across the entire country. Pregnant women are screened for and diagnosed with GDM within primary healthcare

institutions operated by MoH. Women with GDM are managed in ANCs by healthcare professionals, including nurses, midwives, and general practitioners. There is no data available from the MoH evaluating any of the previously mentioned GDM guidelines to the researcher's best knowledge. This chapter has discussed implementation science and highlighted the theoretical framework used to guide this thesis. COM-B model is a diagnostic part of the behavioural change wheel applied in the current thesis. The following chapter provides a critical analysis of the existing literature regarding the implementation of both the 2010 and 2015 GDM guidelines, experiences of healthcare professionals working in PHC in addition to the barriers and facilitators of implementing these guidelines. This literature review discusses the main existing healthcare strategies that encourage healthcare professionals to adopt change behaviours.

Chapter 3. Literature review

3.1. Introduction

This chapter examines the evidence supporting the importance of screening and diagnosing gestational diabetes mellitus (GDM) for pregnant women using existing international guidelines. It aimed to identify the gap in what? to justify the importance of this study and to inform research questions. Additionally, to explore the role of healthcare professionals (HCPs) in screening for GDM in primary healthcare centre (PHCs) and highlight the barriers and facilitators in the implementation of GDM guidelines. This chapter comprises a systematic search of the literature and is presented narratively to answer this study questions. i.e., What is the clinical compliance with GDM guidelines in Oman? What barriers do healthcare professionals face that limit the implementation of GDM screening guidelines?

A narrative review is considered to deal with the published studies' findings and interpret them accordingly (Mays et al. 2005). According to Gregory and Denniss, (2018) narrative review presents non-systematic summation and analysis of available literature. Also, it has a flexibility that allows broader coverage of relevant quantitative and qualitative evidence (Mays et al. 2005). The literature surrounding theoretical perspectives on implementation science and behaviour change theories are described and analysed. Literature regarding the experience of HCPs in the implementation of GDM guidelines worldwide is reviewed.

This chapter describes three main themes that emerged from the literature review, firstly, the extent to which screening for GDM complies with the principles of an effective screening tool. This theme examines and applies the Wilson and Jungner (1968) principles of screening. Secondly, compliance of health care professionals with GDM; this theme focuses on the effectiveness of the implementation of GDM

guidelines by healthcare professionals. Finally, literature that explored the barriers and facilitators which healthcare professionals face that affect the implementation of GDM screening guidelines is critically appraised.

In Oman, the MoH emphasises the use of universal screening for GDM (MoH 2017). This means all pregnant women should do a random blood glucose test at registration and receive an oral glucose tolerance test (OGTT) within two weeks if the random blood sugar (RBS) result is highly abnormal. However, if the RBS result is within the normal range, the OGTT can be done at 22-24 weeks of gestation. This does not mean if an RBS is raised that the woman might get GDM as the sensitivity and specificity might be compromised according to each woman's risk factors. Even though an RBS result is abnormal, some women might have OGTT results within the normal range. Gestational diabetes mellitus is often asymptomatic and detected during screening at registration by HCPs; guidelines are available in each health centre, and details of diagnostic tests clearly stated. To enhance the strengths of a narrative, review the reporting of search strategies should be explicit (Collins and Fauser 2005). The following section describes the search strategy used to find the relevant literature and discusses the significant literature regarding the barriers and facilitators faced by HCPs implementing guidelines.

3.2. Search strategy

A preliminary literature search was conducted from April 2015 to November 2016, prior to submitting the research proposal. The search was continuously updated until November 2020. EBSCO alerts were set up to follow recent literature on the screening of GDM. Literature was sourced using the keywords in the databases, combined with the Boolean operators 'AND/OR/NOT/', the titles and abstracts were reviewed using inclusion and exclusion criteria to identify potentially relevant literature and finally, the

full-text articles were read and critiqued. Truncation was used by adding * to the word stem to include different spellings and acronyms for the search terms, e.g., pregnan* (O'Connor et al. 2014). An in-depth systematic search was conducted using the electronic databases Cumulative Index of Nursing and Allied Health Literature (CINAHL), Medline (Ovid), British Nursing Index, Cochrane Library, Google Scholar, Applied Social Sciences Index and Abstracts (ASSIA), SCOPUS, and Psych INFO. Identified references from the relevant literature were searched manually by tracing the citations from the reference lists. The literature search strategy included a comprehensive search of books, journals, and databases, accessed via Cardiff University library portal. Two librarians from Cardiff University were consulted to help with the literature search. The search consisted of the principles of practice in screening for GDM. The aim of this search was to identify evidence in the literature outlining the available guidelines in the screening of GDM in Oman and worldwide, to identify the extent of compliance with GDM guidelines and barriers faced by HCPs when implementing guidelines. The search was limited to studies written and published in English, but no geographical limitations were applied. Subject headings and key search terms used combinations and included: pregnant women; pregnancy; pregnan*; pregnancy with diabetes; gestational diabetes mellitus; *birth* or combined with (OR); (AND) nurse*; general practitioner; gp*; midwives; midwives' attitudes; Wilson and Jungner principles; healthcare providers experiences; and compliance to GDM guidelines. Other terms used included: Oman diabetes guidelines, NICE GDM guidelines; effective GDM screening in reducing perinatal complications; early detection of GDM.

In total, 4,237 papers were accessed through the databases, thirty-one were identified through the manual assessment of reference lists and citation links to specific articles. Limiting the search to articles published from 2003 resulted in the exclusion of 3,594 articles. The remaining 643 articles were screened for duplicates, which eliminated 309

articles. The remaining 334 studies were screened for eligibility through their titles and abstracts, which resulted in the further exclusion of 200 studies. The remaining 134 articles were read in full for relevance to the research question, which resulted in the exclusion of 94 studies. These studies were excluded because seven of them did not include pregnant women, experiences, or views. Furthermore, five were opinion pieces and editorials. A PRISMA flow chart (see appendix A) on the number of articles included in this review is provided in table (3.1). The remaining (n= 38) were then filtered for relevance to the screening of GDM and the effectiveness of various screening strategies in reducing perinatal complications of GDM. The included literature explored.

- a) Screening of GDM using Wilson and Jungner principles of screening (see Box 1) (n= 18)
- b) Compliance with GDM guidelines (n=6)
- c) Barriers and facilitators in the implementation of GDM guidelines in the clinical practice (n=14).

The literature search identified only one study conducted on screening of GDM from the United Arab Emirates (UAE) Agarwal et al. (2015). The following section introduces the Wilson and Jungner (1968) criteria for screening diseases in public health and discusses its application to screen for GDM.

3.3. Characteristics of the studies

The total number of relevant studies identified was 38 (table 3-4) and were conducted in Australia n = 9, Europe n= 3, Italy n = 1, United Kingdom n = 2, , Netherlands n = 1, Finland n = 2, Sweden n = 1, Spain n = 1, Belgium n = 1, France n = 2, United States of America n = 2, Canada n = 1, Brazil n = 1, , Israel n = 2, Georgia n =1, Thailand n = 1, Arab Countries: (Oman n = 3, United Arab Emirates n = 2, Morocco n = 1).

Table 3-1 Studies characteristics

Study design	Researchers and date	Country
Surveys	Agarwal et al. 2015	UAE
	Edwards et al. 2014	
	Flack et al. 2010	Australia
	Flack and Ross 2016	Australia
	Stuebe et al. 2010	Europe
	Wilkinson et al. 2013	Australia
	Pintaudi et al. 2016	Italy
	Bell et al. 2018	England
	von Treuer et al. 2018	Australia
Randomised control trials	Utz et al. 2017	Morocco
	Luoto et al. 2011	Finland
	Crowther et al. 2005	Australia and UK
	Landon et al. 2009	USA
	Metzger et al. 2008 (HAPO)	9 countries
Retrospective cohort	Koning et al. 2018	Netherland
	Murphy et al. 2016	Auckland, New Zealand, Adelaide, Australia; Cork in Ireland and the UK (Manchester, Leeds, and London)
	Abu-Heijja et al. 2015	Oman
	Riskin Mushiah et al. 2009	Israel
	Persson et al. 2009	Sweden
Prospective cohort	Sweeting et al. 2016	Australia
	Duran et al. 2014	Spain
	Kalter-Leibovici et al 2012	Israel
Qualitative descriptive studies	Mersereau et al. 2011	Georgia

	Wilkinson et al. 2019	Australia
	Hannes et al. 2010	Belgium
Systematic reviews	Darker et al. 2018	Brazil
	Buckley et al. 2011	Europe
	Poolsup et al. 2014	Brazil
	Légaré et al. 2008	France
	Jun et al. 2016	USA
	Horvath et al. 2010	Europe (Germany, Austria)
	Audit	Moses et al. 2003
Jacklin et al. 2017		England and Wales
Non-randomised controlled trial	Gayet-Ageron et al. 2008	France
Cross-sectional	Chitme et al 2016	Oman
	Ammouri et al. 2014	Oman
	Albarrak et al. 2013	UAE/ Dubai
	Ruengkachorn et al. 2006	Thailand

3.4. Quality of the relevant studies

A total of (38) studies met the inclusion criteria. A Grid table (Appendix B) contains the extracted studies summarising each study. These were appraised using the Critical Appraisal Skills Programme (CASP) (2015) to identify and assess each paper's strengths and limitations, validity, reliability, trustworthiness, and relevance to the research questions. CASP has designed specific critical appraisal checklists for cohort studies, RCTs, systematic reviews and qualitative studies to critique the extracted studies. The CASP tool was chosen to make sense of the evidence, including the strengths and limitations of the literature. According to Kuper et al. (2008), a quality assessment is essential to whether the research findings can be trusted and applied to a particular context. A tool adapted from the Joana Briggs Institute (JBI) that contains questions similar to those in the CASP checklist was used for the critical appraisal of cross-sectional surveys and qualitative studies. JBI tool includes an "evaluation/outcome" criterion that can be used to evaluate the congruity between conclusions and other parts of the research process rather than the legitimization of the conclusions (Hannes et al. 2010). The link between the conclusion and other stages of a research project might contribute to evaluative validity (Hannes et al. 2010).

One of the early detection stages stated by Wilson and Jungner (1968) is secondary prevention of the disease. Screening tests should result in early detection of the disease so early treatment can reduce the incidence rate of a particular disease. Also, high socio-economic factors in some developed countries might reduce communicable diseases because of the higher resources that would be utilised to improve the health facilities and ensure the treatment's availability. However, there may be an increase in the prevalence of non-communicable diseases such as diabetes mellitus, because of the sedentary lifestyle (Wilson and Jungner 1968).

3.5. Wilson and Jungner principles of screening

Wilson and Jungner, (1968) proposed criteria for screening diseases in public health, including mass (or universal), selective, multiple (or multiphasic) and surveillance screening. Universal screening is used to screen a large-scale population group, whereas in selective screening only the high-risk group are screened (WHO 1968). Multiple screening provides two or more screening tests combined to large groups of people (Wilson and Jungner 1968). The surveillance screening provides the screening examinations repeatedly at intervals of time (Wilson and Jungner 1968). The ten screening criteria of Wilson and Jungner (1968) have been adopted and published by the World Health Organisation (WHO 1968) to appraise the validity of screening public health diseases, including GDM (see Box 1). These were reviewed by Sheehy et al. (2009); who concluded that the ten principles are still applicable in modern healthcare. Ten years later, Smith (2018) stated Wilson and Jungner' s principles of screening are perhaps the most widely referenced work in the screening literature.

Box 1 Wilson and Jungner classic screening criteria adopted from, WHO (1968)

1. The condition investigated should be an important health problem.
2. There should be an accepted treatment for patients with a recognised disease.
3. Facilities for diagnosis and treatment should be available.
4. There should be a recognisable latent or early symptomatic stage.
5. There should be a suitable test or examination to provide diagnosis.
6. The test should be acceptable to the population.
7. The natural history of the condition, including development from latent to declared disease, should be adequately understood.
8. There should be an agreed policy on whom to treat as patients.
9. The cost of case-finding (including diagnosis and treatment of patients diagnosed) should be economically balanced in relation to possible expenditure on medical care as a whole.
10. Case-finding should be a continuing process and not a "once and for all" project.

According to Sheehy et al. (2009), disease screening should meet specific criteria to be medically and financially acceptable. In this section, the applicability of these principles to GDM screening is examined. The first principle is that the condition investigated should be an important health problem. GDM is a significant health issue

in Oman as the number of women diagnosed with GDM is increasing every year. GDM screening is considered high priority in managing non-communicable diseases in the Ministry of Health (MoH 2014). Only two studies were conducted in Oman investigation surveillance of GDM.

The first study was a retrospective study conducted by Abu-Heija et al. (2015) to assess the prevalence of GDM and pre-gestational diabetes mellitus (PGDM) among Omani women who delivered at Sultan Qaboos University Hospital (SQUH) in Muscat. The study was conducted between January 2009 and December 2010 using 2010 GDM screening guidelines. The sample used was Omani pregnant women who had pre-gestational diabetes and gestational diabetes mellites. The women were divided into two groups, one with the obstetric outcomes and another group with perinatal outcomes. At that time, universal screening for GDM using RBS was followed and risk factors for GDM were not a priority for screening. The data collected using available records in the health institutions. The findings of the study revealed that there were no significant differences in the mean of the parity between the two groups (31.3% versus 39.6%; $p = 0.237$). The incidence of shoulder dystocia was the same in both groups (1.7% vs 1.7%; $p > 0.999$). There were no significant differences in mean birth weight $< 2,500$ g (8.8% versus 13.6%; $p = 0.231$). There was no significant difference in the incidence of Macrosomia ≥ 4 kg, (4.9% vs10.3%; $p = 0.120$) between the two groups. The study's findings highlighted those women with PGDM are higher risk to have obstetric and perinatal complications. The incidence of macrosomia was much lower in the current cohort of women with PGDM (10.3%) and those with GDM (4.9%). This may be due to early diagnosis, strict glycaemic control, and labour induction. GDM is an important health issue in Oman as pregnant women who had a history of recurrent macrosomia; miscarriages, fetal malformation and unexplained intrauterine death were considered with a high risk of GDM.

Chitme et al. (2016) conducted a cross-sectional, randomised multicenter, case-control study on pregnant women diagnosed with GDM in Oman. They used 2015 Oman GDM screening guidelines with universal screening using RBS, but the risk factors for GDM were used as a priority to screen women. The study involved 98, 94, and 99 women with GDM and 100 control women each from Nizwa polyclinic, Sohar Hospital, and Rustaq Hospital, respectively. The details of randomisation were not explained by the authors. A total of 591 women were enrolled (291) diagnosed with GDM and 300 women without GDM from February to July 2015 at three governmental referral hospitals; Nizwa polyclinic, Rustaq and Sohar hospitals. The women's demographic data, obstetric history, birth outcomes, glucose profile, diabetic history, and other information were gathered using a literature-based questionnaire. The authors used multi-centres to conduct their research include. The primary data collections (face-to-face interviews) for the women were conducted by the research team and staff nurses who worked in these hospitals. According to Gray et al. (2017), using staff nurses and other hospital staff to collect the data for the study while they are performing day-to-day routine care should be observed closely to identify the degree of consistency in both collections and recording of the data. It is also important to assess the reliability of the newly trained data collectors and the expert trainer throughout data collection to ensure consistency from the first to the last participant in the study (Gray et al. 2017). The authors did not report in the method section how they trained the staff nurses for data collection hence the consistency of data collection process cannot be ascertained (Gray et al. 2017). Secondary data were collected through a retrospective chart review of GDM cases and control.

The strength of the study was that despite MoH distributed Oman GDM guidelines (MoH 2015), the authors also used the NICE guidelines (2015), which are up-to-date to classify pregnant women with GDM. The rationale behind using the NICE guidelines was not explained in their study. The authors identified some limitations in their study

e.g., there is paucity in the studies that measured the risk factors and glucose profile related to the disorder in Oman.

The results showed a significant relationship between GDM and family history of DM2 in both groups ($p < 0.001$). The chance of a woman with GDM having a mother with DM2, compared to women without GDM was OR 1.2 (CI 95%, 0.6-1.9), and a father with DM2 was 1.0 (CI 95%, 0.3-1.7). The women with GDM with a history of diabetes in other family members, including grandfather, grandmother, cousins, family relatives, and distant relatives, compared to women without GDM was OR 1.9 (CI 95%, 0.4–9.6). Women with GDM in the study had a family history of GDM was (84% vs 16%) of low-risk cases. There was a significant relationship ($p < 0.010$) between the incidence of GDM and multiparous women compared to the control group. Chitme et al. (2016) recommended that HCPs consider the findings of the study to develop a comprehensive primary and secondary prevention and care program for gestational diabetes in Oman. The results of the study support that GDM is an important health issue in Oman because of the significant relationship between GDM and family history.

The second criterion (Wilson and Jungner 1968) is that there should be an accepted treatment for patients with a recognized disease in that country. If a woman tests positive for GDM there should be treatments that contribute to reducing the complications of pregnancy outcomes among women and their babies. The principles of screening state that if a problem exists, it is essential to identify the treatment (Sheehy et al. 2009). The principle of screening in Oman mentioned a similar statement of availability of treatment of GDM in the National Policy in Screening and Management of Diabetes in Pregnancy (MoH 2017) that is provided free of charge to healthcare professionals in the Ministry of health. According to MoH (2017), the multiple daily self-measurement of blood glucose is vital for recognising women who should begin treatment. Gestational diabetes mellitus is recognised as an important health problem in Oman, and the guidelines proposed by MoH in Oman recommend

screening, diagnosis, and treatment according to the classifications of the GDM (MoH 2017). There were no studies that highlighted the treatment or the management of GDM in women in Oman. However, two studies Crowther et al. 2005; and Landon et al. 2009 test the effect or availability of treatment of GDM with similar treatment regimens to Oman.

Global literature (Crowther et al. 2005; Hyperglycemia and adverse pregnancy Outcome (HAPO), 2008; Landon et al. 2009; Horvath et al. 2010; Poolsup et al. 2014) explored the measurement of perinatal outcomes to determine the effectiveness of GDM treatment. A large, randomised control trial (RCT), the Australian Carbohydrate Intolerance Study (ACHOIS), assessed the effectiveness of GDM treatment on the pregnancy outcomes of GDM-positive women (Crowther et al. 2005). The ACHOIS trial was conducted to assess whether the treatment of gestational diabetes would reduce perinatal complications and assess the effects of treatment on the maternal outcome, mood, and quality of life. There were (n=490) women in the intervention group and (n=510) women in the routine-care group from September 1993 to June 2003. The study was ethically approved; however, an ethical aspect of the study design arose in those women in the routine care group were not informed of their diagnosis of GDM during the study (Crowther et al. 2005). Additionally, as both groups were similar inclusion criteria at entry, a performance bias was detected as the women in the routine-care group and HCPs were not aware of women who developed GDM, so no treatment was provided.

Crowther et al. (2005) found that treatment of GDM reduces serious perinatal morbidity and may improve the woman's health-related quality of life. The trial reported reduced risks of poor outcomes in women receiving blood sugar monitoring, dietary advice, and insulin in the intervention group compared with routine care. The rate of serious perinatal outcomes among the infants, defined by one or more of the primary

outcomes, was significantly lower in the intervention group than in the routine-care group (1% vs 4%; $p < 0.01$).

Landon et al. (2009) conducted a large multicentred randomised controlled trial to determine whether treatment of women with borderline GDM reduces perinatal and obstetrical complications. A total of 1889 women were randomised into two groups (485 to the treatment group and 473 to the control group). An additional 931 women with normal results on OGTT were included in the group that received usual prenatal care. The HCPs who monitored the women's daily blood glucose level were blinded to which group received the treatment.

It was observed that there was no significant difference between the treatment group and the control group in terms of the frequency of the composite primary perinatal outcome (32.4% vs 37.0%, respectively); RR, 0.87; (97% CI, 0.72 to 1.07; $p = 0.14$) and no perinatal deaths in either group. The mean birth weight greater than 4000 g (5.9% vs 14.3%) RR 0.41 (97% CI, 0.26-0.26, $p < 0.001$) were significantly reduced in the treatment group as compared with the control group. The treatment group had a significantly lower frequency of shoulder dystocia (1.5% vs. 4.0%), RR 0.37 (97% CI, 0.14-0.97, $p = 0.02$). Overall, the study showed a positive effect of the intervention on reduced risk of macrosomia, shoulder dystocia, and the need for caesarean section.

Horvath et al. (2010) conducted a systematic review of the treatment of women with GDM. The review included 18 randomised control trials published between 1966 to 2009 and included 2999 women. The authors assessed the risk of performance bias in the included literature; blinding was not considered a major issue in the review as the participants received multiple interventions. Both randomised trials by Crowther et al. (2005) and Landon et al. (2009) reported on shoulder dystocia that there was a significant difference in favour of the intervention group (0.40, 0.21 to 0.75). The findings revealed a significant reduction in the risk of pregnancy adverse outcomes

such as macrosomia, shoulder dystocia and large for gestational age. There were non-significant effects on perinatal or neonatal mortality, birth trauma and preterm births and no benefits of treatment were observed on these outcomes. Treatment for GDM, including treatment to lower blood glucose concentration alone or with other specific treatment, seems to lower the risk for some perinatal complications.

In the systematic review conducted by Poolsup et al. (2014), they included ten randomised control trials, including 3881 women from the respective inception to 2013. Both reviews (Horvath et al. 2010; Poolsup et al. 2014) had assessed the risk of performance bias in the included literature, blinding was not major issues in both reviews as multiple interventions were received by the participants (NOTE: this feels repeated from another paragraph). There were similarities in the findings of both reviews; a significant reduction was found in the risk of pregnancy adverse outcomes such as macrosomia, shoulder dystocia and large for the gestational age. There were non-significant effects on the perinatal or neonatal mortality, birth trauma and preterm births as no benefits of treatment was observed on these outcomes (Horvath et al. 2010; Poolsup et al. 2014). Both reviews provided evidence that treatment of GDM seems to have beneficial effects on reducing some complications of pregnancy.

Presently there is no research similar to the above trials conducted in Oman or the neighbouring Gulf countries. While some of these findings may be transferable, they provide a starting for this research and suggests that providing treatment for gestational diabetes may reduce the incidence of shoulder dystocia.

The third principle in the criteria of Wilson and Jungner (1968) is the availability of facilities for diagnosis and treatment. This principle suggests that facilities not only for screening or diagnosis but also for subsequent treatment of identified client (Grootendorst et al. 2009). The facilities are available in in the PHC in Oman and the

women have free access to the PHC without the need of medical insurance. However, no research regarding the diagnosis and treatment of GDM conducted in Oman or the Middle Eastern countries. A prospective study conducted by Sweeting et al. (2016) in Australia included 4,873 women. The participants were stratified by the type of diabetes and timing of GDM diagnosis (12, 12–23, and 24 weeks of gestation). Almost 1/3 of the sample were diagnosed with GDM prior to 24 weeks of gestation (27.4%), compared with women in whom GDM was diagnosed at or after 24 weeks of gestation. Early diagnosis of GDM was associated with increased requirements for insulin therapy (75.0%, 59.1% and 42.7%, $p < 0.0001$). Although women who had an early diagnosis were more likely to receive treatment with insulin therapy, they were more likely to have adverse birth outcomes compared to women not having insulin therapy. There was no difference in the incidence of macrosomia (21.8% vs 20.3%, $p = 0.8$), large-for-gestational age (39.6% vs. 32.8%, $p = 0.4$), and neonatal intensive care admission (38.5% vs. 39.7%, $p = 0.9$), respectively, in women with T2DM compared with GDM diagnosed at <12 weeks of gestation.

Kalter-Leibovici et al's. (2012) of 277 Israeli women who were already participated in HAPO study 2008 and met the International Association of the Diabetes and Pregnancy Study Groups criteria (IADPSGC) for the diagnosis of GDM. Women were divided into two groups: positive IADPSG and negative IADPSG. The purpose of the analysis was to explore alternative methods for detecting women at risk for adverse pregnancy outcomes. The prevalence of macrosomia among positive IADPSG women was 16.4% compared with 8.1% among IADPSG negative women. An identifiable one-third of the IADPSG positive women had rates of macrosomia slightly greater than the rates among IADPSG negative women. This means the prevalence of macrosomia among the one-third of IADPSG positive women who scored >166 was 9.8% compared with 19.7% in the two-thirds of IADPSG-positive women who scored ≥ 166 . Implementing IADPSG recommendations will significantly increase GDM diagnosis.

Risk-stratification in IADPSG positive women may reduce insulin therapy treatment and reduce the chances of adverse pregnancy outcomes such as macrosomia and shoulder dystocia. This study provides pertinent information for making locally relevant and evidence-based decisions on screening and diagnosis policy in GDM.

Koning et al. (2018) conducted a retrospective study in the Netherlands to evaluate the possible impact on GDM diagnosis and pregnancy outcomes when applying the new WHO 2013 criteria instead of WHO 1999 criteria. The study included n= 4431 women with risk factors of GDM between January 2011 and September 2016. The authors found that women who had undergone an OGTT and were subsequently found to have normal glucose tolerance (NGT) also had a rate of large gestational age (LGA) neonates higher than that of the women receiving treatment after being diagnosed with GDM based on the WHO 1999 criteria for 2HG (18.0% vs 15.4%). Although this finding was not statistically significant, it was a considerable difference compared with the incidence of LGA neonates in the general obstetric population (18% vs 11%).

It is evident from the above three studies that although they used different guidelines findings showed an early diagnosis of GDM reduces adverse birth outcomes such as macrosomia.

The fourth criterion described by Wilson and Jungner (1968) is the presence of a recognizable latent or early symptomatic stage. Gestational diabetes mellitus is often asymptomatic and detected during screening at registration by HCPs. However, the common symptoms might appear for some women who had high blood glucose such as thirst, frequent urination, and tiredness, which many women also experienced due to physiological changes during pregnancy (WHO, 2016). A survey was conducted by Edwards et al. (2014) in Australia to assess current health service delivery for women with diabetes in pregnancy (DIP) by surveying HCPs' views and practices in DIP screening and management. The survey contained 43 questions across five themes:

communication; care-coordination; education, orientation, guidelines; logistics and access; and information technology. The study found that 43% of HCPs providing screening early in pregnancy reported using the 75g OGTT, which is in line with current practice. However, the gap between the evidence and current practice was indicated by 34% of HCPs reporting that they were not providing screening for any women early in pregnancy. The authors suggested they should focus on continuous education and clarity of the guidelines. The authors concluded that it is promising that many HCPs report following the current guidelines in conducting early pregnancy screening for DIP in high-risk women. During this study, the guidelines being used were in the process of being revised to recommend screening women with high-risk factors at the first antenatal visit with a 75g OGTT and again at 24–28 weeks of gestation if the initial test is negative.

The fifth criterion is the availability of suitable test or examination; the available tests to be used in GDM screening should be suitable to the disease. The fasting plasma glucose is simple, inexpensive, and harmless to the clients. Additionally, OGCT and OGTT are two diagnostic tests that used to confirm the diagnosis of GDM. The WHO GDM guidelines (1999) were updated based on the data results of the HAPO study 2008 (WHO, 2013). The previous diagnostic level of fasting plasma glucose (FPG) was ≥ 7.0 mmol/l that is universally considered too high. This was the rationale behind some groups using only the 2-h plasma glucose (PG) measurement without measuring the FPG, while others used both FPG and 2-h PG measurement (WHO, 2013). In the latter case, the cut off points of ≥ 7.0 mmol/l or ≥ 6.1 mmol/l (WHO, 2013) are used. The HAPO study confirmed the increase in the prevalence of GDM from 11.3% with old criteria to 16.1% with new criteria. Colagiuri et al. (2014) supported the increase in the prevalence from different countries after using the new criteria, for example, United Arab Emirates (UAE) from 20.3% to 37.7%, and in Australia from 9.6% to 13.0%.

Despite the international and national GDM guidelines, the healthcare professionals have no uniform guidelines that can be followed. Health education and counselling on physical activity and changing to healthier lifestyles might reduce the number of GDM cases (Flack et al, 2010).

GDM can be diagnosed at any time in pregnancy, according to WHO (2013). However, it is important to identify one or more of the following criteria:

- fasting plasma glucose 5.1–6.9 mmol/L (92–125 mg/dL)
- 1-hour plasma glucose 10.0 mmol/L (180 mg/dL) following a 75 g oral glucose load 2-hour plasma glucose 8.5–11.0 mmol/L (153–199 mg/dL) following a 75 g oral glucose load. (WHO, 2013)

A randomised control trial was conducted by Luoto et al. (2011) in Finland to examine whether gestational diabetes mellitus can be prevented by using lifestyle counselling for at-risk pregnant women. The study enrolled 399 women in 14 municipalities, 219 in the intervention group and 180 in the control group. The findings showed that the adherence to the intervention was evaluated based on self-reported changes such as physical activity and diet intake. 15.8% of women in the intervention group and 12.4% in the routine care group developed GDM, OR 1.36, (95% CI 0.71–2.62, $p=0.36$). The findings of the study emphasise the importance of counselling on the topics of physical activity, diet, and weight gain in maternity care, especially for women at risk of GDM in order to prevent LGA new-borns possibly causing problems in delivery, and both the women's and the child's later weight development. The study showed that lifestyle counselling is effective in decreasing new-borns' birthweight among women at risk of GDM and producing behavioural change.

The sixth criteria are the acceptable test to the population; acceptability is related to the nature of the risk involved (Harris et al. 2011). For example, women should be aware of GDM and the screening tests from health education. A non-randomised interventional study was conducted by Gayet-Ageron et al. (2008) in France in two periods; Period one was from April to October 1999 before the implementation of WHO GDM guidelines and included 333 pregnant women. Period two was from April to October 2001 and included 345 pregnant women, after the implementation of the WHO guidelines 1999. To compare their results with a control group, the authors used the data from a fourth public obstetrical. Authors evaluated the impact of the WHO guidelines for GDM screening on clinical practice and explored its acceptance by the sample women. They found no major differences in demographics or medical history between periods one and two. The included women had a history of GDM (0% vs 1.2%, $p = 0.13$), and had at least one risk factor for GDM, (47.4% vs 43.5%, $p = 0.30$). In period one, 42 out of 333 (12.6%) women underwent screening for GDM compared with 233 (67.5%) women in period two ($p < 0.001$). In the control group, the women who underwent the GDM screening test had no significant changes between the two periods (12.0% vs 20.0%, $p = 0.27$). After the implementation of the WHO guidelines, the GDM screening test increased significantly from 3 (0.9%) to 204 (59.1 %) women in the three hospitals ($p < 0.001$). The HCPs accepted the WHO guidelines and modified their practices after the implementation of these guidelines. The pregnant women who were cared for in the obstetrical units showed a high rate of acceptance. The acceptance of the WHO screening by 175 women was evaluated using a questionnaire distributed on days 1–2 after delivery. The results indicated that the WHO test for GDM was acceptable by 161 of the screened women (97.6%) who answered the questionnaire, 163 (97.0%) considered it was important to receive information on GDM during pregnancy, and 143 women (88.8%) reported that screening was essential. A total of 145 women (89.5%) would accept to be screened again during another pregnancy.

Pintaudi et al. (2016) conducted a survey in Italy to describe the degree of diffusion and acceptance of national guideline on screening and diagnosis of GDM among Italian women and to detect possible areas for benchmarking. One hundred twenty-two diabetologists of 122 different diabetes centres of all the Italian regions completed the questionnaire. The HCPs reported a lack of strong scientific evidence in determining the glycaemic cut-off suggested by IADPSG. In contrary to the IADPSG guidelines, selective screening based on the presence of any GDM risk factors was recommended. The authors found a good level of reception of the recommendations. It also recognized some criticisms, linked explicitly to the choice of universal or risk factor-based screening. Overall, the results of the survey gave a closer picture of the implementation of screening and diagnosis GDM guidelines by the HCPs. These findings are relevant to this thesis because GDM screening guidelines need to be disseminated and discussed on a local basis (stakeholders and pregnant women) in order to be applied in a more extensive way. Benchmarking activities could be programmed to avoid heterogeneity in the application of the GDM recommendations. There was a limitation of the study as the research is susceptible to selection bias when the participants were only diabetologists, and other specialities were not involved.

The natural history of the condition understood is the seventh criteria of Wilson and Jungner (1968) principles of screening. The natural history of the condition, including development from latent to declared disease, should be adequately understood. It is necessary to have conducted enough research to know: 1) what changes should be regarded as pathologic and what should be considered physiologic variations?

2) are early pathologic changes progressive?

The Hyperglycemia and Adverse Pregnancy Outcome (HAPO) study conducted by the HAPO study cooperative research group, Metzger et al. (2008) was a prospective observational epidemiological study that aimed to explain the risk of adverse outcomes associated with several degrees of maternal glucose intolerance in particular the women who were diagnosed with GDM. A total of 25,505 women at 15 centres in nine countries were enrolled in the study (see appendix B). The women underwent 75g oral glucose tolerance testing at 24 to 32 weeks of gestation, and the results were blinded, the FPG level was 105 mg per decilitre (5.8 mmol/l) or less and the 2 hours PG was 200 mg per decilitre (11.1 mmol/l) or less. Blinded data minimised the bias among HCPs. Data for 23,316 women were blinded and analysed. 746 (2.9%) were excluded because their data were unblinded, 1412 (5.5%) were excluded mainly because they had undergone glucose testing or delivery outside the context of the HAPO study, and 31 (0.1%) were excluded owing to missing key data or an implausible gestational age (> 44 weeks). The data collection and utilisation of centralised laboratory tests were inconsistent with each other. The data results were blinded to the HCPs. A strength of the HAPO (2008) study was that it consisted of large numbers of participants from nine countries. The data collection and utilisation of centralised laboratory tests were inconsistent with each other. There were no significant associations between clinical neonatal hypoglycaemia with the fasting plasma glucose level and the 2-hour PG level.

Although women with pre-existing diabetes were excluded from the study, the authors graded associations between fasting glucose level and primary outcomes but not preterm birth or neonatal intensive care admission. The frequency of GDM development increased from 1.0% in the lowest glucose category to 11.7% in the highest OR 11.92 (95% CI 5.39–26.37). The frequency of LGA neonates and/or macrosomia increased from (7.9 to 19.4%) OR 2.82 (1.67–4.76). Primary caesarean section rates increased from (12.7 to 20.0%) OR 1.94 (1.11–3.41).

Riskin-Mashiah et al. (2009) retrospectively evaluated the associations between first-trimester fasting plasma glucose level and adverse pregnancy outcomes between June 2001 and June 2006 in Israel. 7,126 women were enrollees of Clalit Health Care Services. Findings showed no significant associations between fasting glucose level category and either preterm delivery before 37 weeks of gestation or neonatal intensive care unit admission OR 0.73–1.35, (95% CI and $p < 0.1$). In addition, there were associations between the first trimester fasting maternal plasma glucose level, below those diagnosed of diabetes, and adverse pregnancy outcome including the development of GDM, LGA and/or macrosomia, and primary caesarean delivery. They found strong, graded associations between fasting glucose level and primary outcomes but not preterm birth or neonatal intensive care admission. The frequency of GDM development increased from 1.0% in the lowest glucose category to 11.7% in the highest OR 11.92 (95% CI 5.39–26.37). The frequency of LGA neonates and/or macrosomia increased from (7.9 to 19.4%) OR 2.82 (1.67–4.76). Primary caesarean section rates increased from (12.7 to 20.0%) OR 1.94 (1.11–3.41). The compliance to the GDM guidelines was not assessed. The study was conducted in one healthcare centre which increase the bias because this might influence the results of the mode of delivery and NICU admission in that centre but not the other parts of the world. Some confounders, such as previous gestational diabetes mellitus or previous macrosomia, may have influenced clinical decisions such as the choice of delivery route.

The eighth criterion is consensus for treatment; all pregnant women with GDM should be treated when needed. In 1952, Jorgen Pedersen presumed his hypothesis on the impact of maternal hyperglycemia on adverse pregnancy outcomes such as macrosomia which is considered as the basis to current understanding of the fetal effects of GDM (HAPO 2008). The HCPs in PHCs can diagnose and manage GDM using the available GDM screening guidelines. The IADPGS, 2012 represented

document which consists of a consensus recommendation for screening and diagnosis of GDM. According to Agarwal (2018), management of GDM is important to reduce maternal and fetal complications. The treatment of GDM can be provided either by advising the woman with diet or offering oral hypoglycaemic medicine. The guidelines of dosage, frequency of glucose monitoring and time of delivery vary from one organization to another (Agarwal 2018).

The ninth criterion is the cost of case findings; GDM screening programmes should be cost-effective in screening women at an early stage for GDM. The cost associated with the screening of GDM differs from one country to another and according to the type of test used included FBS, RBS, OGCT (using 50 g), OGTT (using 75g or 100g), diagnostic criteria, universal or selective screening. A decision analytical framework was conducted by Jacklin et al. (2017) to compare the cost-effectiveness of the NICE (2015) national guidelines and the WHO (2013) international guidelines diagnostic thresholds for GDM. The population comprised women of gestational age 24–28 weeks without pre-existing diabetes. The three datasets are shown in the following table (3-2):

Table 3-2 The three datasets used by Jacklin et al. (2017) study.

HAPO	Norwich	Atlantic Pregnancy	Diabetes in
A dataset from the two UK (Manchester and Belfast) and two Australian (Brisbane and Newcastle) centres of the HAPO study,	These data were routinely collected between 2008 and February 2014 on women who had an oral glucose tolerance test	These data were collected between 2007 and 2013 in Ireland to improve pregnancy outcomes for women with diabetes	

referred to as HAPO (OGTT) on the basis of the before, during and after presence of one or more pregnancy. risk factors for GDM. The results were obtained from laboratory records with no identifiers.

The authors found that selective screening might increase missing cases of GDM so, there would be, on average, fewer adverse outcomes than in cases in a population with risk factors. The study's focus was on the optimal fasting level as this is where the greatest controversy lies concerning potentially missed treatment opportunities. The authors concluded that universal screening would seem to offer poor value for money and does not appear cost-effective compared with the current NICE guidance (2015) of targeting high-risk women.

No studies were found evaluating the cost-effectiveness of GDM screening in Oman.

A prospective cohort study examined the cost-effectiveness of the one-step International Association of diabetes and pregnancy study Groups Criteria (IADPSGC) (2012) for screening and diagnosis of GDM compared with traditional two-step Carpenter-Coustan (CC) criteria was conducted by Duran et al. (2014) in Spain. The use of IADPSGC resulted in an apparent increase in GDM rate (35.5% vs. 10.6%) and an improvement in pregnancy outcomes, with a decrease of premature birth rate (6.4 to 5.7%; -10.9%, $p < 0.039$), caesarean section (25.4 to 19.7%; -23.9%, $p < 0.002$), large for gestational age (4.6 to 3.7%; -20%, $p < 0.004$), and admission to neonatal intensive care unit (8.2 to 6.2%; -24.4%, $p < 0.001$). The cost of 100 women using two-step or one-step screening for GDM is estimated total cost savings was 14, 358. 06 evaluated using IADPSGC versus the group evaluated using CC. Despite the

increased apparent prevalence of GDM by a factor of 3.5, the introduction of the IADPSGC was cost-effective. Reduction in the caesarean section and low admission of neonates to intensive care contributed directly to saving money. The study showed evidently that 1) using IADPSGC was associated with a decrease in pregnancy adverse outcomes compared to the use of CC criteria, 2) the application of IADPSGC results in increases in the apparent prevalence of GDM, 3) it did not modify the percentage of patients needing insulin therapy and was accompanied with improvement in pregnancy outcomes, 4) finally, using of IADPSGC is cost-effective.

The last and tenth criterion is the process of determining cases of diabetes. Determining who has GDM among pregnant women should be followed up from the diagnosis during pregnancy to six weeks postpartum (MoH 2017). According to WHO (2016), GDM should be diagnosed at any time in pregnancy if one or more of the following criteria are met:

- fasting plasma glucose 5.1–6.9 mmol/L (92–125 mg/dL)
- 1-hour plasma glucose 10.0 mmol/L (180 mg/dL) following a 75 g oral glucose load
2-hour plasma glucose 8.5–11.0 mmol/L (153–199 mg/dL) following a 75 g oral glucose load

Risk factor screening includes family history, previous GDM, BMI greater than 30 kg/m², and previous macrosomia is used in some settings as a strategy to determine the need for a 2-hour 75 g oral glucose tolerance test (OGTT) (WHO 2016).

3.6. Summary

Screening of GDM meets the Wilson and Jungner (1968) criteria for screening for disease. The GDM guidelines exist nationally and internationally, but compliance with these guidelines needs to be further monitored. A large body of evidence (Crowther et

al. 2005; HAPO 2008; Landon et al. 2009) shows that perinatal complications due to GDM can be reduced with proper diagnosis and treatment. However, there is paucity in studies conducted in Oman and Middle East countries that examine the effect of GDM screening in reducing perinatal complications. Almost all studies reviewed in this section identified the poor consensus in GDM screening guidelines. There was no consensus on whether to offer all women routine screening tests for GDM or to offer women with risk factors of GDM only (Agarwal et al. 2015). Instead, the literature examined either selective or universal screening of GDM would be cost-effective (Jacklin et al. 2017; Crowther et al. 2005).

In comparison between the two trials, the ACHOIS (Crowther et al. 2005) and RCT of treatment for mild GDM (Landon et al. 2009), the ACHOIS findings determined that universal screening revealed a significant reduction in perinatal morbidity among low-risk women for GDM. The glucose tests used in the Landon et al. (2009) was 100g diagnostic OGTT, whereas a 75g OGTT was used in the ACHOIS trial. Both trials showed apparent compliance to the GDM guidelines, for example, the reduction in pregnancy adverse outcomes such as macrosomia, shoulder dystocia, and the increased risk of brachial plexus injury in the offspring of women with diabetes which are well documented. The authors found a reduction in the rate of shoulder dystocia when women with mild GDM received treatment (1%, vs 3% in the control group). However, both trials had insufficient power to detect significant differences in uncommon adverse outcomes such as injury to the brachial plexus. These tests were done to assess the reduction in the pregnancy adverse outcomes. The literature provided evidence that IADPSGC guidelines (2012), WHO (2013) and NICE guidelines (2015) are cost-effective. These guidelines that used in Oman are partially adapted from best practice.

Some studies examined the adherence of HCPs to the GDM guidelines (Sweetings et al, 2016; Edwards et al. 2014) and found that HCPs were not following the GDM

guidelines properly. This might be for different reasons; firstly, the GDM is asymptomatic, so the HCPs could not identify the pregnant woman if she had GDM unless she undergoes a diabetic test such as RBS, OGTT. Secondly, the routine workload and inappropriate education of GDM screening may lead to misdiagnosis in some women before 24 weeks of gestation. Thirdly, GDM screening guidelines need to be disseminated and discussed with stakeholders and pregnant women to improve the early detection of GDM (Pintaudi et al. 2016).

Healthcare professionals' behaviours towards the adherence to GDM screening guidelines will be elaborated in the following section. Several studies examined the HCPs compliance to GDM screening guidelines from different countries (Moses et al. 2003; Agarwal et al. 2015; Murphy et al. 2016; Bell et al. 2018).

The literature search identified several papers relating to barriers and facilitators (Légaré et al. 2008; Stuebe et al. 2010; Agarwal et al. 2015; von Treuer et al. 2018). However, these were not generally across GDM screening, instead they focused on barriers to organisational context such as lack of time, shortage of staff and work overload. Other barriers were identified, too, for example, the barrier to evidence-based practice and knowledge. The following section will discuss the literature identifying the level of awareness of HCPs regarding the screening of GDM guidelines. The barriers and facilitators faced by HCPs and potential when implementing guidelines will be discussed too.

3.7. Synthesising the literature

This section will examine the core literature that focused on the following:

- The compliance with the clinical guidelines

- Barriers and facilitators faced by healthcare professionals within the maternal health services.

3.7.1. Compliance of healthcare professionals with GDM guidelines

Five previous studies addressed the research question in terms of compliance to GDM guidelines, an audit, a survey and two cross-sectional studies (Moses et al. 2003; Ruengkachorn et al. (2006); Persson et al. (2009); Murphy et al. (2016); Bell et al. 2018). An Australian audit of birth records conducted by Moses et al. (2003) to determine the effectiveness of a policy of universal screening for GDM. The study evident that all obstetric care providers were highly compliant with testing. The limitation in this audit that the adherence to GDM guidelines among healthcare providers was not assessed. Furthermore, no consensus in GDM screening was found. Moses et al. (2003) found high compliance with testing by all obstetric care providers. The authors concluded that it remained essential to determine whether compliance with a policy of universal testing would be different in terms of reducing the prevalence of GDM if there was compliance with a policy of selective testing based on risk factors.

Contrary to the above study, a descriptive cross-sectional study conducted in Thailand by Ruengkachorn et al. (2006) aimed to evaluate the rate of non-compliance to clinical practice guidelines for screening of GDM and clinical risk factors. The researcher defined non-compliance as not to receive screening and diagnostic tests of GDM. About 159 pregnant women were included in the study with at least one risk factor for GDM at one hospital in 2004. The highest clinical risk was maternal age ≥ 30 years, found in 76.1% of the cases. The family history of DM2 was reported in 37.7%, obesity was at 10.1%, previous GDM was 2.4%, and no women had a previous history of congenital fetal anomalies. The rate of inadequate screening was highest among women who had ANC in private clinics (82.1%). According to the authors, this might be due to the cost of the test or the ignorance of the HCPs. Significantly higher compliance was found among women with two or more risk factors than women with

one risk factor for each group ($p= 0.028$). It is possible that a higher number of clinical risks raised more concern to the physicians, and the compliance rate was also increased. The authors suggested launching a policy to motivate and accentuate the importance of screening and diagnosis of GDM among the HCPs to improve the compliance of GDM.

Persson et al. (2009) conducted a retrospective cross-sectional study in Sweden that investigated compliance with a local screening of GDM guidelines and describes the outcomes of pregnancy and birth in relation to the risk factors of GDM in Sweden. Data were collected from questionnaire and medical records. Participants were put into four categories depending on the presence of the risk factors for GDM. The rationale for this categorisation was to compare the characteristics and outcomes of women with or without risk factors of GDM. Although the authors aware of the bias of data collection but they stressed that data were collected accurately, specifically that collected from the women in the first few days after delivery however, there were discrepancies between the midwives' records and physicians' records regarding data accuracy. The midwives' records found more accurate than physicians' records. The authors found that there was no national consensus addressing the screening for GDM in Sweden. It was evident in this study that not all women with risk factors for GDM will develop GDM during pregnancy.

The authors found that although it was recommended in the local guidelines that women with GDM risk factors should have an OGTT, one in three pregnant women with risk factors underwent an OGTT. The authors concluded that surprisingly low compliance with the local guidelines of screening for GDM was found, although the study did not investigate the possible causes for the low compliance with the local guidelines of screening for GDM.

A recent retrospective analysis of nulliparous women was conducted in Auckland, New Zealand, Adelaide, Australia, Cork in Ireland, and the UK (Manchester, Leeds, and

London) by Murphy et al. (2016). The study aimed to investigate compliance with risk-based screening for GDM. A total of 2432 nulliparous women with singleton pregnancies were recruited to a prospective cohort between May 2007 and February 2011. In Murphy et al. (2016), the study was restricted within the UK centres and Ireland using NICE local guidelines. Data collected on an internet accessed central database with a complete audit trail (MedSciNet). While data collection, the researcher found NICE screening guidelines (2015) were used to offer GDM screening in all sittings, however, in Ireland, maternal age over 40 years was identified as an additional risk factor. Whereas in Manchester, all risk factors were considered except the ethnicity was not included in their local guidelines.

Compliance with screening in the UKs centres was less than the Irish centres (42% vs. 71%). The obese women in the Irish cohort were correctly screened compared with women in the UK (78% vs 49%). Women who reported first-degree family relative with diabetes were not screened in 33% (n = 106) of cases. 29% (n = 88) of obese women (BMI \geq 30 kg/m²) were not screened from the whole population. A total of 54 women were diagnosed of GDM. All risk factors had poor compliance rate, and the reason was not clearly understood. The most likely risk factor that missed was ethnicity. This is because each hospital had a different policy which resulted in a lack of consistency for diagnosis GDM. A potential explanation for the failure to identify the risk factors was not performing the screening. Barriers to the screening included lack of motivation among the HCPs and women and fear of diagnosis of GDM. However, the facilitators included the HCPs and women in health education regarding the risk of undiagnosed GDM and the benefits of appropriate screening. The findings of the study strongly supported universal screening rather than selective screening. This is because even if the HCPs followed the risk-screening guidelines strictly, they would still miss 70% of cases. This result was similar to studies conducted by Ruengkachorn et al. (2006)

and Persson et al. (2009) that showed poor compliance with local guidelines ranging from 31 to 61%, respectively.

A national online survey conducted in England by Bell et al. (2018) to assess the compliance with NICE guidelines among healthcare professionals involved in care for pregnant women. They included in the survey a total of 113 NHS Trusts, and they received responses from 212 (84%) healthcare professionals from all England's regions, which indicate there is partial compliance with GDM NICE guidelines.

In regarding the screening methods (universal or selective) among the 106 Trusts that responded to these questions, the majority (n = 86, 81%) indicated that their Trust was compliant with NICE guidelines (2015) and used risk factors screening for 75 g OGTT at 24–28 weeks. Of the 106 respondents, 71% were using all the risk factors specified in the NICE guidelines to offer GDM screening, but only 61% were using these risk factors to offer OGTT and therefore fully compliant with the NICE guidelines (2015). Of all 212 respondents, 190 (90%) answered the questions relating to barriers to implementation of BMI risk-factor screening. Almost 40% of NHS Trusts were not fully compliant with NICE criteria for offering OGTT, primarily due to not complying with the previous GDM, BMI \geq 30 kg/m², and ethnic minority group risk factors.

3.7.1.1. Summary

From the review, it was found that all five studies provided a clear statement of their research aims and background information relating to the GDM screening of high risk women and the compliance with the GDM guidelines. Also, the aims and type of approach are clearly stated within the abstract or introduction. Few researchers supported the universal GDM screening to early detection of GDM (Moses et al. 2003; Ruengkachorn et al. 2006). However, many GDM guidelines focused on selective

GDM screening as cost-effective (Bell et al. 2018; Murphy et al. 2016). Persson et al. (2009) and Murphy et al. (2016) highlighted that implementation of GDM guidelines is a challenge for National maternity Health Services and a large proportion of women with risk factors do not receive an OGTT in Sweden and the UK.

Additionally, some important methodological limitations were identified from the studies. Three of the studies (Ruengkachorn et al. (2006); Persson et al. 2009; Murphy et al. 2016) included a section on ethical considerations, which is a key element in nursing research. The informed consent was gained from the participants before starting the study. According to Parahoo (2006) that some questions may contain sensitive issues that invade the participants' privacy, so it is important to include whether informed consent was obtained from the participants. However, the other two studies were considered an audit for the current practice so, no ethical approvals are required (Moses et al. 2003; Bell et al. 2018).

Persson et al. (2009) and Bell et al. (2018) used questionnaire to collect the data. The method of distribution of the questionnaire to the participants was different as Bell et al. (2018) used an online questionnaire and Persson et al. (2009) used pre-paid envelopes which were sent by post mail. The study findings could be used with caution because it was conducted by an online questionnaire that considered as one of the limitations as healthcare professionals may provide a general desirable answer (Bell et al. 2018).

Sampling criteria were not clearly explained which might affect the generalisation of the findings as it was a nulliparous, primarily Caucasian cohort, the results may not apply to high risk populations (Murphy et al. 2016). All studies outlined the inclusion and the exclusion criteria used for the sample. The sample sizes of the reviewed studies varied between 159 women (Ruengkachorn et al. 2006); 212 responses (Bell et al. 2018); 822 women (Persson et al. 2009); 1648 births (Moses et al. 2003) and 2432 women (Murphy et al. 2016).

A part of lack of motivation (Murphy et al. 2016); understanding what other barriers the HCPs are faced with that make the compliance to GDM guidelines difficult is crucial to improve screening of GDM.

3.7.2. Barriers and facilitators in the implementation of clinical practice

To achieve a high level of job satisfaction, HCPs should not experience constraints or situations in the healthcare settings that disable them from practising their role successfully (Spector and Jex, 1998). There are many barriers that contribute to the challenges of the effective implementation of guidelines. One of the barriers is organisational constraint: a presence of some factors that acts to create difficulty at workplace and interfere in an individual performance so he or she fails to complete the job properly (Pindek and Spector 2016). One of these constraints is work overload characterised by difficulties to complete the tasks because of doing many things simultaneously, which inhibit implementation of GDM guidelines accurately (Spector and Jex 1998). Other organisational constraints include lack of time, poor interpretation of GDM guidelines (insufficient training), standards of care (routine care in ANC), sense of competency (e.g., sufficient confidence in skills), uncertainty in the practice (performing unnecessary tests), and poor application of EBP (knowledge barrier) (Spector and Jex, 1998). The literature reviewed within this context is presented in the sections below.

3.7.2.1. Organisational constraints: work overload

Organisational constraints are defined by Peters and O'Connor (1980) as situational inhibitors to perform a job (Klein and Kim, 1998). These inhibitors include work overload, lack of time, lack of resources, lack of in-job training, and lack of motivation (Pindek and Spector, 2016). Firstly, two surveys will be discussed from Australia that highlighted the workload as a barrier to implement the GDM guidelines (Flack et al. 2010; Flack and Ross, 2016). Secondly, I discuss five studies that assess other

organisational constraints such as lack of time, lack of communication and job dissatisfaction (Légaré et al. 2008; Stuebe et al. 2010; Agarwal et al. 2015; von Treuer et al. 2018).

A survey in Australia was conducted by Flack et al. (2010) to assess the impact on HCPs workload when they used the recommended diagnostic criteria; IADPSG. The authors used secondary data to assess the impact on workload in screening GDM women with Australian Diabetes in Pregnancy Society (ADIPS). The proposed consensus cut-off criteria of FBS (5.1) where the findings revealed that the workload would increase by 57.9%, with an additional 731 women to be managed in the GDM clinics over the 21month period (Flack et al. 2010). The authors stressed that HCPs might face difficulties coping with the high number of women diagnosed with GDM under the new guidelines. The results did not present what is going on; instead, predicted that healthcare professionals (HCPs) will experience an increase in the workload. The participants were all pregnant women screened for GDM in six hospitals. Over two time periods, initially November 2005 to August 2007, and later September 2007 to August 2009. The authors concluded that the approach of change might need to be revisited, and health education might aid the understanding of the women to consume an appropriate diet.

An Australian survey by Flack and Ross (2016) re-assessed the impact on workload in GDM screening using ADIPS, but they used a one-page questionnaire with a yes/no answer. A questionnaire was distributed to the HCPs who work in the national association of diabetes (NADC). Of 96 members of NADC, 37.5% HCPs should have the knowledge and the capability to carry out changes in these guidelines. Globally, HCPs were qualified with different education levels such as diploma, bachelor's degree, and masters. However, the knowledge in terms of understanding the GDM guidelines is questionable.

Flack and Ross (2016) found in their survey similar findings to Flack et al. (2010) regarding concerns related to workload and workforce issues, the majority who changed to the new screening criteria of IADPSG reported workload increases which varied between 5 and 200%. Responses as to why services had not adopted new screening criteria predominantly related to workload and workforce issues. The numbers of women who have been diagnosed early with GDM tend to spend more extended periods in the clinics, which ultimately increased the workload of the healthcare providers. Flack and Ross 2016 concluded that recommended early GDM screening and new diagnostic criteria acceptance far from complete with significant workload increases almost universal.

A systematic review by Légaré et al. (2008) in Canada identified the barriers and facilitators to the implementation of clinical guidelines. They included English articles and a French article in their review. The reason for using English language publication was for consistency in analysis of literature as some of literatures were conducted in non-English speaking countries which can lead to bias in publication. The authors focused on implementation of decision-making in the clinical practice. The participants in the above studies where healthcare professionals include nurses, physicians, and allied healthcare professionals. The inclusion criteria in these studies were primary studies of barriers and facilitators by the HCPs of clinical guidelines. The findings revealed that time constraints were the most cited barriers for implementing the decision-making across many different cultural and organisational contexts. There was general consensus on lack of resources and lack of agreement on applicability with shared decision-making due to the clinical situation. Overall, Légaré et al. (2008) evident that gaps in knowledge still exist, and no consensus was made to reduce these gaps in the implementation of decision-making implementation within the clinical practice.

Clinical guidelines are designed to standardise the care and act as a guide for the HCPs to make informed decision making (Jun et al. 2016). A systematic review was conducted in the United States of America by Jun et al. (2016) to appraise and synthesize the current literature on barriers and facilitators in the use of clinical practice guidelines by registered nurses. Sixteen articles were identified that met the aim of the research. The findings indicated those nurses' attitudes in implementing the clinical guidelines were highly positive compared to the physicians ($p < 0.001$). The study also showed that nurses had a lack of motivation in using the clinical guidelines at work resulted in a reduction in using these guidelines. Furthermore, the study shows there was a lack of leadership that led to creating confusion and uncertainty in which reduced the adherence to the guidelines. Lack of awareness that created a gap on how to implement the clinical guidelines was identified by the physicians.

Furthermore, a lack of understanding of the contextual factors for an organisation may affect the success of change in the work environment as stated by von Treuer et al. (2018) who conducted a survey in Australia. The aim was to examine the effect of organizational climate and leadership variables on organizational readiness for change. Two hundred and fifty-five employees from 21 residential institutions were included. Two hundred and two participants (87%) were female, and 33 (13%) were male. They were divided into two groups; a management group that include nurses, physiotherapists, allied health, and a non-management group that include Personal Care Assistants (PCAs) or Direct Carers and other respondents such as leisure and lifestyle staff, an administration manager, and a cleaner. The finding revealed that the relationship between work pressure and readiness for change was positive. So, workers may perceive that any change will alleviate pressure and consequently look forward or are ready for a change to produce that positive outcome.

In European peer-reviewed literature study by Buckley et al. (2011) aimed to identify and review the best available European evidence from (Austria, Belgium, Denmark,

Finland, Italy, Ireland, the Netherlands, Poland, Spain, Switzerland, and the UK) relating to current screening practices and barriers to screening. The authors found that one of the barriers that contributed to inconsistent clinical practice in screening for GDM was the lack of consensus on best practice for the detection and diagnosis of gestational diabetes, contributing to inconsistent clinical practice in screening.

Stuebe et al. (2010) from the USA conducted a survey that assessed the barriers to implementing of GDM guidelines. They recruited different HCPs, including obstetricians, gynaecologists, certified nurse-midwives, primary care physicians and nurse practitioners who provide first-line care for pregnant women, the total response rate of 43.3%, 84.0%. Stuebe et al. (2010) found that lack of communication between obstetrician-gynaecologists (OB) and primary care providers, and to a lesser extent, lack of provider awareness of guidelines, as major barriers to screening. This study was assessed for validity by included a small group of physicians for a pilot study.

A survey was conducted by Agarwal et al. (2015) in the Middle Eastern (include UAE and Oman) and included 21 questions to physicians in seven hospitals in the UAE and one hospital in Oman. The survey aimed to appraise the current regional practice screening, diagnosis, and follow-up of GDM because of the inconsistently GDM screening approach. The authors did not include nurses or allied health in the survey. Agarwal et al. (2015) found physicians' evident poor knowledge of Hyperglycaemia and Adverse Pregnancy Outcome study (HAPO), 2008, and international association of diabetes and pregnancy study groups (IADPSC) guidelines on screening of GDM women (69% vs 61%) respectively. The university/ academic physicians were not any more aware compared with non-academic physicians of either the HAPO study or IADPSC recommendations.

In summary, four surveys discussed the organisational constrains such as lack of time, lack of resources, lack of communication and work overload, in Australia and one in the UAE. Most of the studies obtained ethical approval before conducting their surveys

however one study did not require ethical approval because it was conforming to the standards established by the National Health and Medical Research Council for ethical quality review (Flack and Ross 2016). In some studies, methodology was not reported which affect credibility and transferability of the finding (Agarwal et al. 2015; Von Treuer et al. 2018). However, validity and reliability of the instruments used in one survey (Stuebe et al. 2010) was discussed as they developed the survey questions based on previous survey conducted in their institution.

An integrative review that examined the barriers and facilitators of the use of clinical guidelines by nurses in the clinical placements in the USA, Jun et al. (2018) reviewed papers on nurse's attitudes, perceptions, and knowledge of the clinical guidelines. The inclusion and exclusion criteria were stated clearly in the method section in all reviews (Légaré et al. 2008; Buckley et al. 2011; Jun et al. 2018). The quality of the studies included were assessed by two reviewers using mixed methods appraisal tool to appraise complex qualitative, quantitative, and mixed methods literature (Jun et al. 2018). In Légaré et al. (2008) the quality of the studies was assessed using Quallsyst validated tools by two reviewers independently. However, in Buckley et al. (2011) the name of the quality appraisal tool used for the assessment of the included studies was not specified. The inclusion of the studies was based on the relevance to purpose of the study and based on conceptual richness of the studies.

There were similarities in the above reviews' findings including lack of familiarity, awareness, and agreement with the applicability of the clinical guidelines and time constraints. These findings confirmed the poor adherence to the implementation of clinical guidelines. On the other hand, the authors highlighted the facilitators include education and continuing education to increase the awareness and familiarity of the clinical guidelines among the HCPs. These can be improved by ensuring regularity in checking the availability of the required equipment's in the clinical settings and

continues motivation of the HCPS which can be achieved using clear communication among disciplinary (Légaré et al. 2008; Buckley et al. 2011; Jun et al. 2016).

3.7.2.2. Barriers to knowledge

Darker et al. (2018) determined the barriers and facilitators to the implementation of 33 national clinical programmes (NCP). The authors interviewed 33 participants and highlighted a variety of factors of different combinations and co-occurrence by identifying six themes identified through interviews in their qualitative study in Ireland. The themes were: leadership, governance, and clinical networks; social and political context; resources (both in terms of funding and manpower); resistance to change; data and information systems; and changing the model of care. The authors found that lack of communication process led to unnecessary confusion and uncertainty within NCP network.

In the USA, a qualitative study was conducted by Mersereau et al. (2011) focused on barriers that pregnant women and the HCPs may face in control the glycaemic profile and reduce adverse pregnancy outcomes. Focus groups were conducted with physicians, midlevel practitioners, and certified diabetes educators in Georgia by Mersereau et al. (2011). Data collection was performed in Atlanta, in December 2003. The study consisted of 53 participants in six groups, selected according to a convenience sample. Inclusion and exclusion criteria were included in the study. Results concluded no guidelines for educating pregnant women that physicians and midlevel practitioners would refer to and lack of educational materials. The authors used medical records to determine whether patients complete screening and have found low utilization rates. Primary care physicians (PCPs) reported that they were unlikely to assess a woman's GDM history (74.3 vs 21.5%, $p < 0.001$), and OBCPs reported that they were unlikely to order screening for women with a known history of GDM (72.9 vs. 41.0%, $p < 0.0001$). The authors reported that (50.0%) of the HCP in

primary healthcare settings had lack of familiarity with GDM screening guidelines, a lack of screening for a GDM history (43.0%), and a lack of patient understanding about the long-term risks associated with GDM (41.5%). OBCPs and PCPs opinions were similar regarding barriers ($p > 0.2$ for all comparisons) except follow-up for abnormal glucose screening results: 13.9% of OBCPs identified difficulty of follow-up as a significant barrier compared with 3.4% of PCPs ($p = 0.01$).

The findings revealed that most healthcare practitioners had some point of reference for guidance in caring for pregnant diabetic women. However, few practitioners reported that the guidelines were not universally used. Practitioners grouped their perceptions into three: lack of knowledge, awareness, access, and attitudes barriers such as lack of compliance. Some practitioners stated they had no formal guidelines, some of them stated that they had an internal checklist and others stated the use of the internet to find information and they recommend it to their clients.

An Australian survey conducted by Wilkinson et al. (2013) aimed to describe this assessment and the planned intervention to implement a schedule of dietician consults for GDM care. Data collection for 44 participants was via hospital records, clinic observation, and staff surveys. The authors found a lack of staff awareness of GDM Nutrition Practice Guidelines and lack of staff 'belief' in benefits of seeing a dietitian or GDM/benefits of on-going dietetic support/importance of dietary modification. This indicated poor compliance with the GDM guidelines.

Utz et al. (2017) used structured interviews to assess knowledge and practice regarding screening and management of GDM amongst general practitioners (GPs), nurses and midwives working in a primary healthcare facility in Morocco. The study aimed to assess the knowledge and practices of GPs, nurses and midwives working at primary health care facilities in Morocco regarding screening and management of gestational diabetes (GDM). Data were collected from 100 doctors, midwives, and nurses at 44 randomly selected public healthcare centres. The authors stressed that

the results of this study should be handled with caution and direct observation is essential to provide a realistic presentation of the current situation in the PHCs. The authors did not assess the confidence of the HCPs in screening for GDM. They concluded that updating the knowledge and skills of the HCPs for national GDM guidelines through education and in-job training is vital.

Wilkinson et al. (2019) conducted a qualitative descriptive study in Queensland in Australia used a purposive sample of eight participants from two regional sites. Five participants were from one site, which indicates an imbalance between both sites, and the results might not apply to other sites, which led to poor generalisation. The semi-structured interviews were conducted via telephone, and they lasted between 9- 37 minutes which indicated that some interviews were very short, which might be not much information the participants wanted to share. Four main themes were divided with reference to the study include 1) catalyst for positive change in the local delivery of GDM services. 2) Managing project logistics as some participants expressed uncertainty about their project roles and methods, and processes. Work overload, lack of time, and lack of understanding of the project. 3) Overcoming barriers include resourcing constraints and communication processes within sites. 4) Achieving change as they acknowledged improved clinical practices within the border model of care. The changes adopted within the project improved patient outcomes. The participants found that the inclusion of dieticians in a stronger team approach was well appreciated. The participants stressed the importance of regular communication with all stakeholders during site engagements.

3.7.2.3. Barriers to the application of Evidence-Based Practice

Implementing best practice at healthcare institutions helps in improve the individual's wellbeing and ensure delivering of high-quality care. There are many terminologies used concerning evidence-based practice (EBP), evidence-based nursing practice,

evidence-based medicine (EBM), evidence-based decision making and evidence-based healthcare (Barker et al. 2016). According to the USA, National implementation Research network, 2015, EBP is used in healthcare services to reduce the gap between the research findings and the practice and to deliver optimally and high quality of care for the public. The most widely accepted definition accepted across all professions in healthcare for EBP is defined by Sackett, 1996,

“Evidence based medicine is the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients. This means integrating individual clinical expertise with the best available external clinical evidence from systematic research” (Sackett et al. 1996, p 71).

Regarding EBP that includes the patient’s involvement, this is defined by Peile, 2004:

“Evidence-based practice entails making decisions about how to promote health or provide care by integrating the best available evidence with practitioner expertise and other resources, and with the characteristics, state, needs, values and preferences of those who will be affected” (Peile 2004, p103).

Part one highlighted the poor uptake in EBP within the HCPs in PHC in Oman. This section explores relevant literature that examines the barriers to implementing EBP in different settings in healthcare institutions in Oman and different countries worldwide. This is to understand the process that can be used to overcome the barriers. To plan and target strategies that are effective and sustainable, it is important also to understand factors and experiences that influence the implementation of best practice guidelines (Ploeg et al. 2007; Francke et al. 2008). Hannes et al. (2010) conducted a qualitative study in Belgium that explored the barriers in the implementation of evidence-based practice experienced by psychiatrists. included 39 psychiatrists were categorised into interest to evidence-based practice (EBP), expertise with EBP, geographical region, and setting (in-out patient care). They were divided into five groups ranged from 6 participants to 16 according to the variability in the treatment approaches of participants and organised between September 2004 and September 2006. They reported that a major theme when considering evidence implementation, the characteristic of the evidence. This was informed on lack of use of evidence due to

heavy workload, which makes it difficult to locate a proper time for reading an article. In addition, poor quality and applicability of research in practice led to poor application of EBP.

Scholars found that barriers include lack of time, knowledge, resources, and work overload references. Additionally, HCPs feeling discouraged (lacking in confidence or enthusiasm; disheartened) or their supervisors discourages them from being active to care for clients (Hannes et al. 2010). The majority of these barriers arise when evidence and clinical guidelines were proposed into routine daily practice (Grol and Grimshaw 2003).

The following discussion will present studies using implementation science and determine the barriers that HCPs are exposed to in clinical settings.

Evidence-based medicine (EBM) is considered in Oman and other Arab countries such as the Middle East and Arabian Gulf countries. Albarrak et al. (2013) conducted a cross-sectional study in Dubai between June and August 2010 in two phases, 48 participants responded to the survey questionnaire, and 13 responded to individual interviews. The study aimed to assess the current EBM knowledge, attitude and perceptions of physicians and evaluate barrier and facilitator factors toward implementing EBM. The physicians who attended EBM courses 70.3% reported using EBM. More than half (65.0%) of the physicians believe that between 50% and 75% of the patients are capable of participating in the clinical decision, while Two-third (71.8%) of the respondents reported the concept of EBM is applicable to their culture. About a third of the participants reported no access to the EBM resources such as literature, Journals etc, and had no time to practice the EBM because of work overload (37.0% vs 38.0%, respectively). 27.0% of the participants identified the threat to clinical freedom/judgment as the second most frequent barrier toward implementing the EBM. Lack of encouragements for the administration to attend EBM courses was mentioned by the interviewees (40.0%). Senior physicians' resistance to change their practice

(30.0%) was the second most frequent reason for not applying and practising the EBM in clinical practice. Language barrier was a barrier, for example, communicating using the English language. Another factor was highlighted by the authors that insufficient dissemination process for implementing the clinical guideline acts as a barrier for accurate implementation of best practice.

Similar findings were reported by Ammouri et al. (2014), who conducted a descriptive, cross-sectional study in Muscat, Oman. They distributed Self-reported questionnaires (evidence-based practice questionnaires, EBPQ) in four hospitals in Muscat. The study aimed to examine and describe the practices, attitudes, and knowledge/skills associated with EBP, as well as the perceived barriers to EBP implementation reported by nurses in Oman. In Oman, several initiatives have been implemented to train health personnel working at the MoH and SQUH to use EBP. Conferences and workshops have been conducted by experts from the USA, UK, and Australia to train medical and nursing staff on the concepts and application of EBP. However, the study did not state the number or percentage of nurses encouraged to attend these conferences and workshops. The sample comprised 414 nurses. The EBPQ results found that the attitudes had the highest positive response 75.4% followed by the practice 74.6%, and then the knowledge/skills 63.3%. The results from the Developing Evidence-Based Practice Questionnaire (DEBPQ) indicated that the greatest barriers to EBP were the difficulty in finding research reports 77.1% and insufficient time to find research reports 60.4%. The lowest scored barriers did not know how to find and difficulty in finding organisational information, e.g., guidelines of protocols (46.1% and 46.6%, respectively). Insufficient resources to change practice (70.6%) and insufficient time at work to implement changes in practice (62.2%) were identified as the two greatest barriers to changing practice. The least significant barrier to changing practice was a lack of confidence (40.3%). Insufficient time and resources were identified as the main barriers to using EBP among nurses in Oman. The greatest barriers to developing EBP

among nurses in Oman were insufficient time to find and read research and insufficient resources to change their practice.

3.7.2.4. Summary

The literature identified several factors that affect the accurate implementation of GDM guidelines among HCPs, including lack of awareness, lack of time, lack of knowledge, and lack of resources. The heavy workload was the main barrier in the implementation of GDM guidelines. Most qualitative studies were appropriate to explore the participants lived experience with a barrier to knowledge (Darker et al. 2018; Mersereau et al. 2011; Utz et al. 2017) and barriers to utilisation of evidence-based practice (Hannes et al. 2010). A descriptive qualitative design is appropriate to address the objective to describes stakeholder experience and learnings to inform the implementation of the model of care (MOC) across Queensland (Wilkinson et al. 2019). Regarding the eligibility criteria, three studies (Hannes et al. 2010; Mersereau et al. 2011; Darker et al. 2018) explicitly outlined the inclusion and exclusion criteria used for the sample except for the studies. The sample size varied from eight (Wilkinson et al. 2019) and 33, 39, 53, 100 participants (Darker et al. 2018; Hannes et al. 2010; Mersereau et al. 2011; Utz et al. 2017). This sample size has considered relevant to a qualitative study because it does not aim of generalisation but rather at developing an in-depth understanding and representative of the sample in these studies (Creswell and Clark 2017). Two qualitative studies collected data by combining interviews with focus group discussion. Two studies used face-to-face interviews and telephonic interviews. One qualitative study provided information regarding reflexivity with an explanation about the pilot of the interview schedule (Darker et al. 2018). No data had provided about the researchers' position in the remaining qualitative studies.

Regarding the validity and reliability of the survey, the researcher followed the outline recommended by French et al. (2012) that involved four steps assessing the

influencing factors and the design of implementation strategies in a translational research project (Wilkinson et al. 2013). The study guide by using the Theoretical Domains Framework. In Albarrak et al. (2013) cross-sectional study findings could be used with caution due to small sample size. The use of interview in the survey is considered as a strength because physicians may ask for clarification before responding to the questions to increase validity. There were several limitations with Albarrak et al. (2013) and Ammouri et al. (2014) as they assessed the knowledge and attitudes amongst only one category of healthcare providers (physicians or nurses). There is a need for research that examines barriers to the implementation of EBP for multidisciplinary healthcare providers. Albarrak et al. (2013) stressed that barriers to implementation of EBP had found more among the senior physicians. On the contrary, Ammouri et al. (2014) reported that nurses who had more years of experience had reported more frequent use of EBP. This may be due to cultural differences within healthcare provision between Oman and Dubai.

3.8. Conclusion

To summarise, several studies discussed changes in the GDM screening and diagnosis guidelines (WHO 2013; IADPSG criteria 2010; NICE 2015) and how to utilise findings in the clinical settings to improve the quality of maternal and child healthcare. Part one of this chapter highlighted GDM screening globally and in Oman using principles of screening criteria by Wilson and Jungner, 1968. The literature review demonstrated there is no united GDM screening and diagnosis guidelines that can be used worldwide. Two types of screening (universal and selective) screening were discussed. Most guidelines use selective screening because it is cost-effective. The literature review revealed few studies which focused on compliance of healthcare professionals to GDM screening guidelines. The few that have been conducted

included an audit from Australia, one from Thailand in Asia and one retrospective study from Sweden in Europe. A qualitative study was conducted in Morocco investigating the knowledge and practice of HCPs in using GDM guidelines; however, no study had yet been conducted in Oman or Gulf countries about compliance with GDM screening guidelines. Thus, GDM screening guidelines were recommended by experts in the field and were considered best practice to implement in clinical settings. HCPs compliance with screening guidelines is an important aspect of antenatal care which ensures that they are practising the best practice and enable them to detect the GDM in an early stage. To evaluate the compliance to the best practice would require further research.

Secondary outcomes among staff include lack of awareness, lack of confidence, and lack of self-efficacy (Légaré et al. 2008; Wilkinson et al. 2013). Facilitators that were identified include motivation of the healthcare professionals, shared decision-making leads to a positive impact on the patient's outcomes and on clinical process and understanding of HCPs for implementation science will contribute effectively on improving the implementation of GDM guidelines (Légaré et al. 2008; Wilkinson et al. 2013).

The literature confirms the association and correlation between GDM and certain risk factors; however, GDM may also occur in the absence of identifiable risk factors. Therefore, there is a need to study the risk profile of women who are likely to develop GDM, which will help physicians recognize GDM and advise women to modify their lifestyle appropriately early enough to minimize consequences to them and their fetus.

In Chapter 4, I explain how women are screened in Oman and investigate the reason for missing cases. Barriers in implementing the GDM guidelines were highlighted in this chapter include organisational barriers to GDM screening, screening used in Omani culture and other similar culture in neighbourhood countries. There is a gap in the literature highlighted by the absence of capacity in implementing evidence-based practice in clinical settings. The aspects of understanding the implementation of the

guidelines were poor among HCPs, and very little literature identified how to overcome the barriers to implementation of GDM guidelines.

Chapter 4. Methods

4.1. Introduction

The study reported in this thesis is a mixed-methods study including a retrospective review of case records, followed by qualitative face-to-face semi-structured interviews with healthcare professionals (HCPs) in primary healthcare centres (PHCs) in Oman. In this chapter, I describe the philosophical underpinnings of the research paradigms, study design, locations, sampling, inclusion and exclusion criteria, data collection methods, the process for recruiting HCPs to the study and data analysis. I describe the research design, the ethical review process; permissions granted by Cardiff University as well as Oman and explore the quality of the study design in terms of considerations such as validity through feasibility and reflexivity.

4.2. Philosophical underpinnings

Acquired knowledge has traditionally been divided into two paradigms: positivist and interpretivist (Guba and Lincoln 1994), although the paradigm currently preferred by most researchers using mixed-methods is pragmatist (Johnson and Onwuegbuzie 2004). For this study, the most suitable paradigm to use is pragmatism, which combines aspects of both positivist and interpretivist approaches. Guba and Lincoln (1994) define research paradigms as a set of belief systems including axiology, ontology, epistemology, and methodology assumptions. Morgan (2007, p49) visualised research paradigms as “systems of beliefs and practices that influence how researchers select both the questions they study and methods that they use to study them”. Epistemology refers to the development of knowledge and is usually concerned with what does or does not constitute knowledge; it is questioning the reality that must be justified in some way. Ontology is a sub-division of philosophy, dealing with the essence of phenomena and the nature of its existence and methodology. It refers to what would be known (Symon and Cassell 2012).

For the purposes of this study, my epistemological position was obtained from the literature review, which highlighted the nature of knowledge and identified the best path to follow in designing this study. The literature review described studies that highlighted the global deficit of a united consensus for screening and diagnosis of GDM. It also identified potential barriers to and facilitators of the implementation of GDM guidelines in Oman and other Middle Eastern countries. Barriers identified in the literature included work overload, staff shortage, and inadequate training updates on evidence-based practice. Striving to improve the quality of work within organisations would be essential for the healthcare system in Oman. The semi-structured interviews were conducted to explore the perceptions and experiences of the HCPs when implementing GDM screening in PHCs in Muscat.

Ontology is allied to the reality of the researcher's knowledge and what there is to know about the world (Guba and Lincoln 1994). Although the characteristics of ontology might be unknown, it does however, exist in reality, potentially waiting for researchers to conduct their assessments and discovery (Symon and Cassell 2002). In this study, my ontological perspective was that knowledge of the GDM guidelines among HCPs exists but is subject to individual interpretation related to context. My aim was to understand HCPs perspective towards the reality of their experiences regarding the implementation of the GDM guidelines.

Methodology refers to a theoretical and philosophical system that structures the way research is conducted. This is then shaped by the researcher's experience in collecting and analysing the data (Guba 1990; Creswell 2013) guided by the ontological and epistemological beliefs of the researcher. During this study, I adopted an approach that explored both the participants' perceptions and their experiences in implementing the guidelines.

Axiology highlighted my beliefs, values, and reflexivity during my journey as a researcher (see section 4.11). In 2015, the MoH in Oman updated the GDM guidelines and distributed these to all governmental and private healthcare institutions in Oman. The updated guidelines aimed to increase early detection of GDM and provide good quality of care to reduce the chances of adverse pregnancy outcomes. These guidelines were circulated and were in use by the HCPs.

In Oman, there was a paucity of literature that assessed the implementation of the 2010 and 2015 GDM guidelines. Within the annual yearly statistics (2014, 2015, and 2016), the MoH reported an increase in the number of women diagnosed with GDM. This apparent increase might be due to changes in lifestyle and an apparent increase in obesity amongst women. In this study, a retrospective review of case records was undertaken to identify compliance with the GDM 2010 guidelines. Face-to-face interviews were chosen as a means of exploring how HCPs implement GDM screening

guidelines in PHC settings and to explore barriers and facilitators of implementing these guidelines.

Greene et al. (1989) stated that triangulation is one of the five elements present when conducting mixed-methods research (the other four being complementary, development, initiation, and expansion). Triangulation refers to using multiple methods of data collection, such as documentation, observations, and interviews (Polit and Beck 2018). Creswell (2013) states that in triangulation, the researcher includes evidence from multiple and different resources, theories, and methods.

4.3. Pragmatic paradigm

In mixed-methods design, the pragmatism paradigm focuses on the outcomes of the research, merely asking, “what works?” (Creswell 2012; Morgan 2013). According to Polit and Beck (2018), some researchers prefer the use of pragmatism paradigm in mixed-methods research, as it helps the researcher to drive the design of the study. Pragmatism is defined as the workable approach to problem-solving (Morgan 2013). Thus, using a pragmatic approach to determine the reasons behind the attitudes and behaviours of the HCPs was considered an appropriate research design.

4.4. Research design: a mixed-method design

A quantitative study alone was not adequate for this research. Bryman (2012) notes that the term ‘mixed-methods’ research refers to combining quantitative and qualitative research within a single project. The two approaches can be integrated into various ways and frame the study within a specific design (Creswell 2015a). The rationale behind using a mixed-methods approach in this study was to explore the compliance to 2010 GDM guidelines among HCPs and identify any barriers and facilitators faced

during the implementation of these guidelines. The results of the study will be used to determine recommendations for behavioural changes for the HCPs. A convergent mixed-methods design was selected for this study (see figure 4.1). This design is the most familiar amongst the core, and complex mixed-methods approach (Creswell and Creswell 2018). This design consists of combining the quantitative and qualitative data within a single-phase approach, in which the researcher collects both quantitative and qualitative data, then analyses them separately (Creswell and Creswell 2018).

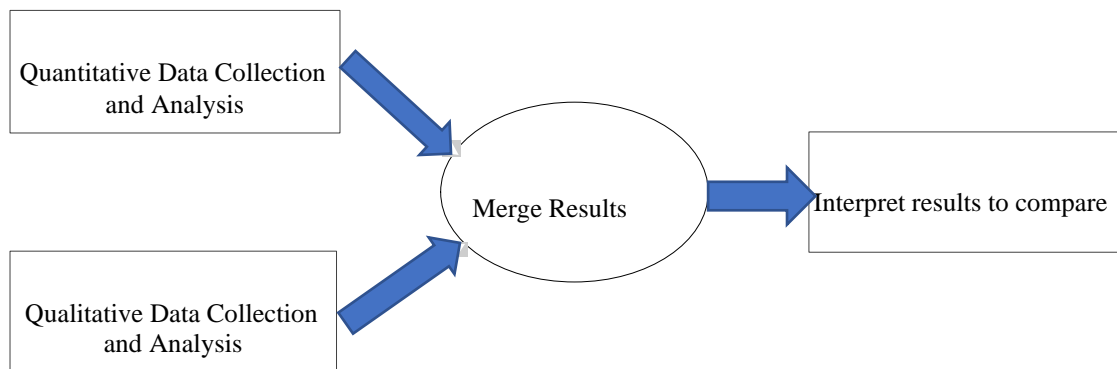


Figure 4-1 Convergent Design (one phase design) from Creswell and Creswell, (2018)

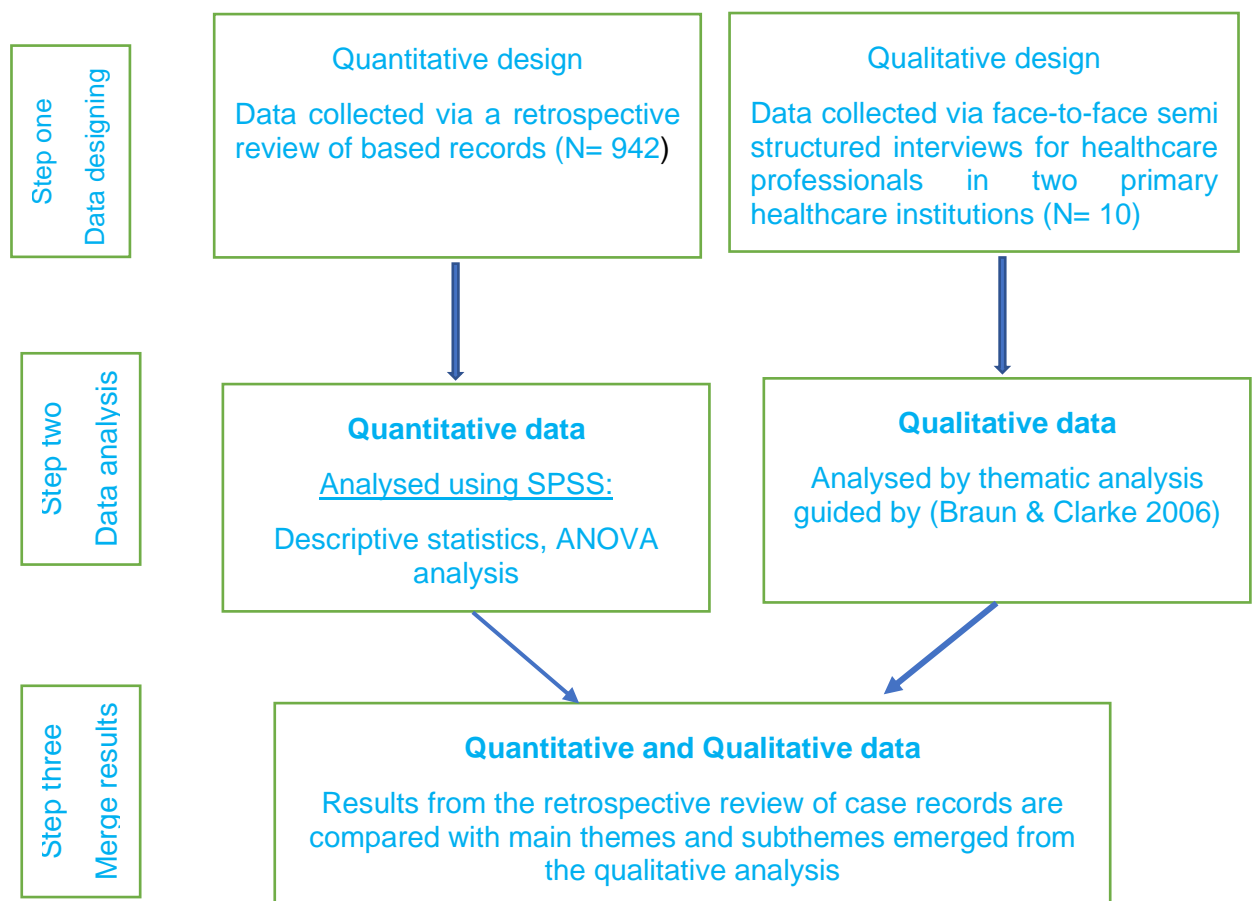
I have chosen this design to obtain different data from two different approaches, which complement each other, to best understand the research problem (Creswell 2014). It is an appropriate design for researchers who wish to collect quantitative and qualitative

data in a single visit and have only limited time for data collection (Creswell 2014). During the second year of my PhD study, I paid a visit to Oman for the purposes of data collection and found this approach to be the most appropriate way to address the research questions of this study for several reasons. In the first instance, this research explored the complexity of implementing GDM guidelines in PHCs and conveyed the multiple perspectives of the participants in Oman (Creswell et al. 2017), which had not been previously explored. This supported the need for a comprehensive research approach. The convergent parallel design in this study involved an illustration of results from the retrospective review of case records and a presentation of findings from face-to-face interviews with HCPs regarding their implementation of GDM screening in Oman. Data from both methods have equal importance when it comes to addressing the study's research questions. The integrated complementary data from both sources was used to develop a comprehensive understanding of compliance to the GDM guidelines in Oman.

A plan for this study is provided, showing the steps taken to implement the convergent design, based on a flow chart by Creswell (2014) (see figure. 4-2). The first step of this selected design is data collection, namely a retrospective review of case records regarding screening GDM in Oman, utilising routinely collected data from PHCs. Within the qualitative design, face-to-face interviews with HCPs exploring current practices in two PHCs in Muscat were employed, the overall aim being to gain an in-depth understanding of HCPs experiences around implementing GDM screening guidelines in Oman. Data were collected concurrently, in which quantitative and qualitative data were independent of each other yet collected at approximately the same time.

Further detail of data collection is provided in chapters 5 and 6. The second step was the analysis of quantitative and qualitative data, which took place separately, using standard procedures applicable to each type of data. More details of the analysis procedures conducted on the quantitative and qualitative data are provided in chapters

5 and 6. Once the two data components were finalized, they were merged by directly comparing and contrasting the quantitative results obtained from the survey with the findings from the thematic analysis. Thematic analysis is an inductive approach used in qualitative research, in which the researcher aims to identify the themes that emerge from their data (Harding 2013). Finally, the merged data was interpreted and examined to ascertain the degree to which they matched or differed, how they related to each other and whether they could be combined in order to provide a better understanding of the study's overall purpose.



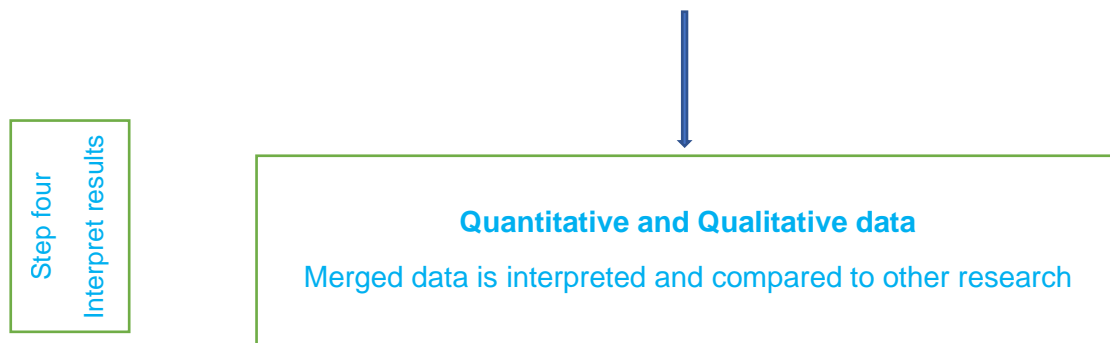


Figure 4-2 Flow chart of the convergent method design according to (Creswell 2014, p79)

Regarding sampling, there were two criteria used: time orientation and relationship of the qualitative and quantitative samples (Onwuegbuzie and Collins 2007). This mixed-methods approach enabled the identification of the strengths and weaknesses of screening for GDM in Oman and offered in-depth insights into the HCP's implementation of GDM screening. According to Giddings and Grant (2009), validation strategies include the articulation of the research question, use of triangulation, establishing audibility, expert critique and use of member checking. Some of these validation strategies were applied appropriately for each phase of the study to promote the integrity and the quality of this mixed method. For example, it was important for me to structure a clear research question that could guide me through the process of data collection and data analysis so as to ultimately obtain a clear answer.

4.4.1. Phase 1: a retrospective review of case records

A retrospective review of case records involves using existing data that has been recorded in an organisation for purposes other than research (Hess 2004). A retrospective review of case records was considered appropriate for this study because the required data was present in the antenatal registry book and the

electronic record health system (computer system) in the PHCs. Convenience sampling is a non-probability sampling method and was felt to be suitable for this study. The advantage of convenience sampling is that the researcher can enrol subjects according to their availability and accessibility (Elfil and Negida 2017). The present study included data relating to women who registered their pregnancy in one PHC (PHC1) in the Muscat governorate. Where women were referred to secondary care for part of their antenatal care, including GDM screening, these records were accessed from the relevant secondary healthcare institution (SHI1). The retrospective review is a quick, convenient, and inexpensive method that allows data collection from a large population (Jones and Rattray 2010).

4.4.2. The rationale for conducting the retrospective review.

The initial plan for this thesis was to conduct a cross-sectional survey across two large health centres in the Muscat governorate. However, during the data collection, I requested help to access the data from the electronic record health system from the Directorate of Information Technology (DIT) at MoH Headquarters. Unfortunately, the DIT staff experienced some challenges when attempting to extract the data due to technical faults within the records section. Therefore, I decided to access the data manually from each health centre; this included the data extracted from the ANC registry book that was used to record the demographic and clinical details of each pregnant woman. Also, I used the electronic record health system, which is a computer system used in all governmental PHCs in Oman to record details of the client visits. I found it hard to do it by myself because the possibility of making errors would be high. So, I hired an assistant who is not from the healthcare field but has knowledge and skills in using computers.

Before the data collection began, one of the PHCs (PHC2) apologised, saying that the antenatal care registry book had been destroyed for the year 2014, meaning that data

could be collected from only one healthcare institution. During data collection, the screening procedures for GDM of over 1,000 women from PHC1 were manually extracted. Unfortunately, some data was incomplete, as no records were found in the electronic record health system or the antenatal registry book for certain variables, including OGCT and OGTT. I requested permission to access the data for the same women from SHI1. The request was granted from (Directorate General of Healthcare Affairs) DGHA and DIT. This data was accessed in the secondary healthcare institution, but again the records were incomplete. After discussion with the medical officer in-charge and nurse in-charge in PHC1, they suggested it might be possible to find the records of blood glucose from the maternal health cards, held by the individual women. However, accessing maternal health cards was not possible as ethical approval had not been obtained for this, as I was initially unaware that HCPs had not maintained complete records in the electronic record health system and antenatal clinic registry book.

4.4.3. Phase two, Face-to-face interviews

In scientific research qualitative interviews are referred to as:

“Getting a better understanding of reality” (Wengraf 2001, p3).

The purpose of conducting in-depth semi-structured interviews is to develop/ construct/ test or verify a ‘model’ of some aspect of reality (Wengraf 2001). Semi-structured interviews are organised around pre-set open-ended questions, with other questions emerging from interviewees’ replies (DiCicco-Bloom and Crabtree 2006; Bryman 2016). One of the main advantages of semi-structured interviews is creating a successful dialogue between the interviewer and interviewee (Kallio et al. 2016). The interview flow can be flexible; for example, the researcher might not fully adhere to the planned questions but develop a natural flow of conversation (Gibson and Brown 2009). Face-to-face interviews are usually conducted over a period of 30 minutes up to

several hours, dependent on the topic of research and whether it is an interview with individuals or a group of people (Kallio et al. 2016). In this study, I conducted one-to-one interviews and the interview period lasted from 30 to 50 minutes.

Semi-structured in-depth interviews were deemed to be most appropriate for this study and were used to answer the research question using open-ended questions (Polit, Beck 2018), to encourage the participants to share their thoughts and experiences on implementing the GDM guidelines.

I conducted all the interviews between July and August 2016. Written consent was obtained from the participants, and all interviews were audiotaped. Data was collected from PHC1 and PHC2, both situated in Muscat Governorate.

4.4.4. The rationale for conducting a face-to-face interview.

The purpose of conducting in-depth semi-structured face-to-face interviews was to explore the current practices of HCPs when screening for GDM and better understand the experiences of each HCP, concerning the implementation of GDM guidelines (DiCicco-Bloom and Crabtree 2006). Interviews using audio or video recording are considered rich in communication, with contributions during the discussion highlighting different opinions (Gibson and Brown 2009). Moreover, audio or video recording is important for accurate and complete transcription. The study aimed to obtain information relating to barriers and facilitators by interviewing HCPs working with pregnant women in ANCs.

4.5. Ethical approval

I secured ethical approval before undertaking any study activities. The request for ethical approval was submitted to the Research Review and Ethical Screening Committee (RRESC) at the School of Health Care Sciences (HCARE) at Cardiff

University. Approval was obtained on 19 January 2016 (see Appendix B). Subsequently, ethical approval was obtained from the Research and Ethical Review and Approve Committee (RERAC) in the Centre of Studies & Research/Directorate General of Planning and Studies at Ministry of Health Oman on 25 July 2016 (see Appendix C). Following obtaining ethical approval from both healthcare institutions, negotiations commenced regarding the participants' recruitments with administrators at the Primary Health Care level at the Directorate of General Health Services (DGHS) in the Muscat governorate.

4.5.1. Informed consent (phase 1)

Before the study, the director of DGHS and the head of the Department of Information in DGHS at the Muscat governorate received a request to allow information to be used for study purposes (see Appendix D). A request letter was sent to the Director of Health Affairs/Muscat for permission to gather data. The director of DGHS has the right to know and understand the purpose of the study, along with the name and job title of the researcher. Permission to undertake the study was obtained from the director of the DGHS, as he/she leads the PHC institutions in the Muscat governorate. Informed consent was not obtained from the women because the researcher did not contact the women directly. Instead, data was collected from the antenatal clinic registry and the electronic record health system in PHC1. Personal data such as name, address, postcode, phone/mobile number, and marital status were not collected. The researcher confirmed that the women's identity was well secured and not shared with any third parties. In addition, to ensure anonymity and confidentiality were maintained throughout the research, each individual was assigned a numeric reference code. To facilitate data analysis, all data was transformed into numeric codes. The data was kept secure in a password protected computer. In compliance with the UK Equality Act of 2010, it is impossible to identify any individuals involved in the study based on their

individual characteristics (Data protection policy at Cardiff University). The director of DGHS and the head of the Department of Information were informed that they had the right to stop data collection at any time if confidentiality was not maintained. They were also informed that the study would not harm any participant.

The data from Oman's electronic record health system was recorded in English. Socio-demographic information, results of laboratory investigations and clinical features such as weeks of gestation at booking, blood pressure, type of pregnancy etc, were used for this study (see Appendix G). The following flowchart shows the research recruitment procedure for the retrospective review:

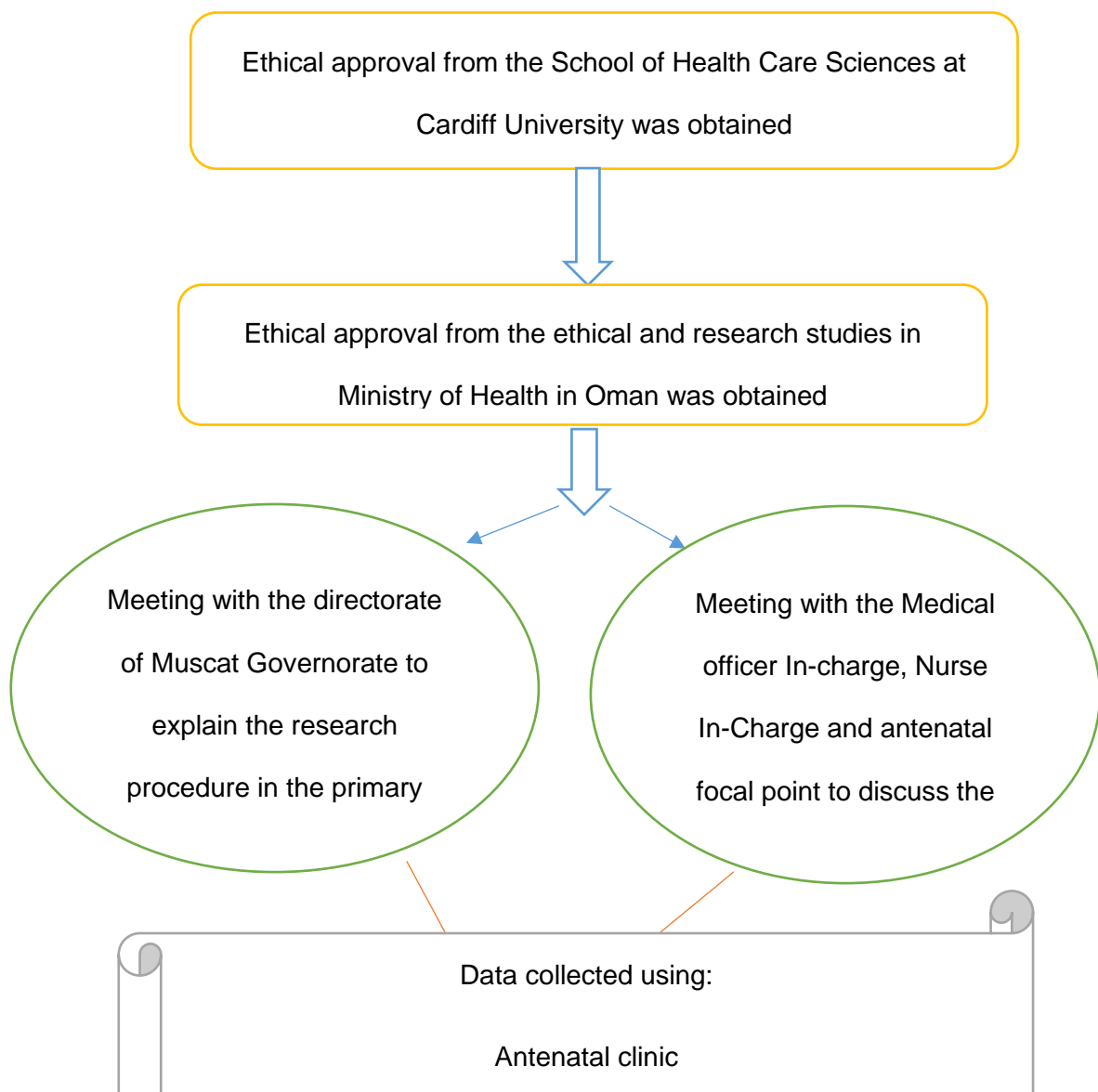


Figure 4-3: Flow chart of the ethical approval

4.5.2. Informed consent (Phase 2)

Face-face interviews: a letter was sent to the director of DGHS/Muscat to request permission to start data collection for phase two. Permission to undertake the study was obtained from the head of each PHC. Prior to undertaking the study, all nurses, midwives, and medical practitioners were informed that anonymity would be maintained, and their personal details will not be shared with any third parties. They had the right to either agree or refuse to participate in the study. It is the researcher's responsibility to ensure that any collected data shared by a subject is kept private from others (Grove and Burns 2015). Anonymity and confidentiality were maintained throughout the study. For instance, in this study, the participants were provided with an ID code i.e. a nurse who was interviewed first in PHC2 was known as (N1C2), a nurse who was interviewed second in PHC2 was referred to as (N2C2), and in PHC1 as (N2C2), nurse in-charge who interviewed first in PHC2 (NI1C1) and in PHC1 (NI2C2), a general practitioner in clinic 2 (GP2C2), general practitioners in-charge in PHC2 (GPI1C1) and were used during the transcription and analysis (details provided about the data coding in Chapter 6).

Before requesting consent, the participant information sheet (see Appendix K) explaining the study's purpose and requirements was provided to all the prospective participants (see Chapter 6, section 6.6.1). This was done to ensure the prospective

participants understood what the research was about, so that they could make an informed decision about whether or not to participate. Informed consent was obtained from all participants to ensure their autonomy was respected (see Appendix H). This also ensured that the participants knew and understood the study's purpose, which is in accordance with their 'right to know'. They were informed of the name and job title of the researcher. They were assured that they had the right to withdraw from the study at any time without incurring any penalty and also that their confidentiality would be maintained throughout the study, and that no harm would come to them. Once the participants agreed to take part, they were asked to sign a written agreement, which was also then signed by the researcher (Kvale and Brinkmann 2009). Details of the recruitment process, data collection and data analysis will be provided in chapter 6.

4.6. Storage of data

Data from phases one and two were stored securely. Once collected, data was transferred to the UK via fast file. After arrival in the UK, data was downloaded and stored in a university owned password-protected computer only accessible by the researcher. Data was managed and stored according to Cardiff University Policies (Data Protection Act 1998).

In phase one: Data was transferred to the UK in SPSS (Statistical Package for the Social Sciences) version 23. Data was anonymised and non-identifiable as it did not contain any personal identifiable information. None of the participants' identifiable data was transferred out of Oman. Initially, during data analysis, the collected data was coded, and each woman was given a unique numeric code to ensure that her anonymity and confidentiality was maintained, the code being the only identifier of each woman. The original, identifiable data was stored separately in Oman, and a copy of the data was created with codes, thereby reducing the chance of subject bias. The

copy of the data was backed up and stored in a secure network server in Cardiff University. This data can only be accessed by the researcher and supervisors via a shared file as well as on the researcher's personal computer (PC) for which only I hold the password to prevent any unauthorised access. Data is securely held, and backup copies developed to prevent accidental loss (Creswell 2013).

In phase two: The personal data of the participants (HCPs) includes their name, job title, address, e-mail address and telephone numbers. All this information was not required in the transcripts, so as a researcher I made sure that all transcripts were stored without identifiers. I stored all the data, as well as a digital recorder and consent forms, in a locked cabinet at my desk at Cardiff University. The personal data was stored in physical files at Cardiff University. The researcher ensured that no identifiable details were kept in the physical files, also by giving a code to each participant (see section 4.5.2). These codes were the only identifiers for each participant in the physical files. There is no access to any information linking participants to their codes for anyone except myself. This information is kept separate from the data in the secure locked cabinet. The transcribed and analysed data was stored in the researcher's PC, which is password protected and only used by the researcher. In accordance with Data Protection Act's requirements (1998), an encoded area was created on the PC where all the data could be securely stored. In addition, the transcriptions of the interviews were transferred to the personal computer, again password-protected and securely stored. To access this computer, permission from the researcher is required.

The researcher ensured that all data was held securely throughout the study. Based on the needs of the director of DGHS and upon request, the researcher was able to provide the director with a summary of her research results in one of the following formats: by e-mail, by post or through a telephone conversation. After data analysis, the data needs to be stored from 5 to 10 years (Creswell and Creswell 2018). Then,

the stored data will be destroyed within the time frame of Cardiff University policy and guidance, 2009.

4.7. Records Management

The researcher followed the Cardiff University policy, in line with the Data Protection Act of 1998 as the data will be stored in Home drive (H:/) or in a dedicated Quickr TeamPlace with appropriate access control implemented to restrict access to data and records to authorised individuals only. Both the network shared drive and Quickr TeamPlaces are backed-up regularly by INSRV to: (i) protect against IT system failure; (ii) ensure files can be recovered within 3 months of accidental deletion or corruption.

Access to electronic data and records was controlled by passwords and the researcher made sure that she logged off her computer when not attended.

4.7.1. Validity

In many mixed methods studies, qualitative data supports quantitative findings by complementing or expanding the understanding of quantitative data (Giddings and Grant 2009). As a researcher, I had to ensure that both the validity and reliability of the data collection tool in this mixed-methods study were met in order to achieve a meaningful conclusion of the study. According to Creswell and Plano Clark, (2007, p146) “to draw a meaningful and accurate conclusion from all data in the study”, validity is defined as:

“Validity is the degree to which an instrument is measuring the construct it purports to measure” (Polit and Beck 2018, p176).

Validity in quantitative research is the possibility of obtaining meaning from the scores on the instruments (Creswell and Creswell 2018). Applicability overlaps with the meaning of external validity or generalisability of the results (Dekkers et al. 2009).

4.7.2. Reliability

Reliability refers to the consistency of measurement within a study (Lacey 2015). It also refers to whether the data collection techniques and analytic procedures would reproduce consistent findings (Creswell and Creswell 2018). According to Price et al. (2015) there are three types of reliability: test-retest reliability (over time), internal consistency (across items), and inter-rater reliability (across different researchers). For this study, the data for the retrospective review of case records was accurately entered in SPSS version 23. Applicability can be achieved by a well-designed study delivering a reliable result, addressing the details of the instruments used to collect the data, reporting on the detail of the framework used within the study, whilst considering the implications for both current and future research. (Rees et al. 2015). The results of the retrospective review care records cannot be generalised because the data comes from only two clinics, both of which are in Muscat.

4.8. Trustworthiness

In quantitative assessment the criteria of validity and reliability must be met, whereas in qualitative assessment, the criteria of trustworthiness including credibility, transferability, dependability, and confirmability are important to achieve the rigour of the study (Guba and Lincoln 1985).

4.8.1. Credibility

According to Polit and Beck (2018), credibility refers to the researcher's confidence in the truth and honesty of the data and their subsequent interpretations. Credibility can be established by process of checking the validity of the interpretation by a reader, who

then tests the findings and interpretations with the participants (Lincoln and Guba 1985). As part of the in-depth semi-structured interviews, I ensured that I built both a trusting relationship with participants and continued to develop a rapport with them. Before starting each interview, I read through the study information sheet and consent form with each participant. I reminded each participant that no identifier would be used in my written thesis and reassured them that all personal data would be anonymised. I transcribed all interviews. I read and re-read the transcription line by line to ensure there were no mistakes. During the coding process, I ensured that there were no drifts in the definition of the interview codes, because if this happens it alters the meaning of these codes (Creswell, and Creswell 2018). I developed the questions for the semi-structured interviews (see Appendix L) and discussed them with my supervisors to ensure they were clear and understandable. Peer reviews provided an external check of the research process that keeps the researcher apparently honest (Lincoln and Guba 1985). Regular meetings were conducted with the supervisory team before, as well as during data collection and analysis, to maintain peer debriefing. An action plan was developed prior to data collection and was used as a guide for data collection and analysis. The first two interview transcripts were shared with my supervisors via emails, and suggestions were provided, which were taken into consideration. Throughout data collection and analysis, the supervisory team were updated by the sharing of interview transcripts which were not identifiable, as well as coding templates and concept mapping and their provided feedback was considered during the process of the study. Several drafts of coding templates were shared with the supervisory team and thoroughly discussed until we agreed on the appropriate representation of data codes and themes (Graneheim and Lundman 2004). As a step towards enhancing the credibility of my research, this was an opportunity for me, as a novice researcher, to meet with my supervisory team to discuss and share the codes and themes. Also, these regular meetings and discussions resulted in the affirmation of the appropriateness of codes to the supporting data (Graneheim and Lundman 2004).

4.8.2. Dependability

Dependability refers to the data's stability over time and over condition (Polit and Beck 2018). It was essential to ensure that the dependability and confirmability of the research process were clearly documented (Koch 1994; Tobin and Begley 2004). According to Polit and Beck (2018), dependability can be achieved when the study is repeated with the same participants and the same context; the findings should be the same. In this study, the analysis of each interview was coded in the same way, so it was easier for the researcher to detect the replication of different type of data within the results for each code that used for individual participant. This process was shared with the supervisors during the regular meetings and due to the time and resources constrains, this study did not go through an external audit process.

4.8.3. Confirmability

Confirmability refers to objectivity, in which the data accuracy, relevance and meaning can be agreed upon by two or more participants (Polit and Beck 2018). The records of raw data, transcripts and reflective journals are available for other researchers to check if they wish (Halpern 1983). In this study, the descriptions of data design, sampling, settings, data collection methods and data analysis were finalised. Additionally, the first two interview transcripts were sent to my supervisors in order to seek their expert opinions regarding the quality of probing questions that were included in the interviews guide (see appendix M). The supervisors made some amendments to the probing questions. Moreover, all raw data of retrospective review of case records, the transcription of face-to-face interviews and thematic analysis records were documented by the researcher and made available to the supervisors.

4.8.4. Transferability

Transferability refers to the generalisability of the qualitative research, specifically the extent to which the findings of the study could be applied to other settings (Polit and Beck 2018). According to Lincoln and Guba (1985), transferability is the responsibility of the researcher, in as much as ensuring that they describe the data explicitly so that the reader can assess the applicability of the data to other settings or context. The reflective journal contains the decisions and choices made throughout the study, providing the rationale for the methods used at each stage. Each study site was fully described, with information about each HCP documented at the start of each semi-structured interview (Guba and Lincoln 1989).

4.9. Reflexivity

Reflexivity is the process of critical self-reflection and analysing personal values that could affect data collection and interpretation (Polit and Beck 2008). Creswell (2007) stated that reflexivity means that the researcher is aware of their biases, values and experiences related to the study that he or she has undertaken. Qualitative researchers write field notes that describe the things seen, said, or not said, and done or not done during the research process, along with their interpretation of the associated meaning (Topping 2015). In this study, I had concerns as to whether the HCPs would agree to share their experiences because the context of the study was sensitive as it touched on their practice in implementing GDM screening. The staff came from diverse backgrounds, and the involvement of the general practitioner in-charge (GPI) and the nurses in-charge initially made the rest of the participants feel uncomfortable. Each participant thought that the in-charge would be made aware that he/she had participated and that they would subsequently be questioned about the answers they gave. I assured each one of them that whatever they said in the interview

would be confidential, and none of their managers would know about their participation. I assured the participants that no report or feedback would be provided to their managers about who contributed to the research or the time or location of the interviews.

My background is nursing and midwifery, so the participants reported that this made them feel comfortable and able to use medical terms during the interview. Most of the participants were Omani (80%) which meant that they could speak freely about how they felt about maternal health services in the PHCs. As a midwifery educator, I was not involved in the development of GDM guidelines but was familiar with the national and international GDM screening guidelines. Some of the participants were excited, as it was the first time for them to be involved in an interview, and they were looking forward to gaining experience in the ways interviews might be conducted. A few of them remarked that it was an opportunity for them to contribute to research that might change the practice, which gave them the freedom to speak up about the fears and challenges they faced in clinical practice.

4.10. Ethical issues in PHC1

Some ethical issues arose during the data collection, such as inaccurate records in PHC1's antenatal care registry and an individual using their authority to change the blood glucose threshold without first obtaining an agreement from the MoH. For example, there were many errors that were identified by both myself and my assistant during the data collection for phase one, including records that one woman had delivered normally, but the registration of the birth outcome was incomplete. However, we found within the electronic record health system that the same woman had had a miscarriage at 16 weeks.

Another example of a further ethical issue arose during the interview with one of the GP's in PHC1; she said that the obstetrician from the secondary institution had sent them a fax that contained an instruction to change the blood glucose threshold before making the decision regarding a diagnosis of GDM. To clarify, the national guidelines state that when fasting blood sugar value (FBS) is ≥ 5.1 mmol/l, women should be offered OGTT, but the obstetrician sent them instructions that women who had an FBS value of ≥ 5.1 mmol/l should be considered as low risk for GDM and to offer the woman an OGTT if the FBS was ≥ 5.3 mmol/l.

I met with the general practitioners in-charge and the nurses' in-charge to discuss these issues found while collecting the data. The meeting was in private, and confidentiality was maintained during the meeting. Regarding the inaccurate records, they thanked me for bringing these issues to their attention and assured me that they would investigate this issue to resolve the problem and to avoid this happening in the future. Regarding changing the blood glucose threshold policy, they explained that usually, an obstetrician in-charge at the secondary healthcare institution is responsible for the ANC in the PHCs. Therefore, s/he has responsibility for the decisions they made, and the general practitioners in the PHC should carry out the request.

4.11. Conclusion

In this chapter, I described the study design that was found to be most suitable to explore the practice of screening for GDM by the HCPs in 2014 and identified the barriers and facilitators that HCPs faced during the implementation of these guidelines. The importance of correct storage of the raw data was also highlighted. In this study, the pragmatism paradigm was used to understand the similarities and differences of the findings in both PHCs. The following chapter will discuss the method and result of the quantitative component.

Chapter 5. Retrospective review of case records results

5.1. Introduction

This chapter describes a retrospective review of case records exploring the extent to which gestational diabetes mellitus (GDM) screening undertaken in Oman in 2014 was compliant with national guidelines. This chapter presents the study methods, analysis, and findings.

5.2. Aim

The aim of this study was to explore screening for GDM performed on a cohort of women who registered for antenatal care at a governmental primary healthcare centre in Oman during 2014.

5.3. Method

Antenatal care includes registration of pregnancy, with follow up care being offered in primary healthcare institutions, including health centres and polyclinic/extended health centres within each Wilayat in Oman. A retrospective review of case records was undertaken. Data relating to all women was extracted from records at the primary healthcare centre (PHC1) in Muscat governorate. Whenever women had to be transferred to secondary care for part of their antenatal care, records relating to GDM screening in this secondary care institution (SHI1) were also accessed. Usually, secondary care was offered at an extended health centre providing primary healthcare services as well as some specialised outpatient clinics, serving people within their catchment areas (MoH 2017). In this study, secondary care was offered to women in the Wilayat Hospital. The Wilayat Hospital provides both primary and secondary health care to the Wilayat inhabitants in which it is located and those living nearby (MoH 2017). The other site offered tertiary care is the Obstetrics and Gynaecology Polyclinic situated in the Tertiary Hospital within the Muscat governorate. The records of GDM screening offered at the tertiary polyclinic can be accessed electronically from the Wilayat Hospital.

5.4. Objectives

- To describe the practice for screening and diagnosis of GDM amongst pregnant women in Oman.

- Compare the observed practice with national and local guidelines.

5.5. Background

Chapter Four presented the description of a retrospective review of case records and its justification. A retrospective review of case records is a process by which retrospective data is obtained in order to answer clinical queries (Sarkar and Seshadri 2014). This particular retrospective review of case records related to women registered for antenatal care in 2014. The care review was conducted in 2015 and reviewed the implementation of the GDM guidelines, 2010 (Directorate General of Health Affairs 2010).

To set the retrospective review of case records in context, this chapter begins by outlining the expected standards for GDM screening in Oman in 2014.

5.6. Expected local standards

In 2014 the expected standards for GDM screening in Oman were set by the Oman GDM guidelines of 2010. These stated that universal screening for GDM should be offered to all pregnant women. The expected standards for GDM screening in the 2010 national guidelines are summarised below and in the Figure 5-1:

Prior to registration, all women to have a random blood sugar level test :

If normal - offer OGCT at 22-24 weeks

If abnormal – offer OGTT within 2 weeks.

Note: local practice also dictated that any woman with a close family history of diabetes or a raised BMI ≥ 30 kg/m² be offered an OGTT within two weeks of registration, regardless of the RBS result.

If OGCT not yet performed or performed with normal results, at 22-24 weeks, perform OGCT:

If normal – no further testing required.

If abnormal –offer OGTT as soon as practicable.

Any woman with an abnormal OGTT to be referred to secondary care for further management.

Urine to be tested at registration and each antenatal check-up – if

Glucose + detected on two occasions repeat OGTT.

Glucose ++ detected on one occasion repeat OGTT.

See Figure 5-1:

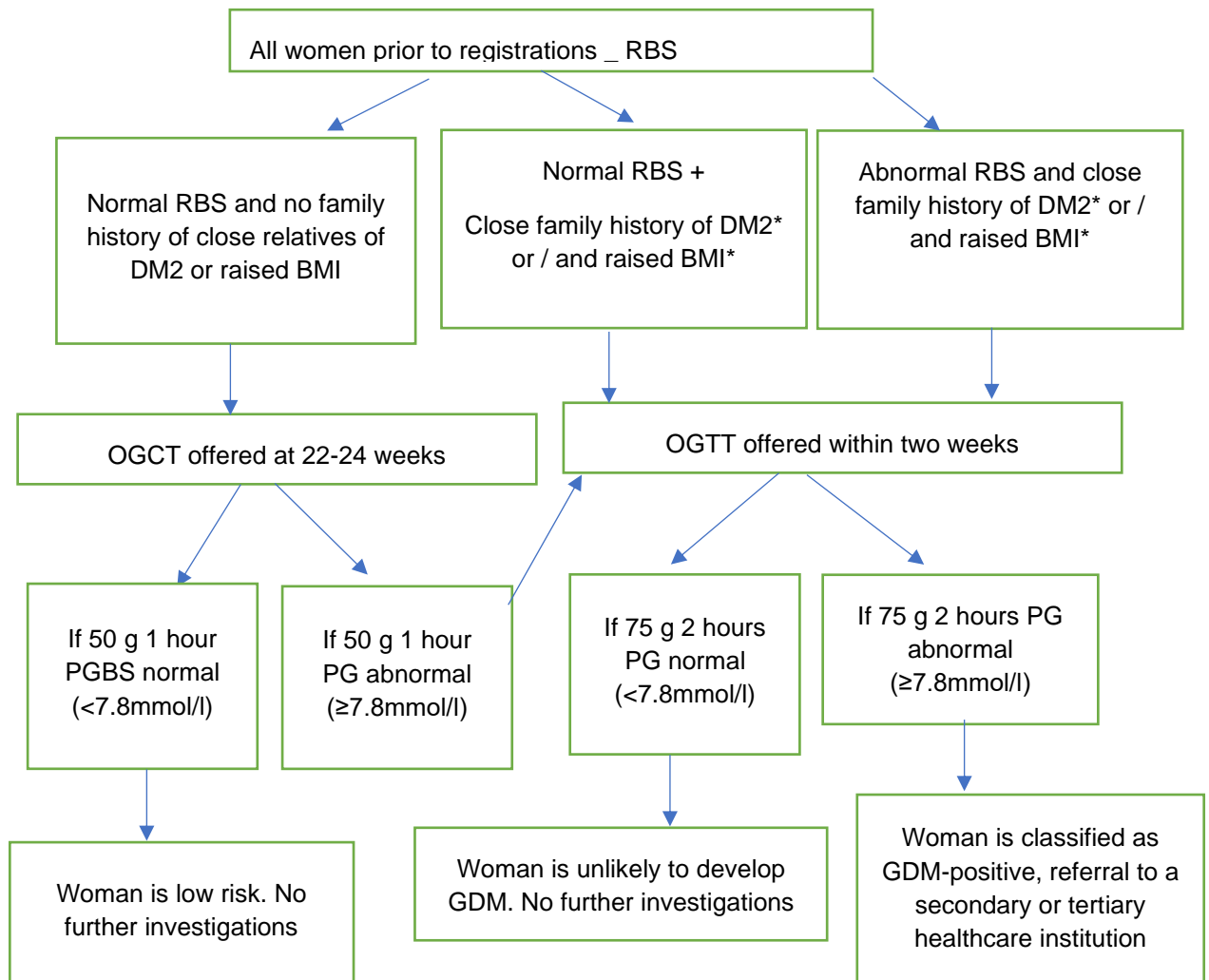


Figure 5-1 Summary of the expected local standards of GDM screening in PHC1

*Included in local but not national guidance.

5.7. History-informed screening for GDM

One objective of antenatal care is the early identification of women with obstetric risk factors such as diabetes mellitus, hypertension, anaemia, and cardio-vascular disease who require additional antenatal, intrapartum, or post-partum care. In an antenatal clinic, the nurse or midwife collects the obstetric history from each pregnant woman on the day of registration.

According to the guide for nurses, midwives and doctors published by the Directorate of Health Affairs (MoH 2010), all pregnant women were required to be classified as either low or high risk during pregnancy, informed by their history and results of laboratory tests. At the first antenatal clinic visit, women were asked if they had a history of diabetes mellitus amongst their parents or any first-degree relative including siblings. Women who presented with a second or subsequent pregnancy were also asked whether they had a history of the following risk factors of GDM: previous pregnancies with GDM, a previous macrosomic baby, previous miscarriages, previous birth outcomes with congenital abnormalities, a history of unexplained stillbirth or a history of neonatal death. Maternal weight and height should be measured at the first antenatal appointment, and the woman's Body Mass Index (BMI) calculated (weight (kg)/ height (m²).

Although risk factors were being recorded in all antenatal clinics and despite the association between risk factors for GDM and the risk of a woman developing GDM, the 2010 guidelines algorithm did not include a separate pathway for women identified as having such risk factors. However, within the clinic where the retrospective care notes review was undertaken, any woman presenting to the antenatal clinic with a close family history of DM2 or raised BMI ≥ 30 kg/m², even if the RBS was normal, was offered an OGTT within two weeks of registration.

The 2010 GDM guidelines classified any women < 22 weeks gestation with 75 g 2 hours post blood glucose of ≥ 7.8 mmol/l as having DM2. However, if the woman was at ≥ 22 weeks gestation, this should be considered GDM. Any women diagnosed with DM2 or GDM required referral to a dietician for dietary advice and was offered an early appointment at a tertiary healthcare institution for further management. The woman with DM2 usually attends appointments at a diabetic clinic with diabetologists and attends appointments with the consultant obstetrician in a tertiary clinic. However, for the women with GDM, the follow up is with the consultant obstetricians at the tertiary clinic alone. A notice was included locally for staff, informing them that when performing an OGTT, if they found an FBS result of ≥ 7.8 mmol/l, they were to proceed with the 2 hours test without giving glucose.

5.8. Settings

During 2014, there were 68,026 deliveries in MoH healthcare institutions in Oman (MoH 2015). The present study was conducted in the antenatal clinic of PHC1 in Muscat Governorate (capital of Oman). Being the largest primary healthcare institution in the Muscat Governorate (Appendix I) this clinic annually serves up to 2000 pregnant women. In 2014, 1021 women registered at the clinic. The reason for this low number of women receiving care in 2014 is not known. Data relating to women referred to obstetric care at the secondary care facilities was also collected from SHI1.

5.9. Sampling

Convenience sampling is non-probability sampling and is widely used in research (Elfil and Negida 2017). Convenience sampling was used for this study. The study included all women who registered their pregnancy from January to December 2014. PHC1 served an overall total population of 50,802 in 2014 (MoH 2015).

5.9.1. Inclusion criteria

All women who registered for maternity care at PHC1 from January to December 2014 were included.

5.9.2. Exclusion criteria

Women who received some maternity care in the private healthcare sectors and did not return to health centres for follow up care were excluded.

In addition, data of women who were transferred to tertiary healthcare institutions for antenatal care and continued their ANC in these tertiary institutions permanently were excluded. The present study did not obtain permission to access these institutions' records; therefore, these women's full record could not be accessed.

Women whose pregnancy ended in miscarriage following registration; usually, these women did not come back to the health centre, and the hospital did not send a report about the miscarriage.

5.10. Permission and gaining access

Creswell (2007) stated that it is important to ensure getting access appropriately to the research site. In the current research, a meeting was held with the general practitioners in charge (GPI), Nurses in charge (NI) and the nurses/midwives who run

the antenatal clinic in PHC1. Ethical approval was obtained in writing from the Ministry of Health (MoH) and distributed to all these people.

5.11. Data collection process

The researcher introduced herself to the GPI and NI by name and job title. The GPI, NI, and the nurses/midwives explained that all data of the pregnant women registered in the ANC registry book in 2014 were stored in a cabinet in the antenatal clinic. The details of pregnant women were entered manually in the antenatal clinic registry book and electronically into the electronic record health system. At all times, the antenatal clinic registry book records and the electronic record health system had treated as strictly confidential.

One additional person supported the researcher in manually extracting the data from the registers. This assistant was selected because of his expertise in records management and the relevant computer software.

As is the practice in PHC1, the RBS collected from the pregnant women at the first visit to the GP is before the day of actual registration at the antenatal clinic. This practice has followed in all primary healthcare institutions in Oman, so a woman who misses her period should firstly report to the GP. The GP examines her and advises for a urine pregnancy test to confirm the pregnancy. If this test is positive, the GP would ask the woman to book an appointment to register the pregnancy at the antenatal clinic. Besides, the GP would send the woman to the laboratory for the following routine blood tests:

- Fasting blood sugar or Random blood sugar
- Venereal Disease Research Laboratory (VDRL)
- Human immunodeficiency virus (HIV)

- Hepatitis B (HB)
- Completed blood count (CBC)
- Sickle cell

All these results, including the RBS, were available at the antenatal clinic and within the computer system.

Whereas the blood investigation results such as OGTT and OGCT were missing from the records of the PHC1. The researcher pursued the missing data with support from the GPI in the same institution. Where necessary, the GPI directed the researcher to the SHI1 to which women had referred. Where available, this data has collected from the SHI1 after obtaining permission from the Directorate of General Health Services (DGHS) Muscat.

5.11.1. Data extraction

Extracted data items included BMI, family history of DM2, previous obstetric history, and GDM related laboratory investigations: blood glucose tests and urine tests.

The following Table (5-1) provides details of the data extracted and its sources. Sociodemographic data were recorded in the antenatal clinic registry book.

Table 5-1: Details of data extracted and their sources

Collected Data	Source
<ul style="list-style-type: none"> • Sociodemographic data • Date of antenatal clinic registration • Gestational weeks at registration • Gravidity and parity 	Antenatal clinic registry book

<ul style="list-style-type: none"> • Type of pregnancy (single or multiple) 	
<ul style="list-style-type: none"> • BMI • Family history of diabetes mellitus • History of neonatal deaths • History of miscarriages • History of congenital abnormalities • Urine analysis results • Blood investigation results including RBS, OGCT, OGTT 	the electronic record health system
<ul style="list-style-type: none"> • Blood investigations for women referred to a SH11 care • OGCT • OGTT 	antenatal clinic at SH11

* The information was not always available in the antenatal clinic register book, so data was also collected from the electronic data system in PHC.

5.12. Data analysis

Data were analysed using descriptive and inferential statistics using the software Statistical Package for the Social Sciences (SPSS) version 23. All data were anonymised prior to analysis.

5.12.1. Data entry and encoding process

Each woman was identified using an identification number when entering the data. Data was coded into numeric variables, for example, a family history of DM2 “1” for mother, “2” father, “3” for both. Missing values were assigned in SPSS. , The entry of the dataset into SPSS was discussed with my study supervisors at Cardiff University.

Comments and suggestions given by the supervisory team were considered, and amendments were made accordingly. During data entry, the researcher discovered that some women who had normal RBS results did not have any further blood sugar investigations. The reason might be that either the test was done in SHC but was not recorded on the maternal health card or that the woman refused to do the test.

5.12.2. Data extraction methods

During data collection, the researcher and assistant sat together in the health centre. The assistant opened the antenatal clinic registry book and Al-Shifa healthcare system, while the researcher opened the SPSS. The researcher allocated an ID number to each woman. The researcher entered the data directly into SPSS. The following day and before entering any new data, the researcher and her assistant verified the previous day's data entry visually to ensure that the data recorded was complete and accurate. This step was completed every day to ensure the accuracy and rigour of data entry to avoid problems such as missing data and irrelevant entry of data. During this step, the assistant again read the details of each woman from the antenatal clinic registry book to confirm that the correct information had been entered in SPSS by the researcher. For blood and urine tests, the results were confirmed by re-checking the correct data on the Al-Shifa health system in PHC1 and SHI1.

5.12.3. Accuracy of the data

During data collection, the recording of risk factors relating to previous pregnancies and birth outcomes was poorly recorded in the handwritten register and incomplete in the Al-Shifa computer-based records. This included a history of previous neonatal death, previous macrosomic baby, previous GDM, previous congenital anomalies and previous stillbirths. Some of these details may have been recorded on the maternal

health card that the pregnant woman kept with her at all times, but these could not be accessed.

5.13. Results

The number of women who registered for antenatal care in PHC1 from January to December 2014 was 1021 (245 primigravidae and 776 multigravida). Of the 1021 registered women, 79 were excluded from the study (58 women miscarried, and 21 women transferred to private or tertiary healthcare institutions). Therefore, the total number of women who were included in the study was 942 (245 primigravidae and 697 multigravida women). Most women delivered in 2014, and some had antenatal care that continued into 2015. During data collection, the recording of risk factors relating to previous pregnancies and birth outcomes was found to be both poorly recorded in the handwritten ANC register and incomplete in the Al-Shifa computer-based records. This included a history of previous neonatal death, previous macrosomic baby, previous GDM, previous congenital anomalies and previous stillbirths. Some of these details may have been recorded on the maternal health card that the pregnant woman always kept with her, but these could not be accessed.

5.13.1. Sociodemographic data

The socio-demographic characteristics of the sample were available for all 942 women and are shown in (Table 5-2). The majority of women (62.4%) were between 21-30 years old; (31.5%) between 31-40 years (3.7%) < 20 years and (2.3%) > 40 years. The majority were Omani (98.3%) and Muslim (99.8%). Concerning BMI at registration, 18.5% were underweight. Similar percentages had a healthy BMI or were overweight (27.9% and 28%, respectively). Some women (16.5%) were obese, and, a few women (9.1%) were morbidly obese.

Table 5-2: Socio-demographic characteristics of the study sample (n=942)

Socio-demographic Variable	Category	N	(%)
Age at booking (years)	< 20	35	(3.7%)
	21-30	588	(62.4%)
	31-40	297	(31.5%)
	41 and above	22	(2.3%)
	Total	942	(100%)
Nationality	Omani	926	(98.3%)
	Non-Omani	16	(1.7%)
	Total	942	(100%)
Religion	Muslim	940	(99.8%)
	Non-Muslim	2	(0.2%)
	Total	942	(100%)
BMI	Underweight (≤ 19.9)	174	(18.5%)
	Healthy (20 to 24.9)	263	(27.9%)
	Overweight (25 to 29.9)	264	(28.0%)
	Obese (30 to 34.9)	155	(16.5%)
	Morbidly obese (≥ 35)	86	(9.1%)
	Total	942	(100%)

The histogram below (Figure 5.2) presents the age of the women who registered from January to December in 2014, ranging from 16 to 46 years. The mean age was 28.6 years, and the standard deviation (SD) was 5.323.

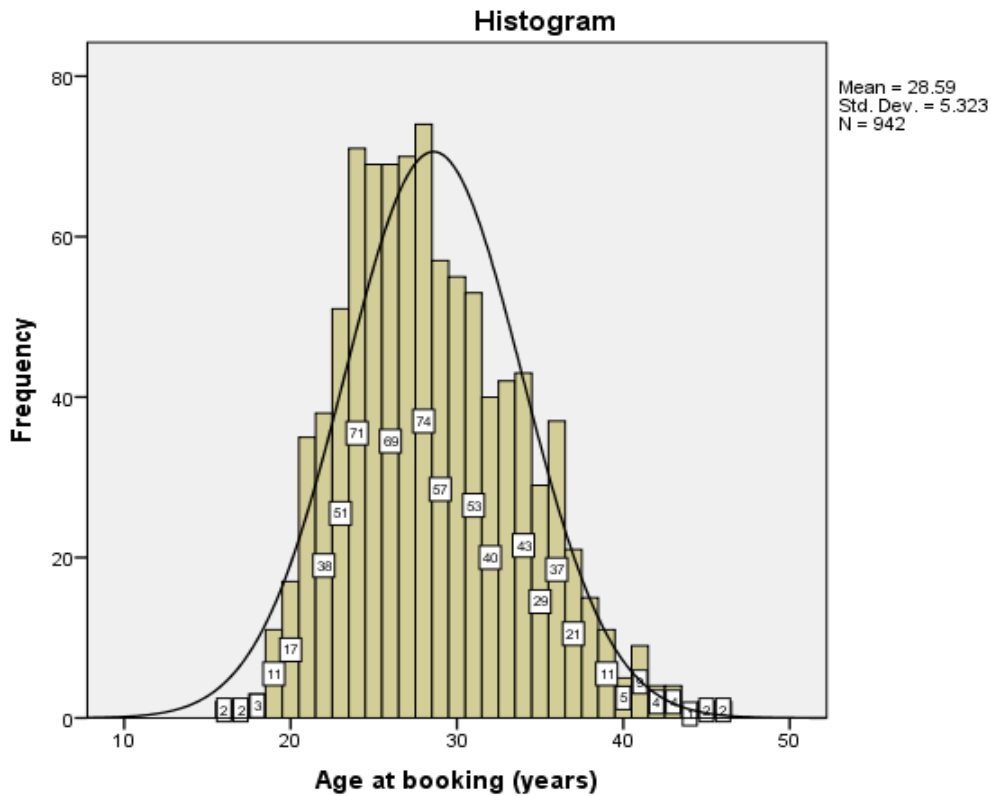


Figure 5-2: Histogram of age at registration

5.13.2. Maternal status during the current pregnancy

Table 5-3 presents the number and percentage of multigravida women (697; 74%) or primigravida (245; 26%). The majority of women (98.8%) were pregnant with one child, and 1.2% were pregnant with twins. 28.5% of the women were expecting their first child, 24.9% their second child, and 46.7% were expecting their third or subsequent child.

Table 5-3: Maternal status during the current pregnancy

Variable		n	(%)
Gravida	Primigravida	245	(26.0%)
	Multigravida	697	(74.0%)
	Total	942	(100%)
Current pregnancy	Singleton	931	(98.8%)
	Multiple	11	(1.2%)
	Total	942	(100%)
Parity type	Nulli-parous	268	(28.5%)
	Primi-parous	234	(24.85%)
	Multiparous	440	(46.7%)
	Total	942	(100%)

5.13.3. GDM screening using OGCT/OGTT

All 942 women in this sample completed the RBS test prior to registration. Of the 942 women, 91.3% (n=860) had normal results (3.5-6.9 mmol/l blood glucose) and 8.7% (n=82) had abnormally high results (7.0-15.0 mmol/l). Of the 82 women who had abnormally high results, 54 (65.9%) were screened using an OGTT; however, none were screened within the required two weeks of registration. Of the 54 women with an abnormal RBS who were subsequently screened using OGTT, 23 (42.6%) were diagnosed with GDM.

All 942 women in this sample completed the RBS test before registration. Of the 942 women, 91.3% (n=860) had normal results (3.5-6.9 mmol/l blood glucose) and 8.7% (n=82) had abnormally high results (7.0-15.0 mmol/l). Of the 82 women who had

abnormally high results, 54 (65.9%) were screened using an OGTT; however, none were screened within the required two weeks of registration. Of the 54 women with an abnormal RBS who were subsequently screened using OGTT, 23 (42.6%) were diagnosed with GDM.

Of the 860 women who had a normal RBS result, in line with the GDM screening guidelines 2010, 248 (28.9%) were screened using OGCT at 22-24 weeks of gestation. Eighty women had both OGCT and OGTT, with no explanation of the rationale for conducting both tests. Although their RBS results were normal, the researcher found that 444 (51.6%) women were screened using OGTT, meaning they may or may not have had a risk factor of GDM. Whereas for 10.2% (n = 88) women, either the screening was not done, or it was done but not recorded in the ANC registry book and the electronic record health system. The researcher was aware that some of the HCPs would record the blood glucose results in the maternal health card, which women keep. The practice usually when the woman has a follow-up visit to the health centre, the GP and the nurse should copy the results in the ANC registry book and the electronic record health system. However, sometimes, these women might continue the maternity care at secondary or tertiary clinics, so the record will not be available in the health centre. Uncompleted records and poor follow up from the HCPs in the health centre indicate poor compliance to the local standards of GDM 2010 (see Table 5-4).

Table 5-4: The results of blood tests for women who completed RBS

Variable	Result	n (%)	Screened using OGTT	OGTT done within two weeks	Screened using OGCT	Screened using OGCT and OGTT	Screening was not done, or data was missing
Random blood sugar	Normal	860 (91.3%)	444 (51.6%)	0	248 (28.9%)	80 (9.3%)	88 (10.2%)
	High	82 (8.7%)	54 (65.9%)	0	12 (14.6%)	2 (2.4%)	14 (17.1%)
	Total	942 (100%)	498 (52.9%)	0	260 (27.6%)	82 (8.7%)	102 (10.8%)

The normal OGCT results is < 7.8 mmol/l. Of 260 women who underwent an OGCT (68.5%) had normal results (< 7.8 mmol/l) and (31.5%) had an abnormal result (\geq 7.8 mmol/l).

Of the 82 women with an abnormal OGCT result (see table 5-5), 64 women subsequently underwent an OGTT, which is in line with GDM screening guidelines 2010, with 23 (35.9%) diagnosed with GDM. However, 18 women were missing as they either were not offered the test or refused to have the test.

Of the 498 women who underwent an OGTT during pregnancy, 172 (34.5%) had abnormally (high) 75 g 2 hours blood glucose, in which they were diagnosed GDM and referred to the dietician and obstetricians for further management. Of the 498 women who underwent OGTT during pregnancy, 326 (65.5%) had normal results (see Table 5-5).

Table 5-5: Results of OGCT and OGTT during the current pregnancy for all women

Test	Result type	Sample results n (%)	Diagnosed positive GDM n (%)
OGCT	Normal (< 7.8 mmol/l)	178 (68.5%)	0
	Abnormal (\geq 7.8 mmol/l)	82 (31.5%)	23 (35.9%)
	Total	260 (100%)	
OGTT	Normal 75g 2 hours (<7.8 mmol/l)	326 (65.5%)	0
	Abnormally high results 75 g 2 hours (\geq 7.8 mmol/l)	172 (34.5%)	172 (100%)
	Total	498 (100%)	

Of the 498 women who underwent an OGTT during pregnancy, 80 (16.0%) also underwent OGCT. Of these 80 women, 15 who had normal OGCT results underwent OGTT. Nine (60%) of these 15 women had abnormally high OGTT results (GDM positive). Sixty-five of the 80 women who underwent both OGCT and OGTT had abnormally high OGCT results. Twenty-five (38.4%) of these 65 had abnormally high OGTT results and were therefore diagnosed with GDM. Oman GDM guidelines (2010) recommended OGTT for all women who had an abnormal OGCT result \geq 7.8 mmol/l at 22-24 weeks. The findings showed that compliance was flawed because not all of the women's antenatal healthcare professionals followed the correct pathway in implementing the GDM screening guidelines (see Table 5-6).

Table 5-6: Results of OGCT and OGTT in women who underwent both tests during the current pregnancy

OGCT	OGTT
Normal (< 7.8 mmol/l) 15	Normal (< 7.8 mmol/l) 6
	Abnormally high results 75 g 2 hours (≥ 7.8 mmol/l) 9
Abnormal high results (≥ 7.8 mmol/l) 65	Normal (< 7.8 mmol/l) 40
	Abnormally high results 75 g 2 hours (≥ 7.8 mmol/l) 25
Total	80

When compliance with the expected local standards and national guidance was assessed, it was frequently found that women with an abnormal OGCT were not being offered a subsequent OGTT. The researcher found that of the 260 women who underwent an OGCT 18 (6.9%) had an abnormal result but did not have an OGTT to either confirm or reject the diagnosis of GDM.

5.13.4. Risk factors for GDM

Risk factors for GDM screening include previous pregnancies with GDM, a previous macrosomic baby, previous birth outcomes with congenital abnormalities, a history of unexplained stillbirth or a history of neonatal death. Women with these risk factors were not identified in the Oman 2010 GDM guidelines as requiring a different pathway

of screening, but the risk factors of a family history of close relatives having DM and BMI >30 kg/m² were identified by the clinic as an indication that OGTT should be offered. The researcher explored the screening provided to women with identified risk factors for GDM. Of the 942 women, 449 women had 0 risk factors, 349 had one risk factor, and 144 had two or more (see Table 5-7).

Table 5-7: women with risk factors for GDM

Number of risk factors for GDM	n (%)
0	449 (47.7%)
1	349 (37.070%)
2	125 (13.3%)
3	17 (1.8%)
4	2 (0.2%)
Total	942 (100%)

Of the 860 women who had a normal RBS result, 424 women had 0 risk factors, and of these, 175 (41.3%) were screened for GDM using an OGCT. This was compliant with the GDM screening guidelines 2010. Of the 860 women, 61 (7.1%) women had one risk factor and were screened for GDM using an OGCT, whereas 13 (1.5%) women had two or more risk factors and underwent an OCGT.

Table 5-8: Number of women who had normal results of RBS, with or without risk factors and were screened for GDM using OGCT

RBS results	No. of risk factors, n %	n (%)	OGCT n (%)	OGCT results ≥ 7.8 mmol/l
Normal 860	0	424 (49.3%)	175 (41.3%)	0
	1	320 (37.2%)	61 (7.1%)	1
	2 or more	116 (13.5%)	13 (1.5%)	1
Total		860 (100%)	249 (29.0%)	2

Of the 82 women who had abnormal RBS results, 25 (30.5%) had no risk factors, 29 (35.4%) women had one risk factor, of whom 19 (65.5%) were screened for GDM using OGTT. Twenty-eight (34.1%) women with abnormal RBS results had two or more risk factors, of whom 20 (71.4%) were screened for GDM using OGTT. This was in line with the 2010 GDM guidelines. However, 8 (28.6%) women did not have OGTT because either they were not offered it or refused to have the test. In general, of the 82 women who had abnormal RBS results, 54 underwent OGTT, which was in line with the 2010 guidelines. Of these 54 women, 36 (66.7%) were diagnosed with GDM (10 women had no risk factors and 26 women who had one and more risk factors) see Table 5-9.

Table 5-9: Number of women who had abnormally high results of RBS, with or without risk factors and were screened for GDM using OGCT

RBS results	No. of risk factors, n %	n (%)	OGTT n (%)	Diagnosed GDM n (%)
High 82	0	25 (30.5%)	15 (60.0%)	10 (66.7%)
	1	29 (35.4%)	19 (65.5%)	10 (52.6%)
	2 or more	28 (34.1%)	20 (71.4%)	16 (80.0%)
Total		82 (100%)	54 (65.9%)	36 (66.7%)

5.13.5. Risk factors included in the GDM guidelines 2010

The following section presented the number of women who had risk factors for GDM. Although it was not included in the national 2010 guidance, local guidance recommended that women with a family history of DM2 or a BMI >30 were screened for GDM using an OGTT at 22-24 weeks. The associations between screening for GDM and the risk factors of family history and raised BMI were tested using chi-square tests. Then, an inferential analysis was run using ANOVA to evaluate the likelihood of receiving OGTT, according to GDM screening guidelines 2010.

5.13.5.1. Family history of diabetes mellitus (DM2)

Of the 319 (33.9%) women who had a first-degree relative with DM2, 86 (27.0%) women had one or more additional risk factors for GDM, while for 233 (24.7%) women, their only risk factor was having a first-degree relative with DM2. Of these 233 women, 147 (63.1%) were screened using OGTT, and 24.5% of these were diagnosed with GDM (see Table 5-10). These findings showed that more than 50% of the women who

had a family history of DM2 were screened for GDM using OGTT, in line with the local standards 2010. It means the HCPs were partially adherent to 2010 GDM guidelines.

Table 5-10: risk factors: family history of DM2 with no risk factors and normal results of RBS who were offered screening with OGTT

Risk factor	n = %	Screened with OGTT n = %	Diagnosed positive GDM n = %
Family history of DM in close relatives only	233 (24.7%)	147 (63.1%)	36 (24.5%)

5.13.5.2. BMI

Of the 241 (25.5%) women who had a BMI ≥ 30 kg/m², for 145 (15.4%), this was their only risk factor for GDM. Of these 145 women, 96 (65.3%) were screened for GDM using OGTT, whilst 49 (33.8%) either declined, missed, or were not offered an OGTT (see Table 5-11). Despite raised BMI being an indication for GDM screening in the 2010 local standards, the HCPs in this study did not administer an OGTT to 33.8% of the 145 women who had raised BMI as their only risk factor. This indicates that the HCPs were partially adherent to the 2010 GDM screening guidelines.

Table 5-11: risk factors: BMI ≥ 30 kg/m² with no risk factors and normal RBS who were offered screening with OGTT

Risk factor	n = %	Screened with OGTT n = %	Diagnosed positive GDM n = %
BMI ≥ 30 kgs/m² only	145 (15.4%)	96 (65.3%)	41 (42.7%)

A two-way ANOVA test between subjects was conducted to evaluate the impact of a close relative having DM2 (n= 319) and raised BMI (n = 241) on the likelihood receiving of OGTT. There was a significant main effect when a close relative had DM2

($F = 27.396$, $p < 0.0001$). There was no significant main effect with raised BMI ($F = 0.002$, $p = 0.966$). There was no significant corroboration between having a close relative with DM2 and raised BMI. Overall, there was no significant main effect of the ($n = 91$) women who had both a close relative with DM2 and raised BMI ($F = 0.380$, $p = 0.538$).

5.13.6. Additional risk factors for GDM

Additional risk factors for GDM include previous GDM, previous stillbirth, previous neonatal deaths, and previous macrosomia, all of which were identified during data collection. These risk factors were collected from the ANC registry book and Al-Shifa health programme in primary and secondary healthcare institutions.

5.13.6.1. Previous GDM

Of the 63 (6.7%) women who had GDM in a previous pregnancy, 49 (77.8%) women had one or more additional risk factors of GDM. This indicated that 1.5% ($n = 13$) had previously had no risk factors for GDM; of these $n = 9$ women were screened using OGTT, and $n = 4$ women were diagnosed positive for GDM (See Table 5-12).

Table 5-12: risk factors: previous history of GDM with no risk other factors and were screened with OGTT

Risk factors	n = %	Screened with OGTT n = %	Diagnosed positive GDM n = %
Previous GDM	13 (1.5%)	9 (69.2%)	4 (30.8%)

A one-way ANOVA test revealed a non-significant main effect of (63 women who had previous GDM and other risk factors) on the likelihood of OGTT $F = 2.590$, $p = 0.076$.

5.13.6.2. Previous stillbirths

Of the 17 (1.8%) women who had previous stillbirths, 13 (76.5%) women had one or more risk factors of GDM. This indicates that 4 (0.4%) women had a previous history of stillbirth as their only risk factor, and 4 (100%) of them were diagnosed with GDM (see Table 5-13).

Table 5-13: risk factors: family history of DM and BMI \geq 30 kg/m² and screened with OGTT

Risk factors	n = %	Screened with OGTT n = %	Diagnosed positive GDM n = %
Previous stillbirth	4 (0.4%)	1 (25.0%)	1 (100%)

One way ANOVA tests revealed no significant main effect of n = 17 women who had previous stillbirths and other risk factors on the likelihood of OGTT, $F = 0.725$, $p = 0.485$

5.13.6.3. Previous neonatal deaths

Of the 12 (1.3%) women who had previous neonatal deaths, 10 (83.3%) women had one or more additional risk factors of GDM. This indicates that of 942 women, there were 2 (0.2%) women who had a previous history of stillbirth as their only risk factor, and both were screened using OGTT and had normal results. (See Table 5-14).

Table 5-14: risk factors: neonatal death as a single risk factor and screened with OGTT

Risk factors	n = %	Screened with OGTT n = %	Diagnosed positive GDM n = %
Previous neonatal deaths	2 (0.2%)	2 (100%)	0 (0%)

One way ANOVA tests revealed no significant main effect of $n = 12$ women who had previous neonatal deaths and other risk factors on the likelihood of OGTT, $F = 0.225$, $p = 0.785$

5.13.6.4. Previous congenital abnormalities

Of the 6 (0.6%) women who had previous congenital abnormalities, 3 (50.0%) women had one or more additional risk factors of GDM. This indicates that of 942 women, 3 (0.3%) women had a previous history of congenital abnormalities as their only risk factor, and 2 (0.2%) women were screened using OGTT and had a positive diagnosis of GDM. (See Table 5-15).

Table 5-15: risk factors: family history of DM and BMI ≥ 30 kg/m² and screened with OGTT

Risk factors	n = %	Screened with OGTT n = %	Diagnosed positive GDM n = %
Previous congenital abnormalities	6 (0.6%)	2 (80.0%)	2 (80.0%)

One way ANOVA tests revealed no significant main effect of previous congenital abnormalities on the likelihood of OGTT, $F = 0.598$, $p = 0.550$

5.13.6.5. Previous macrosomia

Of the 11 (1.2%) women who had a previous macrosomic baby, 9 (81.8%) women had one or more additional risk factors for GDM. All nine women were screened for GDM using OGTT, and one was diagnosed with GDM. This indicates that two (0.2%) women had a previous history of macrosomia only, and both of them were screened using OGTT with normal results (see Table 5-16).

Table 5-16: risk factors: previous macrosomia and screened with OGTT

Risk factors	n = %	Screened with OGTT n = %	Diagnosed positive GDM n = %
Previous macrosomia	2 (0.2%)	2 (100%)	0 (0%)

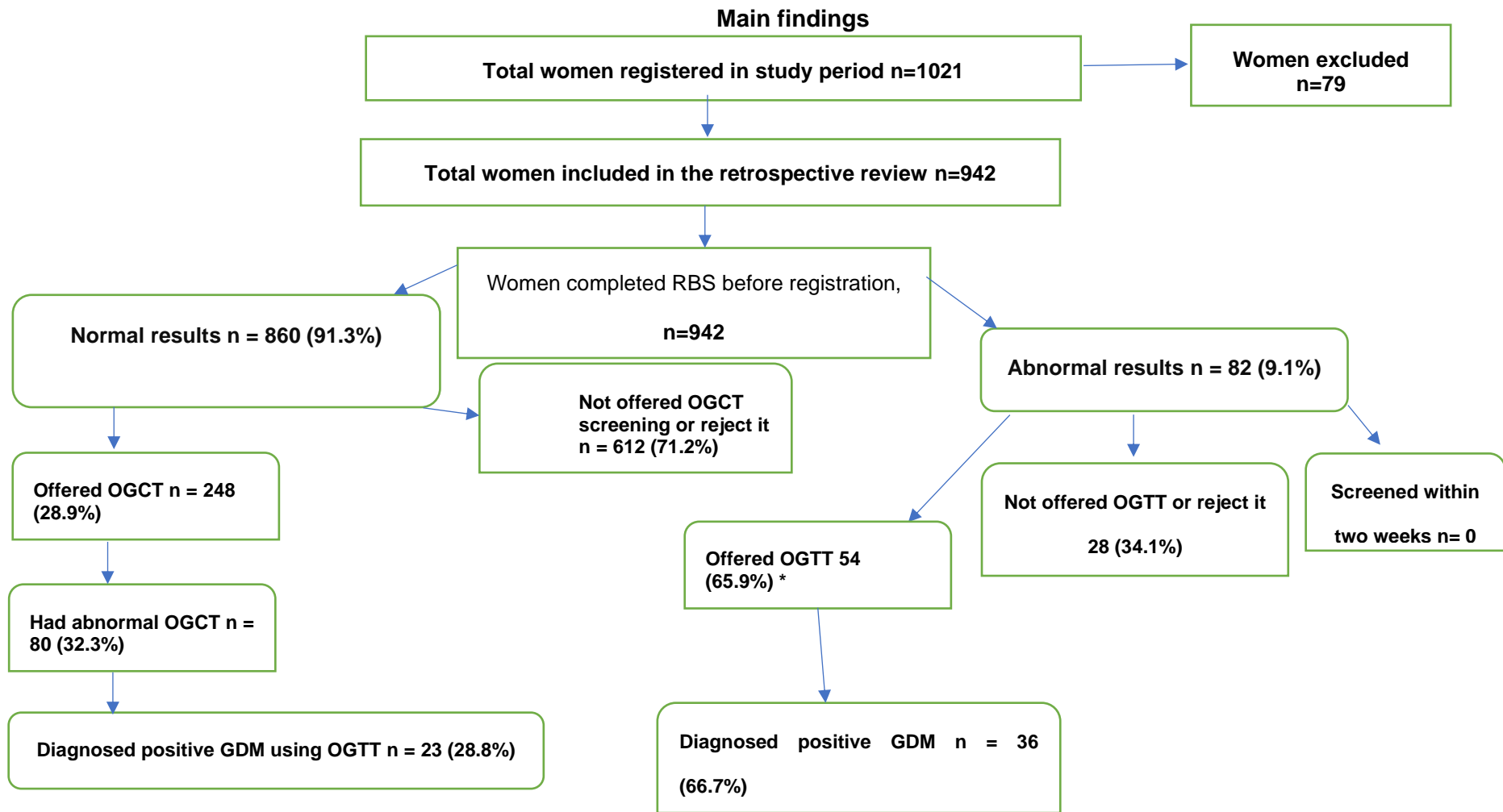
One way ANOVA tests revealed a significant main effect of the previous GDM on the likelihood of OGTT, $F = 3.499$, $p = 0.031$

5.14. Main findings

The retrospective review of case records' main findings revealed that a total of $n = 1021$ women were registered in the PHC1 between January to December 2014. Out of these women, $n = 79$ women either had miscarried or transferred out to other private or tertiary healthcare institutions. The left a remaining total of $n = 942$ women who met the inclusion criteria and had included in this study. All of these women had screened using RBS before the registration of their pregnancies in the antenatal clinic. Out of the $n = 942$ women who completed the RBS, 91.3% ($n = 860$) women had a normal RBS result. Of these 860, 28.9% ($n = 248$) women underwent OGCT, out of which 32.3% ($n = 80$) women had highly abnormal OGCT results and were offered OGTT. Out of the 80 women who underwent OGCT, 28.8% ($n = 23$) were diagnosed with positive GDM.

Of the $n = 942$ women screened using RBS before registration, 9.1% ($n = 82$) women had highly abnormal RBS results. Of these 65.9% ($n = 54$) women underwent OGTT and 66.7% ($n = 36$) women were diagnosed positive with GDM. There were 34.1% ($n = 28$) women who had missed the screening, either because they did not offer the tests or refused the tests. None of the 82 women who underwent OGTT were screened within two weeks of registration (see Figure 5-3). Overall, out of the 942 women

included in this study, 6.3% (n =59) women were diagnosed with positive GDM, which was not in line with the expected prevalence of GDM in Oman (see Chapter 1).



*two (2.3%) women had OGCT and OGTT

Figure 5-3 main findings of retrospective review

5.14.1. Urine investigations

Urine tests are a quick and easy procedure to assess the level of glucose and ketone for an individual . Urine glucose tests are used to screen for diabetes and to monitor diabetic control. Urine analysis is a routine procedure performed at registration in antenatal clinic. A total of 938 women (99.6% of the whole sample) had a urine test at registration (see Table 5-17). In line with the 2010 guidelines, all of these were screened for the presence of glucose and ketones in the midstream urine as a routine test.

Usually, healthy urine contains no glucose because the kidneys can reabsorb all of the filtered glucose from the tubular fluid back into the bloodstream. So, glycosuria is always abnormal. Abnormal glycosuria therefore means that the glycosuria is not like most cases of glycosuria, e.g., renal glycosuria is an example of abnormal glycosuria. This is a rare condition in which the kidneys release glucose into the urine. In pregnancy, the presence of glucosuria reflects the inability of the renal tubule to reabsorb glucose from the glomerular filtrate.

Fifteen women had glycosuria, and 26 had ketones in their urine; two women had both (see Table 5-17). Some women with DM or who developed GDM had glucose in the urine with a high amount. If there is insufficient insulin for the body, cells absorb the glucose, free glucose appears in the urine, and the body starts to break down fats for energy resulting in ketone production. The level of glucose in the urine might goes very high. This usually measured using glucosuria of 2+ or above on one occasion or of 1+ or above on two or more occasions. In most cases in the records, a binary result was entered, whether glucosuria was present or not. Only a few women were specified as glycosuria 2+ or above on one occasion or 1+ or above on two occasions.

Of the 15 women who had glucosuria (without ketones), 5 (33.3%) also had an abnormal RBS result. All five women were offered OGTT, and 3 (60%) were diagnosed with GDM. Of the 26 women who had ketones in the urine (without glucose), 4 (15.4%)

had an abnormal RBS result. All 4 women were offered OGTT, and 3 (75.0%) were diagnosed with GDM. Of the 895 (95.0%) women who had normal urine analysis results (no glucosuria, and no ketones), 648 (72.4.0%) women were offered OGTT. Of the 648 women, 45 (5.0%) had abnormal RBS results, and 45 (100%) were offered OGTT, and 30 (66.7%) were diagnosed with positive GDM.

Table 5-17: summary of urine analysis results in detail

Variable	Name of the test	Number (%) of the total sample	With abnormal RBS results	Number (%) of these screened with OGTT	Diagnosed positive GDM
Results of urine analyses	Glucosuria (without ketones)	15 (1.6%)	5 (33.3%)	5 (100%)	3 (60.0%)
	Ketones in urine (without glucose)	26 (2.8%)	4 (15.4%)	4 (100%)	3 (75.0%)
	Both glucose and ketones in urine	2 (0.2%)	0 (0%)	0 (0%)	0 (0%)
	Neither glucosuria nor ketones	895 (95.0%)	45 (5.0%)	45 (100%)	30 (66.7%)
	Total	938 (99.6%)	54 (5.8%)	54 (100%)	36 (80.0%)

5.15. Conclusions

The main three components that were assessed in this study to identify how well local HCPs adhered to GDM screening 2010 standards included 1) universal screening using RBS before registration, 2) women with normal RBS results and no risk factors which were screened using OGCT, 3) women who had abnormal RBS with risk factors or abnormal results of OGCT and were screened using OGTT.

The findings revealed that all women were screened for GDM using RBS. 28.9% of women who had RBS normal results were screened using OGCT and 69.5% of women who had abnormally high RBS results were screened using OGTT. No associations were found between the tested risk factors for GDM (BMI \geq 30 kg/m, close relatives having DM) and screening for GDM using OGTT. Screening for GDM using OGCT, OGTT and urine analysis were used inappropriately in the sample reviewed here. In the 2010 GDM guidelines, the awareness of risk factors for GDM was not a priority for screening, but women who had normal results of RBS and did not have diabetes, hypertensive, or cardiac disease were given an appointment at 22-24 weeks for OGCT as a routine test for blood glucose level in pregnancy. Despite the Oman GDM (2010) guidelines recommending universal screening for GDM using OGCT or/and OGTT, some women offered screening may not have attended, and some may not have even been offered the tests, including some who had one or more risk factors for GDM. The findings of this retrospective review confirmed some of the researcher's expectations based on anecdotal evidence. However, the researcher did not expect to find that more than 50% of women who had normal results of RBS did not subsequently have an OGCT. Additionally, more than 50% of women with abnormally high glucose levels during OGCT were not sent for further investigations. The research findings confirmed a lack of accuracy in implementing the 2010 GDM screening guidelines at PHC1 in terms of ignorance of the risk factors of GDM and insufficient follow up of those women who had abnormally high results of OGCT.

To determine the knowledge, understanding and attitudes about the implementation of GDM screening in primary clinical institutions, the researcher conducted semi-structured interviews with healthcare professionals in two primary healthcare institutions in Oman. One of these was the clinic at which the retrospective case notes review was conducted, referred to as PHC1. The findings from these interviews are presented in Chapter 7.

Chapter 6. Qualitative methods

6.1. Introduction and aim

This chapter presents the qualitative data findings. Semi-structured face-to-face interviews were undertaken to provide an in-depth understanding of the perceptions and experiences of Omani and non-Omani primary care healthcare professionals (HCPs) related to the implementation of the MoH's GDM guidelines. HCPs' suggestions on improving the implementation of GDM guidelines were sought during the interviews.

6.2. Objectives

- To examine and interpret barriers HCPs face when implementing GDM guidelines in Oman.
- To identify barriers and facilitators that inhibit or support screening and diagnosis of GDM in Oman.

6.3. Background

The Oman GDM guidelines (2010) were used between 2010 and 2014 in PHCs. The retrospective review of case records in PHC1 showed that, although the GDM guidelines 2010 stated that universal screening should be carried out for GDM, there were women who did not undergo GDM screening. Therefore, it was important to examine and interpret how these guidelines were implemented by the HCPs. However, in 2015 (prior to data collection for the interviews), 'The National Policy in Screening

and Management of Diabetes in Pregnancy' was proposed, following a collaborative effort by the Department of Family and Community Health, Department of Non-Communicable Diseases, the National Diabetic Centre, and the Department of Obstetrics & Gynaecology at Royal Hospital at MoH. The recommendation was to stop using the 2010 GDM guidelines, and to implement the new guidelines set out in that policy. This presented a challenge when it came to assessing the behaviour of the HCPs, regarding the implementation of GDM 2010 guidelines. Firstly, this was because the HCPs started implementing 2015 GDM guidelines one year ago. Secondly, the HCPs were too busy trying to understand the 2015 GDM guidelines to be able to implement them accurately. Therefore, I made the decision to explore the behaviours and attitudes of the HCPs towards the implementation of the 2015 GDM guidelines in PHC1 and PHC2 in Oman. Furthermore, I considered their views regarding the similarities and differences between the 2010 GDM guidelines and the 2015 GDM guidelines.

6.4. Study locations

The distance between the two health centres was about 80 kilometres. There was no communication between the HCPs from one clinic with HCPs from the other clinic.

I offered to book rooms for the interviews outside the healthcare centres, but the participants preferred to be interviewed in their respective health centres at break time or the end of their shift. The participants in both health centres suggested that a good location for the interviews might be the dieticians' or physiotherapists' room because in both clinics these were situated at the corner of the building, away from the busy clinic. According to Polit and Beck (2008) it is generally better for the researcher to book a quiet room with as little noise as possible to ensure that the participants would not be distracted during the interview.

6.5. Sampling

The study focused on the HCPs (nurses, midwives, general practitioners (GPs), nurses' in-charge (NI), and the general practitioners in charge (GPI), who worked in two primary healthcare centres, namely PHC1 and PHC2, in Muscat, Oman. The decision had made to interview HCPs who work closely with pregnant women, such as midwives, nurses, and GPs. The inclusion of the NIs and GPIs was because of their link with policymakers in the MoH. The GPI is an experienced registered GP who has undertaken the leadership and management preparation course. S/he manages and supervises the GPs and displays skill at communication. The NI role in the PHC is that of an experienced registered nurse who has display leadership, management, and communication skills. His/her responsibilities are to manage, supervise and assist the nurses and midwives in PHC. Their responsibilities extend to provide administrative support and patient care. Non-probability sampling was used based on accessibility to the PHCs and the HCPs. Purposive sampling had used when the researcher wants a sample of experts, who have specialist knowledge of the research topic, to answer the research question (Polit and Beck 2008; Hunt and Lathlean 2015). It can furnish the researcher with a depth of understanding of the research topic. The sample was purposively selected; it consisted of health professionals with a range of expertise. The distributions of participating HCPs were identical in both clinics, specifically, two staff nurses/midwives, one GP, one NI, and one GPI (see table 6.1). All interviews were audio-recorded.

6.5.1. Inclusion criteria

- nurses, midwives, and general practitioners who work in the ANCs.

-
- nurses-in-charge and general practitioners in-charge of the health centre

6.5.2. Exclusion criteria

- nurses, midwives, and general practitioners who do not work in the ANCs.

6.6. Ethical considerations

The approval of the study was discussed in Chapter Four (section 4.5). The participants were reminded that there was no identifier in the report of the study. The privacy and confidentiality of the participants were maintained throughout the data collection period. Refreshments were provided during the interviews and a gift was given to the nurses' in-charges in both clinics to share amongst all staff, as a token of gratitude for their support and cooperation during the data collection.

6.6.1. Negotiating access to the workplaces

Prior to interviewing the participants, I sought the approval of the Director of the Directorate General of Muscat governorate by writing a letter requesting to interview HCPs who work closely with pregnant women. I visited her in her office in July 2016 and discussed the aim of my research and the rationale for interviewing HCPs. I visited both PHCs and met with the general practitioner in-charge, nurses' in-charge and the HCP teams who work in the ANCs.

6.6.2. Recruitment Process

The recruitment process started after the visit to the director and securing her approval to establish collecting the data in August 2016. A meeting was held in each PHC2 to explain the details of the study. I prepared a poster (Appendix J) to present the research to interested parties in the PHCs and raise awareness of my research. I prepared a PowerPoint presentation and sent an invitation to HCPs who work in ANC to attend. PHC1 invited me to their routine morning meeting, which all HCPs attended. PHC2 arranged one meeting with only general practitioners and their nurse in charge at the predictable morning meeting. On the same day, I conducted another meeting with the nurses towards the end of the morning shift.

At every meeting, I presented a PowerPoint presentation with an explanation of the poster, offering an information sheet to the nurses, midwives, general practitioners who work in ANCs, nurses in-charges, and general practitioners' in-charges (Appendix J). I emphasized that whoever was interested could contact me directly using the contact details on the information sheet. I also provided the consent form (Appendix H) and envelopes. I gave the participants three to five days to consider whether to participate in the study, asking them then to contact me using the mobile number provided in the information sheet. I asked them to sign and return the consent forms in sealed envelopes at the interview time. I asked them to write their name, address, e-mail address, and telephone number to contact them. It also was explained to the participants that their identity during and after the study would be kept confidential. Names of the participants and their workplaces had replaced by ID codes for data analysis and reporting (see Chapter Four). Participants had given the option to withdraw from the research at any time, and if they chose to do so, their data would be destroyed immediately.

I contacted the participants individually and asked them for a suitable date and time to meet. I considered when they have a busy time in the clinic and negotiated a

convenient time to conduct the interview. The recruitment period was not as smooth as I expected because it was hard to get GPs in both health centres to agree to participate in the research. However, they had indicated positivity towards the study before it began. I interviewed ten HCPs across both health centres.

Although the recruitment process did not go as smoothly as expected, the HCPs were positive about participating in the study. The organization of the meetings with the GPs and NIs in both clinics was effective. I felt confident during the preparation to meet with the HCPs in both clinics because the atmosphere was overwhelmingly friendly.

6.6.3. Interviews

Traditionally, interviews are a dialogue between the interviewer and the interviewee. A research interview is a professional conversation held to seek knowledge that can be contextual, linguistic, narrative, and pragmatic (Brinkmann and Kvale 2015; Alvesson and Ashcraft 2012). The researcher seeks answers to the research question(s) from the participants, including their thoughts, experiences, or feelings (Gubrium et al. 2012). The interview is a facilitator for the researcher to gather data from the participants and express their views and share their experiences. The researcher acts as a guide throughout the interview. It is also essential to highlight the fact that sharing experiences may help the researcher gain new knowledge.

In this study, Omani and non-Omani HCPs who speak Arabic or English had included. The interview guide had prepared using the English language because the policy of MoH in Oman is to communicate either in Arabic or English or both languages. The accessed records had maintained in English. In the beginning, I piloted the study on two HCPs, (a nurse from PHC1 and a GP from PHC2), who agreed to provide me with feedback on the clarity of interview questions. I was interested to know if the questions

used were clear and understandable for the participants, whether the length of the interview was appropriate, and to see if they thought that anything could alter them.

Both interviews went well, with the interviewer using the opening question (tell me about your qualifications and experience in caring for the women in the antenatal clinic). The purpose of this question was to ensure that HCPs had completed at least two years working in ANC. The N2C2 was happy to share her experiences working with pregnant women. She also explained that she implemented the 2010 GDM guidelines, and she understood the differences between the GDM screening guidelines in 2010 and 2015. After obtaining this information from the N2C2, I asked her (so, in what stages of pregnancy do you offer pregnant women the screening for diabetes?). She answered that before registration, all women should complete FBS or RBS. However, in the 2015 GDM guidelines, a universal screening using FBS, or RBS should only be done on registration day. If the woman is at risk, an OGTT should follow within two weeks of registration. Then, I asked her, (how can you update your knowledge and practice of GDM screening). Her response was unexpected as she mentioned that she did not attend meetings on GDM and did not update herself with any new information regarding GDM screening.

The responses to these questions were similar to the GP2C2 that I interviewed in PHC2. Although she was aware of the 2015 GDM screening guidelines, she was confused and had an insufficient understanding of the guidelines. She also stated that she had attended a meeting regarding the introduction of the 2015 GDM guidelines but could not understand the reasons for changes in the blood glucose thresholds.

I felt that I could manage the time (duration of the interview) and the type of questions that should follow their responses.

6.6.4. Interview guide

An interview guide is an instrument used when the questions are asked face-to-face or over a telephone (Polit and Beck 2018). An interview guide (set of questions; see Appendix L) was developed by the researcher, with the aim of answering the research questions. The purpose of the interview guide was to structure the interviews and to ensure that the conversation ran smoothly. The questions included in the interview guide were discussed with the supervisors before starting the interviews. After completing the two pilot interviews, I sent the transcripts to my supervisors and some alterations were made to the interview questions. Probing questions were added in order to extract deeper information from participants. All interviews were conducted in English and lasted between 33 and 55 minutes.

The questions included in the interview were as follows:

- Tell me about yourself, including your job title, qualifications, and the number of years you have worked in the antenatal clinic.
- Tell me about your understanding of the current GDM guidelines.
- Tell me about your input or the extent of your involvement in the development of these guidelines.
- Tell me about your strategies to keep yourself updated with evidence-based practice.
- Tell me about any barriers and facilitators to the implementation of GDM guidelines.

6.6.5. Process of the interview

Prior to each interview, I contacted the participants by phone and agreed a date, place, and time to meet. I prepared a list of participants and put the date of their interviews against their names. This list was kept confidential and stored on my personal

computer, which is password protected. On the day of the interview, I arrived 15 minutes before the interview was scheduled to start. I ensured the lights were working and that a comfortable seating was arranged. When the participant arrived, at the beginning of each interview, I introduced myself by name and job title. I reminded them about the clause in the information sheet and consent form where I mentioned that the interview would be audio-recorded. I also showed them the audio recorder, which would be used to record the interview. Then, I asked each participant to confirm that he/she had completed reading the information sheet and had signed the consent form. I was confident about my ability to manage the interview. I started by asking questions about their personal information. Each participant was also encouraged to offer suggestions or comments about how they 2015 GDM guidelines can be improved.

6.6.6. Data Management

After each interview, I transferred the audiotaped interview into a folder in the researcher password-protected computer, The audio file was immediately labelled with the number and date of the interview. The interview transcripts were also labelled with the name of the PHC and the number of the interview and were stored in a different electronic folder. All audio-recorded interviews and transcripts were transferred in the electronic folder via Fast file and stored in the password-protected Cardiff University computer. (Section 4.7).

6.7. Data Analysis

After obtaining permission from each participant via a consent form, the interviews were audio-recorded. I made notes after each interview to reflect on the interview and provide any context that had not previously been mentioned. The transcription of the data was time-consuming because all participants were non-native English speakers,

which meant that Language proficiency was not well maintained. Some of the participants spoke quickly, so I replayed the audio many times to avoid missing any words during the interview. One of the participants was from an Asian background and did not pronounce “e” in English words, so it took me three days to complete the transcriptions of her data. I was cautious whilst transcribing each interview - although the majority of the participants were Arabic speakers, some of them tended to use everyday language such as “يعني” which means “I mean”. Some participants repeated Arabic words to ensure that I understood the meaning of their sentences.

Topics that were covered in each interview included:

- Number of years’ experience in antenatal clinics
- Participant’s knowledge about screening for GDM
- The participant’s experiences of the practice of GDM screening in the clinic
- Any perceived barriers to the implementation of GDM guidelines
- The methods used to update knowledge of evidence-based practice among participants.
- Participants’ suggestions on how to improve GDM guidelines.
- Participants’ beliefs about the suitability of performing GDM screening in the antenatal clinic.
- Participants’ perception of their skills in encouraging the pregnant women to screen for GDM.

For the purpose of qualitative study analysis, thematic analysis was used. I used quotes from the participants to demonstrate the developing themes for all participants. Thematic analysis organises and describes the data set in detail (Braun and Clarke 2006).

Table 6-1: Data analysis process (inductive approach)

Phase one	<p>Read and re-read the interview transcripts.</p> <ul style="list-style-type: none"> • Search for patterns of meaning • Mark ideas for coding
Phase two	<ul style="list-style-type: none"> • Generate an initial list of concepts. • Create initial codes. • Organise data into meaningful groups
Phase three	<ul style="list-style-type: none"> • Sort the different codes into potential themes. • Combine the codes to form two overarching themes – barriers and facilitators. • Use tables or mind-maps or write the name of each code in a separate document.
Phase four	<p>Review and refine themes.</p> <ul style="list-style-type: none"> • Level one: review at the level of the coded data extracts • Level two: review at the level of the coded entire data set
Phase five	<ul style="list-style-type: none"> • Define and further refine the themes. • Identify the 'essence' of what each theme is about. • Determine what aspects of the data each theme captures
Phase six	<p>The final analysis and writing of the report</p>

6.7.1. Initial coding

After listening several times to each interview, I transcribed each interview separately.

After transcribing, I read over and re-listened to the audio recorder to make sure that

all data was included. I read and re-read the transcripts line by line to familiarise myself with the data. I consulted my supervisors on the transcription of the interviews, initially sending them the transcripts for interviews one and three because their job titles were different to each other. The supervisors went through the audio records and transcripts and provided me with feedback to enhance coding. In step one, I began searching for meanings and marking codes on each interview transcript. In step two, I generated the initial list of concepts with the initial codes. Codes are written notes made in the margin of interview transcripts (Harding 2013). I organised the codes and grouped them according to their commonality within the dataset (Harding 2013). In rough copies of the transcripts, I highlighted the important aspects of the participant's answers using different colours (see appendix M). In step three, I sorted through the different codes and combined them into potential themes. I designed a concept map (see appendix N), which helped me to identify a visual representation of codes, grouping and organising them into a table to present all the themes. I listed the differences and similarities between both clinics. Then, I extracted the four major theme as follow:

1. Working experiences and the ability to implement GDM guidelines accurately.
2. Confusion and lack of understanding of the implementation of GDM guidelines.
3. Poor evidence-based practice
4. Work overload, lack of time and resources
5. Women's refusal of GDM investigations and increase of missing cases.

In step four, I reviewed and refined the themes. I reviewed the themes with the coded data extracts, and later I reviewed the themes at the level of the coded entire data set. I found that there were many themes that needed to be amended and some of them were sub-themes. Sub-themes were gathered from the identified codes into potential themes. In step five, I identified the essence of each theme and determined the

aspects of the data that each theme captured. According to Bryman (2012), themes provide an understanding of the data, directly contributing to the findings. The final step of the analysis was to write the report to help make sense of the findings.

6.7.2. Demographic characteristics of the participants

Ten HCPs from different professional backgrounds and varying years (between 2 to 23) of clinical experience from two primary healthcare institutions (PHC1 and PHC2) in Muscat, volunteered to participate in this study. There were five participants from each PHC. In PHC1, four participants were Omani (GPI, NI, N, GP), and one was non-Omani (N). Four Omani participants also volunteered from PHC2 (GPI, NI, two nurses), and one was non-Omani (GP). In both clinics, the nurses and nurses' in-charges had Diploma qualifications in general nursing. The GPs and the GPIs qualified as Bachelor's in Medicine. Table (6-2) presents the characteristics of the interview participants. It also presents the degree of contact these HCPs had with pregnant women. If the HCPs had direct contact with the women, this was classified as a high degree of contact; if they were sometimes involved in the care of the women, their contact was considered medium. If the HCPs were involved in policy decisions but had minimal contact with the women, they were considered to have a low degree of contact.

Table 6-2 Demographic characteristics of the face-to-face interviews

Clinics	Job	Years of experience	Nationality	The degree of contact with the pregnant women who are at risk of GDM	Code used in thematic analysis
PHC1	Nurse	11 years	Omani	High	N1C1
	Nurse	08 years	Omani	High	N2C1
	Head nurse	12 years	Omani	Medium	NI1C1
	General practitioner	07 years	Non-Omani	High	GP1C1
	Head of general practitioner	13 years	Omani	Low	GPI1C1
PHC2	Nurse/Midwife	23 years	Non-Omani	High	N2C2
	Nurse	17 years	Omani	High	N2C2
	Head nurse	20 years	Omani	Medium	NI2C2
	General practitioner	02 years	Omani	High	GP2C2
	Head of general practitioner	05 years	Omani	Medium	GPI2C2

6.8. Conclusion

This chapter described the method used for face-to-face interviews. As a researcher, it is essential to ensure that privacy and confidentiality were maintained throughout the process of data collection. Some of the HCPs might experience challenges that prevented them from sharing their experiences about implementing GDM guidelines in their place of work. For example, a busy clinic might be one reason why someone could not participate in the study. The ten participants shared their knowledge and experiences regarding the implementation of GDM guidelines, which enabled the researcher to extract themes that are presented in Chapter 7.

Chapter 7. Qualitative results: Barriers and facilitators to implementation of GDM guidelines in Oman

7.1. Introduction

This chapter presents the findings of face-to-face interviews with healthcare professionals (HCPs) from two primary healthcare institutions in Oman, the interview discussion topic was implementing GDM guidelines in ante-natal clinics. The HCPs in both health centres were from various professional backgrounds and included nurses, general practitioners, midwives, nurses' in-charges, and general practitioner in-charges. The numbers of individuals from each profession used in this results chapter can be found in chapter 6, table 6-2. During the interviews, the HCPs discussed both positive and negative experiences, namely their personal (awareness and understanding of the GDM guidelines) and professional (knowledge and clinical experiences) perspectives on implementing the GDM screening guidelines. Direct quotes were used to support the generated themes. Two major themes emerged from the data: barriers and facilitators.

7.2. Major theme one: Barriers

Themes and subthemes related to barriers are presented as depicted in Figure 7-1.

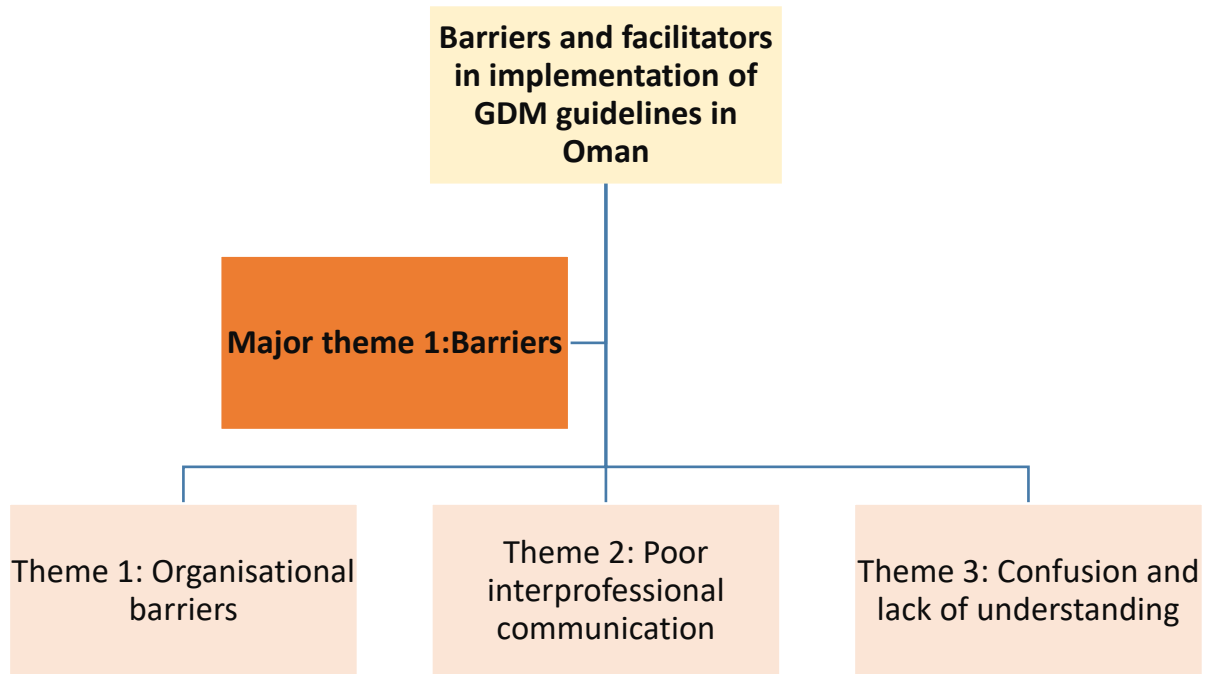


Figure 7-1 Map of major theme and the three main themes

Table 7-1 demonstrates the distribution of the themes and subthemes in the analysis.

Major theme: Barriers	PHC	Subtheme	Title of subtheme
Theme one: Organisational barriers	One and two	A	The gap between rhetoric and reality
	One and two	B	Lack of resources
	One and two	C	Work overload Shortage of staff
Theme two: Poor inter-professional communication	One and two	A	Inconsistency of care
	One and two	B	poor uptake of “continuing education” workshops etc.
Theme three: Confusion and lack of understanding of implementation of GDM guidelines.	Two	A	Lack of awareness
	Two	B	Poor understanding of the guidance.

7.2.1. Theme One: Organisational barriers

Organisational barriers were evident by how the HCPs ran the antenatal clinics. The organisation imposes certain limits on the number of staff (shortage of staff), which resulted in an apparent increase in the work, with this work overload meaning less time to complete tasks. The successful implementation of GDM guidelines means overcoming organisational challenges. Organisational barriers are classified under three subthemes: the gap between rhetoric and reality, lack of resources (such as lack of time, shortage of staff) and work overload.

7.2.1.1. Theme One: subtheme A: Gap between rhetoric and reality

The Oman GDM guidelines (2015) recommend universal screening for GDM. According to the guidelines (both 2010 and 2015 versions), every woman who registers at the ANCs should undergo venepuncture for fasting blood sugar (FBS) or random blood sugar (RBS) at this time. However, in reality, in both health centres, the FBS or RBS was collected prior to initial registration. In the following interviews with the HCPs, although they provided a rationale for their practice, a gap between the guidelines and the reality of their practice was evident. All the HCPs in PHC2 stated the routine practice for screening GDM is supported by the new GDM guidelines (2015). However, there were many differences between the protocols outlined in the GDM guidelines and the practice of the HCPs. The term “booking” was used by interviewees when they discussed the “registration of pregnancy”.

N2C2 described the process that a woman would follow in ANC after the confirmation of her pregnancy. She stated that the woman would visit the GP to do a pregnancy test in order to confirm her pregnancy. If the pregnancy test was positive, the GP would collect the routine blood investigations on the same day. The blood results were usually ready within three days and recorded on the computer. If the RBS test result was abnormal, the antenatal clinic nurse would phone the woman and provide her with an appointment to do OGTT and register the pregnancy. If the blood results were normal, the woman would be given a routine appointment for antenatal care registration. At the first visit to the antenatal clinic, the GP would collect information about any family history of DM2 from the woman and inquire whether she had any previous history of GDM. If the woman was considered high risk for GDM, the GP would offer her an OGTT within two weeks. If the result of the OGTT was normal, the woman was advised to have this repeated at 22 weeks of gestation. If the OGTT result was abnormal, the woman would commence treatment for GDM at the health centre and should be referred to a specialist clinic for (tertiary care) and further management.

“They will come for pregnancy test and investigations to the general doctor so that time pregnancy is positive... they will do routine antenatal investigations that time... if the RBS is more than 7 directly advising for GTT or the doctor will take history... past history also if there is history for GDM or close relative diabetes high risk cases even before booking to the ANC advising for GTT so when they are coming to open the card. most of them the GTT is done and if it is normal, we will be repeated at the 22 weeks again and if it is high as routine for GDM means refer to the dietician ... the blood sugar profile and if after this blood sugar profile, it is high then according to protocol advising phamco doctor to start the treatment in health centre itself. but if no doctor will refer to specialty clinic as tertiary care. The doctor will refer the case”

[N2C2 interview]

N2C2 is the focal point (the nurse responsible for the work at the antenatal clinic) in PHC2. She stated that before registering at the antenatal clinic, the woman should undergo the following blood investigations (see table 7.1)

Fasting blood sugar or Random blood sugar

Venereal Disease Research Laboratory (VDRL)

Human immunodeficiency virus (HIV)

Hepatitis B (Hep B)

Completed blood count (CBC)

Sickle cell disease

On registration in the antenatal clinic, routine care would be provided to the woman if the blood results were normal. If the blood results were abnormal, the GP would follow the procedure outlined in the previous paragraph.

“N2C2: ...they will review investigation... blood investigations (such as) HB... CBC... and VDRL ... HIV...”

Aisha: when the woman does those blood tests?

N2C2: ...this is in first visit... this is in general (GP) they will do in first visit... in our clinic for booking will review those investigations...”

[N2C2 interview]

GP2C2, who works in the same clinic and has direct contact with pregnant women, confirmed that women should have the blood investigations before their registration day. If the blood glucose results were abnormal, women were asked to do the OGTT before registration. The rationale provided by GP2C2 was that women should then have all blood glucose results ready at registration, including the results of OGTT. However, some women did not return the specified ten days after taking the test, instead returning on the registration day, when the GP or the nurse would then offer another day for OGTT. GP2C2 expressed concern that some women who did not complete the OGTT prior to their registration day, therefore, had a delayed diagnosis of GDM in their early pregnancy.

“The woman usually when she comes to do the investigations, we are giving her a message to come after ten days, so this is she should come if she has done the GTT before booking we will see at booking the investigation but if it is after booking it is dependent on the woman if she will come or not...”

[GP2C2 interview]

GP2C2's explanation of the process that she used to register women in antenatal clinics was slightly different. GP2C2 stated that before registration, pregnant women were given routine blood investigations. If FBS or RBS results were abnormal, the woman was to have an OGTT on registration day. This is because she was considered at risk of GDM. However, if the woman presents with low-risk factors and normal blood tests results, the OGTT was planned at 22 weeks during her routine visit to the specialist's clinic. This statement is in line with the GDM guidelines 2015, which stated that women should have an OGTT at 22-24 weeks of gestation if there were no risk factors for GDM.

“First of all, we do CBC, RBS, HIV, VDRL, SICKLING, blood group, and of course urine routine... if she has an infection to roll out and the ICT (indirect coomb tests) in the beginning then if she has the risk factors, she will go directly to the GTT at that time will do an appointment and will give them the GTT if she is not with risk factors so she will do GTT later on at

22 weeks when she goes to the specialist clinic”

Interview]

[GPI2C2,

N2C2 had worked in the antenatal clinic at PHC2 for 23 years and stated that if the woman was assessed as being high risk for GDM, the OGTT was done on registration day. If the woman completed the blood investigations that were routinely completed before the antenatal registration and the RBS report showed abnormally high glucose, the HCPs contacted the pregnant woman and advised her not to eat or drink for eight hours before her registration appointment so that she would be able to have the OGTT on the day of registration.

“...High-risk criteria that we are selecting and to do the GTT in booking time itself to find diabetes...”

[N2C2, interview]

During the interviews, I discovered that there were similarities concerning healthcare strategy in screening for GDM in both clinics. The following quotes are from N2C1, who said that routine practice for an at-risk woman after confirmation of her pregnancy is to offer her two appointments (one appointment for the antenatal care registration and another appointment for OGTT). This means that the HCPs in the antenatal clinic provide a primary assessment confirming her BMI, family history and medical history before offering her an appointment for registration. This primary assessment is to assess whether the woman would require OGTT at registration.

“We are trying nowadays, we give her GTT at booking when she will come from the pregnancy investigation confirmed that she is pregnant and coming for the clinic... we will give two appointments because she is high risk one appointment for booking and one is for GTT from the beginning we will give her and will ask if she is a history of previous GDM... If she is primi or multi if she is primi we will ask her about the family history if anybody... Also, we will see at her body shape if she is obese will check her height and weight so if her BMI is high, she needs to do GTT from the beginning”

interview]

[N2C1,

However, GPI2 C1 made mention of a different process and one which showed poor practice in PHC1. He stated that all women should be offered OGTT before registration. His justification for this being that the woman would then know if she were GDM from the day of registration, and it would be easy for the HCPs to care for her from day one. This contradicts with the GDM guidelines, stating that women should have an OGTT *if* the woman presents with risk factors for GDM, or the RBS results were abnormal.

“...there is appointment for OGTT and that which is supposed to be done before booking, so because we are having all sort of difficult to doing RBS and FBS and we should send this sample to local Hospital. it takes almost two days for results to come ... now by that time I mean we are giving appointment for OGTT before booking so when the patient is coming for booking, we are already having the result with us, so we are telling the patient or the client that you are for example normal reading or not”

[GPI1C1, Interview]

7.2.1.1.1. Summary

Each clinic had its strategy for screening pregnant women for GDM. Although the GDM guidelines (2015) clearly stated the recommended process for screening pregnant woman for GDM, both health centres followed their practice. Some of the HCPs were advising the women to complete the routine blood investigations before registration so that if their blood glucose levels were abnormal, then OGTT could be done at registration day. However, the GDM guidelines (2015) state that FBS or RBS should be done at registration day and not before. This shows an apparent discrepancy between the rhetoric and the reality of the implementation of the GDM guidelines. This poor implementation of GDM guidelines could be due to a failure to use work time effectively or being overloaded with work. . The following subtheme reports the lack of resources in ANCs.

7.2.1.2. Theme one: Subtheme B: lack of resources

Although primary healthcare institutions in Oman are well equipped, human resources problems such as staff shortage and lack of time are serious issues. The lack of such resources means that HCPs struggle to provide a high quality of care. PHC1 and PHC2 both have a laboratory where women usually go for venepuncture and urine tests. A laboratory technician should be available to conduct these procedures. However, the nurses in both clinics report that the procedures are performed by the nurses working in the antenatal clinic. The reason for this was not provided during the interviews, with the nurses instead complaining that this procedure has become part of their responsibilities in the antenatal clinic. N2C2 stated that the doctor enters the request for laboratory blood investigations for OGTT into the computer, but in reality, these are performed by the nurses at the antenatal clinic. . The treatment room in the health centre is also used as an observation room for minor cases, such as for clients who require intravenous fluid for one or two hours and dressing wounds. With regards to the OGTT, the data indicated that the nurses are performing tasks of the laboratory technicians as well as the GPs.

“... now we are doing in our treatment room... actually this blood collection supposed to be from doctor and then we have to give glucose... but here the doctor always busy ... so they asked us to do it in the treatment room... so we are collecting blood fasting and then we will give glucose ... then post glucose we are also collecting”
[N2C2 interview]

“It will be in treatment room and the doctor will request in the laboratory so send the sample”
[N2C2 interview]

7.2.1.3. Theme one: Subtheme C: Work overload and lack of time

Most of the participants from both clinics complained of having a lack of time due to inappropriate use of their professional skills. For example, the OGTT procedure is

carried out either in ANC or the treatment room in the health centre. The nurses withdraw blood from the pregnant women and prepare the glucose solution. The correct practice is to send the women to the laboratory for venepuncture. Each health centre has a laboratory department run by laboratory technicians.

The same issue of an OGTT being performed by the wrong person in the wrong space was reported in PHC1. N2C1 reported that the HCPs had been performing OGTT for pregnant women since the inception of the GDM guidelines in 2010. Previously they used a glucometer, with an almost instant result. The new (2015) GDM guidelines recommend the collection of a blood sample for OGTT via venepuncture followed by laboratory analysis because it was found that the blood glucose results were more accurate using this new technique. In both clinics, the nurses stated that nurses and GPs perform the OGTT procedure, with data indicating that nurses conduct the OGTT procedure for pregnant woman at both clinics. GPs are always busy, so they are excused from withdrawing blood for the OGTT procedure.

“Before I feel it was easy because just taking blood like a drop so, anybody can help us but now no we have to collect blood, so it is our work or doctor’s work... the doctors are having so many patients they are seeing many patients, so we have to do it”

[N2 C1 interview]

During data collection from face-to-face interviews, it became clear that only one nurse/midwife and one GP were running the antenatal clinic every day. This indicated that the GP and the nurse/midwife were attending to the same number of women. However, the nurse’s job was to perform the basic assessments, and the GP would see the at-risk women with more complications, which meant the GP was having longer appointments with these women. The N2C1 stated that the nurses must therefore take up the responsibilities of the laboratory technician, which led to a significant increase in workload for them. I will elaborate on this issue in the following subthemes.

The new GDM guidelines (2015) recommended that if RBS results are between 7.0-11.0 mmol/l, women should be offered OGTT immediately after registration and if the results of this indicate an FBS \leq 5.1 mmol/l or 2hrs post glucose $<$ 8.5 mmol/l, the woman should repeat the OGTT at 22-24 weeks of gestation. The HCPs found this repetition of OGTT increased their workload.

N2C1 stated that the new GDM guidelines increased their workload because of the necessity of repeating the OGTT for almost all pregnant women with RBS results between 7.0-11.0 mmol/l. The N2C1 also mentioned that the OGTT procedure was performed during the morning shift, so sometimes they could be helped by the nurses from the treatment room (who knew how to do OGTT), but the treatment room was usually busy, and so the nurse working in the antenatal clinic had to complete the tasks by herself.

“...our clinic is very busy so many GTT in treatment room and we are struggling with that in the morning duty...” [N2C1 interview]

N2C1 added that any woman deemed to be at risk should have the OGTT repeated (one in early pregnancy and again at 22 weeks), and as a matter of routine, each at-risk woman should be referred to the specialist clinic to be examined by obstetricians. It is expected that these women would be offered the OGTT at the specialist clinic, but N2C2 stated that this was not always the case, with many women either not being offered the OGTT or not attending appointments at the specialist clinic and the PHC2. If the woman visits the ANC in the health centre for a routine check-up between 28-36 weeks of gestation and the GP or nurse discovers that she has missed the OGTT at 22-24 weeks, they will offer her the next available appointment at the health centre. This woman would be considered an extra appointment at the antenatal clinic, increasing the nurse's workload.

“...because earlier in early pregnancy also doing so two times some of them are going late to the specialist clinic. So, they are not doing it in 22 weeks there so again they will come back here and there will be no appointment in the computer near appointment so we are taking them as extra... Otherwise routinely seven cases we are giving appointment then when they are coming, they are already 25 weeks so we can't give them after one month and all so again we are accepting them as extra...” [N2C2 interview]

In PHC1 most of the participants stated that they felt overloaded with work in the antenatal clinic. A focal point nurse in the antenatal clinic, N2C1, discussed the increase in their work following the introduction of the 2015 GDM guidelines. She described the nurse working in the antenatal clinic in PHC1 after introducing the new (2015) GDM guidelines as “super staff”.

“So many works and you are alone there and who will come to take appointment so when you are giving appointment it is taking time because you have to ask her if any risk factors... family history you have to ask her not like this to give the appointment according to her LMP no not like before, so it is really difficult who should be there”
[N2C1 interview]

She added:

“I feel she is a super woman super staff...” [N2C1 interview]

She also stated that her colleagues were not happy about their new role in the antenatal clinic.

“Really most of them they are telling we are not super staff we cannot deal with this clinic we need somebody who is calm she is coming relax and do her work because really it is tough”
[N2C1 interview].

GPI1C1 confirmed what N2C1 said by stating that nurses were not happy because of the amount of work.

“The only thing that they are not happy about it is a large number of clients are being screening “ [GPI1C1, interview].

The data highlighted organisational ambiguity and a lack of human resources in both clinics. This meant that nurses in PHC1 found it difficult to concentrate, leading to malpractice instances, which was ascribed to the work overload. NI1C1 described one such incident:

“We are too much here crowded we forget that for patients sometimes we are doing for fasting... fasting blood sugar and. but from lab they are somethings like stickers not for that patient by mistake and that going that patient and she is taking [miskinah: means poor lady] she will have the GTT and after two hours we take from her this one other blood but the first one it is without ... with mistake by other stickers...” [NI1C1 interview].

NI1C1 said that because the antenatal clinic was so crowded, some nurses sometimes put the wrong label on the container when collecting fasting blood glucose to send to the laboratory. The pregnant woman would then drink the glucose, and after 2 hours, the nurse would collect blood and put a different label on the blood container. When the result comes back from the laboratory, the woman receives the 2 hours blood glucose value but there are no records found for the fasting blood sugar because of the mistake made by the nurse at the beginning of the test. Therefore, the woman would be offered another appointment to repeat the OGTT, which negatively impacts both the woman and the staff.

The data indicated that it was difficult for HCPs to accept the change that came with the 2015 GDM guidelines, although they worked hard to ensure that all women were screened for GDM. GPI2C2 confirmed that the change to the GDM (2015) guidelines was difficult, as the diagnostic tests for OGTT were previously analysed in the health centre. Now 2015 GDM guidelines recommended that blood samples be sent to the secondary healthcare institution, meaning a two day wait for the results. The consequences of this practice were an increase in the number of visits to the health centre to conduct the test, thereby increasing the workload. GPI2C2 stated that this might lead to women deciding not to attend an antenatal clinic at all. However, she stated that the HCPs in the ANC educate the women about the importance of GDM

screening, and that this increased their awareness of the subject. GPI2C2 recommended placing a machine in the laboratory of the health centre, which she believes would help reduce the number of antenatal clinic visits women are required to attend.

“it was difficult to us to change the guidelines because we were doing the diagnostic test here in the health centre before we are not sending to the hospital because now we have to send the blood to the hospital which takes time around two days and then the result will come after so the patient has go and come back because we have no machine in the health centre so this is one issue that increase the visiting of the patient and we may lose the patient in between... these were the difficulties since we started so this was the difficulties but when we started but slowly we through explanation to the patient to come back and the importance of having the results and the follow up we managed to overcome this issue but still we are asking the directorate of health services to have the machine in the health centre so to reduce the number of visits and reduce the pressure over the patient to go and come back each time”

[GPI2C2 interview]

The other incident noted in the PHC1 was how other HCPs, who were not trained nurses or midwives, were utilised. N2C1 said that the nurses in the antenatal clinic might request help from the radiographer to register the woman in the antenatal clinic. The rationale provided was to help reduces the number of women waiting in the antenatal clinic and reduces the work overload. The fact that radiographers were not trained to care for pregnant women may result in inaccuracies and mistakes.

“Because most of them they don’t like the crowdedness, because so much and too much work and too much crowd and too many patients now it is increasing so they cannot manage. So, they are alone sometimes, there is extra staff she will help you radiographer sometimes they are helping us in the registration. so, if it is not there, we will be alone that mean you will do booking, birth spacing, follow up, and you have to enter in the registration you have to do blood collection you have to give GTT and if there is any injection”

[N2C1 interview]

N1C1 stated that women required an OGTT procedure as well as health education. However, only one nurse runs the antenatal clinic, so her time is limited. Therefore, this nurse would be unable to provide health education during the routine antenatal clinic visit. Another reason health education might not be provided is that the nurse working in the antenatal clinic at PHC2 might lack this knowledge herself. N2C2 admitted that she does not really know what to say to women in the antenatal clinic because she has limited experience in dealing with pregnant women. In addition, the multiple tasks that she had been assigned in the antenatal clinic made it impossible for her to deliver any health education to pregnant women.

“They need health education from the staff... why they are coming for GTT... they need health education from the staff... but as you know one staff and it is crowded and women coming to you... you are late you are late it is difficult, and you don't know much of health education because I don't know more about it and say to patient do this and do this...” [N2C2 interview]

7.2.1.3.1. Summary

One of the challenges faced by GPs in both clinics was having just a limited amount of time to carry out their responsibilities. Hence, the nurse/midwife tended to carry out extra responsibilities outside of their job description, such as venepuncture and OGTT, which is the responsibility of the laboratory technician. The following section considers the shortage of staff and the high workload of the existing staff. The entire sample expressed their extreme dissatisfaction with the poor handling of the work overload in the antenatal clinic after the introduction of the 2015 GDM guidelines. One of the inter-professional challenges in both clinics was that there was no agreed job description amongst the HCPs. For example, there was no written agreement on the role of the nurse, GP, or laboratory technician in both clinics. The organisational ambiguity and shortage of nurses in the ANC may have contributed to the multiplicity of tasks that nurses were performing in both clinics.

7.2.1.4. Theme one: Subtheme D: Shortage of staff

One GP and one nurse ran the antenatal clinic in both of the clinics studied. The standard number of new registrations is seven women per day. In addition, each clinic will routinely see 50 women for antenatal follow up and at two weekly and six weekly postnatal reviews. In addition, the clinic accepts new registrations for birth spacing and follow up appointments to offer birth spacing supplements. The nurse and GP undertook these tasks every day.

“Aisha: Ok if I will ask you how many bookings, you will do every day.

N2C1: supposed to be five but sometimes seven or eight because if urgent.

Aisha: right... so, you are giving around seven to eight new booking with all investigation.

N2C1: seven to eight new booking with investigation with one staff

Aisha: and what about the follow up.

N2C1: follow up this is according to their 14 weeks... 20 weeks... 24weeeks.

Aisha: how many roughly you see the women for follow up every day.

N2C1: 50 sometimes

Aisha: 50 women per day plus eight booking

N2C1: same

Aisha: along with the eight booking

N2C1: same you know there is a birth spacing same doctor she is seeing same nurse she is seeing” [N2C1 interview]

N2C1 complained about the multiple tasks that she carried out during her placement in the antenatal clinic. I was told by some nurses who work in both clinics that they used an appointment system to regulate the attendance of women in the antenatal clinic. However, up to seven or eight new registrations every day and up to 50 follow up, postnatal and birth spacing appointments resulted in an overload of work for both the

GP and the nurse in the antenatal clinic. In both clinics, this same nurse was responsible for ensuring adherence to OGTT procedure with the considerable workload meaning there was potential for clinical errors.

“the staff no one else ANC staff only no one can touch that one because of the so many problem... they are giving them in the paper and no one writing in the book so now we told them do not touch it is only in ANC for ANC staff and to be used in the morning time only even if the patient comes in the evening time for investigation we told the doctor to advise the patient to come in the morning to take the appointment... it is difficult because we have problem the patient is coming they have appointment they gave them but not in the list...”
[N2C1 interview]

N2C1 stated that the nurse/midwife and the GP working in the antenatal clinic were wholly responsible for new registrations and follow up appointments. There were four staff nurses and two GPs in each antenatal clinic who work in rotation, with one nurse and one GP per shift. The rationale provided by N2C1 was that if anyone else were to do the work, then the margin of error would increase, leading to problems if the woman were referred to a secondary and specialist clinic. She also added that the work undertaken in the clinic during the morning and afternoon is not synchronised because the nurse who was working the afternoon shift would offer OGTT appointments for women without first checking the availability in the OGTT appointment book in the antenatal clinic. This meant that women were often given the wrong appointments for OGTT, thereby increasing the following morning's workload.

7.2.1.4.1. Summary

Shortage of staff in both clinics is a significant issue that affected good practice, including the delivery of OGTT. One nurse and one GP ran the antenatal clinic that served more than 60 women per day.

7.2.1.5. Theme two: Poor inter-professional communications

The fact that there was poor communication between the HCPs in both clinics was raised during the interviews. The routine in both clinics was that pregnant woman at risk of GDM should be offered an appointment with the dietician and health educator. This would enable her to plan her lifestyle, including diet, exercise, and daily activities during her pregnancy. In addition, the GP also referred the woman to the obstetricians at secondary healthcare institutions or specialist clinics according to her requirements. Unfortunately, there was no continuity of care as the nurse or the GP did not receive any feedback from the dietician, health educator or obstetrician. The following subthemes discuss the inconsistency of care and poor updates in evidence-based practice.

7.2.1.6. Theme two: Subtheme A: Inconsistency of care

It is vital to have a strategy that the HCPs in all clinics can follow to manage the pregnant women in their care who are at risk of GDM. The data obtained from the two clinics studied here led me to understand that there was no follow up for the woman after completing the referral procedure. N2C1 stated that after referring the woman to the dietician, health educator and obstetrician, nothing was fed back to the antenatal clinic nurse or GP.

“Actually, not following with the... may dietician I don't know they are giving second appointment or not ... we are referring first time to the dietician after that she is following, I don't know... I think she is opening visit in the computer and writing this one or maybe she is keeping file I don't know exactly about that how they are following that”
[N2C1 interview]

Also, there was no column in the maternal health card to record the dietician's follow up. So, the nurse did not know the number of times a pregnant woman visited the

dietician for consultation. Therefore, there was no contact between the pregnant woman and the HCPs in the antenatal clinic at her primary health clinic following the referral.

“No column, only because the history only their history and other vaccination and the visits only, because such cases they will be following in tertiary care with obstetrician every two weekly I think they are giving appointment for them, so they are managing the case there itself” [N2C1 interview]

However, N2C1 stated that at both clinics (meaning at PHC1 and specialist clinic), the woman might be given an appointment at the same week. So, when the woman did not appear for the appointment at PHC1, the HCPs would assume the woman was given an appointment at the specialist clinic and was offered OGTT. For some high-risk women, they continued to receive maternity care in the specialist clinic, coming back to the primary health centre for a postnatal check-up two weeks after delivery.

“As a routine if they have appointment at 36 weeks, she will come for the investigation otherwise they will follow up in specialist clinic every two weeks” [N2C1 interview]

In PHC1, the HCPs had the same issue of inadequate communication, which led to a lack of consistency in managing the pregnant women in their care. N2C1 was concerned that each woman needed to understand what the blood sugar profile (BSP) means. BSP is a procedure given to those women identified as having borderline OGTT (fasting blood sugar 5.1 mmol/l or random blood sugar 8.5 mmol/l) and who are then advised to come to the health centre six times in one day i.e., before and after each meal, for further testing. Then, the blood glucose values are sent to the obstetrician to confirm the diagnosis of GDM.

“Aisha: how are you caring about this woman how are you communicating to improve the care of this woman is there any plan or is there any meetings.

N2C1: meetings between us and doctors but health educator... no

Aisha: you never met with dietician or health educator in regard to discuss anything about the woman.

N2C1: no...no I didn't

Aisha: so how do you follow up this woman how do you know what support have been giving by the dietician or by health educator.

N2C1: because I will send her then she will come back to me... she should understand that I have to give her BSP paper “

[N2C1 interview]

N2C1 stated that there was no communication between her and the other HCPs to discuss the women's care in the antenatal clinic. Furthermore, she stated that she referred women to the dietician to ensure that they understood the blood sugar profile procedure that was undertaken for at-risk women. However, she did not know what information the dietician and health educator provided to the woman regarding the management of their blood glucose during pregnancy. Furthermore, she showed little interest in finding out if the woman understood the procedure (OGTT) and the reason behind doing it.

There was a contradiction between NI2C1 and GPI2C1 regarding who has responsibility for referring pregnant women to the dietician. GPI2C1 stated that the GP is responsible for referring the woman to the dietician, health educator and obstetrician, but NI2C1 stated that the nurse is responsible for these referrals.

“Aisha: who is referring this woman to the dietician.

GPI2C1: the GP

Aisha: the GP ... and what is the feedback ... what exactly the feedback that she is expected from the dietician...

GPI2C1: it is only I mean educating the client... it is only educating the client regarding gestational diabetes.

Aisha: ok is like a following up appointments to set with the dietician.

GPI2C1: yes, should be like that” *[GPI2C1 interview]*

The following conversation is with NI1C1 regarding the procedure that HCPs followed for a woman with an abnormal blood glucose level.

“If it is high, we will send her to the dietician for two weeks from staff... she is referring to dietician” [NI1C1 interview]

NI1C1 added that the woman would be given a referral letter to the dietician. She would have an appointment with the dietician within two weeks, and later on, she may start the BSP procedure.

“She has giving her a paper for dietician to send to the dietician and she will see her for two weeks making diet for her after two weeks will start doing BSP for her” [NI1C1 interview]

These quotations from GPI1C1 and NI1C1 demonstrated the duplication in referral to dieticians, the consequences of which could lead to lack of awareness of the job descriptions for both parties. This would provide a context for understanding the poor implementation of the GDM guidelines by the HCPs in the health centre. It might well be due to a lack of awareness or poor understanding of GDM guidelines.

One particular concern was about the level of sharing and the understanding of the GDM guidelines amongst HCPs. How did they communicate in order to gain a better understanding of the GDM guidelines?

“Aisha: I mean like is there any like a collaboration between doctors and the nurses in terms of you know discussing this guideline or putting things in order to improve the implementation of the guidelines.”

GPI1C1: no (his tone changed he whispered the answer)

Aisha: no there is no such communication started.

GPI1C1: no” [GPI1C1 interview]

GPI1C1 said there was no communication between the HCPs regarding implementing of the guidelines and, in particular, no communication with the dietician and the health educator.

7.2.1.6.1. Summary

According to the MoH healthcare policy in Oman, pregnant women should be offered continuity of care from pre-conception until six weeks postnatal. Women were referred from ANC in the primary healthcare institution to secondary care and specialist clinics, as required. This is to ensure that pregnant women receive the best care throughout pregnancy. Moreover, universal screening of GDM was routinely practised in both clinics, although the possibility of missing some women was brought up when the HCPs stated that there were women who refused the OGTT and some women who were referred to the specialist clinic may not be screened for GDM. This is either because the woman was not fasting when she attended the specialist clinic, or the obstetrician was very busy and advised the woman to do the OGTT at the local health centre. The nurses in both clinics stated that following the specialist clinic appointment, the woman was expected to visit the health centre at 36 weeks, which is too late for GDM screening.

These findings show a lack of continuity of care within both clinics and the other specialist clinics that women were referred to.

7.2.1.7. Theme two: subtheme B: poor uptake of “continuing education” workshops etc.

Building on the findings discussed in the previous section regarding the shortage of staff, poor understanding of the GDM guidelines and poor communication among the

HCPs, it was important to determine how the HCPs were keeping their knowledge and skills up to date. The data indicated that the knowledge and skills of the HCPs in both primary healthcare institutions were not regularly updated.

N2C1 displayed a lack of up-to-date knowledge. She said she was unaware of the percentage of women who develop GDM, and that she did not read any GDM guidelines other than Oman GDM guidelines. She was not up to date with screening for GDM guidelines.

“Aisha; Did you manage to read any of the statistics about the yearly statistics about the GDM.

N2C1: no ... I didn't read.

Aisha: did you manage to read anything about WHO guidelines.

N2C1: No”

[N2C1 interview]

The N1C1 was unfamiliar with any evidence-based practice updates within GDM screening and said that she did not read any worldwide GDM guidelines and did not attend workshops either on managing or care of pregnant woman in antenatal clinics. She mentioned that there were meetings with the midwifery team in the secondary healthcare institution regarding the 2015 updated GDM screening guidelines, but unfortunately, she did not attend. She also stated that one of the meetings she attended focused on highlighting mistakes made in the antenatal clinic and not about the GDM screening itself.

“Aisha: did you read your own reading about evidence-based practice in regard gestational diabetes screening.

N1C1: I don't have.

Aisha: do you hear about or read about WHO guidelines about GDM or NICE guidelines

N1C1: no

Aisha: what support that you are having from this health centre to help you to be up to date in your practice.

N1C1: up to date... no workshops sometimes we are having meeting a with midwifery staff in the secondary healthcare institution it was I think last week or before but I was on leave I didn't attend ... they know more about GTT and screening of GDM with the women more than us they are midwifery staff there was a meeting, but I didn't attend because they are telling we are having too much mistakes... not screening the patients specifically"

[N1C1 interview]

Similarly, N2C1 stated that she never took responsibility for updating herself regarding the guidelines for screening for GDM. She added that learning within PHC1 was poor because the HCPs in the secondary institutions just sent them the GDM guidelines without explanation or interpretation. Instead, N2C1 used a blaming strategy to highlight the many mistakes made in the primary healthcare institutions. Misunderstanding lay with the GPs as well as nurses.

"Aisha: did you manage actually to read the GDM guidelines that produce from WHO and NICE... NICE guidelines.

N2C1: no

Aisha: and what you need is right interpretation for each point in this guideline for you to be able to implement it.

N2C1: ... even the doctor she doesn't know, they push it to us, but we don't know even doctors they don't know... I don't know this is something new and then only after sometimes I asked how to do this because they found many mistakes from us... then I told them you start something with us, and you didn't give us the over how to do it when to do it.... and then last before two weeks it was meeting then I told them before start anything new just come explain at least for us or at least for the doctor even doctors they don't know when to start that BSP and mother she has to follow for diet for two weeks like this..."

[N2C1 interview]

GP2C1 stated that she could not remember the WHO GDM guidelines, so she did not know if they were the same as Oman GDM guidelines.

"WHO... not remember WHO guidelines".

[GP2C1 interview]

GPI2C2 expressed her worries and anxiety regarding attendance at the workshops arranged to update the knowledge and skills of the HCPs. She admitted that there were planned workshops on evidence-based medicine; however, in her view, the limited seats at these workshops were the primary reason for not keeping up to date with evidence-based medicine in PHC2.

“There are workshops that are coming through DGHS with the evidence based medicine, but you know the seats are limited so sometimes even we don’t have seat to go it depends on the seats are limited for whole Muscat region so if we get a chance yes, we send the staff there it is once per year it is difficult....”
[GPI2C2 interview]

7.2.1.7.1. Summary

From the data discussed above, it was found that HCPs working in these two primary healthcare institutions were not keeping themselves up to date with information about screening for GDM. Although the MoH in Oman recommends that HCPs follow the 2015 GDM guidelines for screening pregnant women for diabetes, of the ten HCPs who were interviewed, four of them were not familiar with these guidelines. However, they did not keep abreast with new research in the health services because they felt overworked and stressed and also that them taking a day off to attend a workshop might be frowned upon. The interviews conducted with the HCPs a general lack of interest in attending workshops or keeping abreast with the latest research or guidelines. In Oman, it is important for HCPs to know about any new guidelines or policies from WHO because of close collaboration between the MoH and WHO.

7.2.2. Theme three: Confusion and lack of understanding on implementation of the GDM guidelines in PHC1.

Data gathered indicated confusion and a lack of understanding of the GDM guidelines by the HCPs in PHC1. Subtheme one describes the lack of awareness of the GDM guidelines amongst some of the HCPs in PHC1.

7.2.2.1. Theme three: subtheme A: lack of awareness

During the interviews in PHC1, three of the HCPs described how they felt regarding their level of knowledge and understanding of the GDM guidelines. The HCPs in PHC1 made negative comments, stating that they were confused and had a poor understanding of the GDM guidelines. While some of them were aware of the guidelines but unsure how to implement them, others were completely unaware that there were existent guidelines regarding GDM screening.

N1C1 stated that she was unaware of the GDM guidelines, although she worked in the same antenatal clinic for five years. She admitted that she had seen the flow chart depicting the GDM screening guidelines but did not know if it current.

“I didn’t read before this is a guideline... we have this paper (GDM guidelines) in antenatal clinic....it is there... before... when I entered ANC, I saw this guideline...I saw this guideline, but I don’t know if it is for five years or not...” [N1C1, interview]

She did, however, mention that it was important to ask each woman if she had a history of GDM or if any member of the family had type 2 diabetes mellitus (DM2). The rationale provided by her was because it is required by the secondary healthcare1 (SHI1) institution. She also added that this information was gathered to determine whether the woman needed an oral glucose tolerance test (OGTT). Most of the HCPs in the interviews referred to OGTT as a glucose tolerance test (GTT). N1C1 appeared to have a lack of knowledge regarding the importance of collecting this information.

“...before no... but from this year or last year... this year this year... there is a rule from the secondary healthcare institution to ask if the patient has GDM before or family history because this woman needs GTT”
[N1C1 interview]

In PHC1 the nurse in-charge was on two weeks leave, and she had two acting deputies in the clinic. The first deputy nurse in-charge was on annual leave but, the second deputy nurse in-charge was willing to participate in the study. The second deputy nurse in-charge NI2C1 said that she was not aware of the guidelines followed by staff in the antenatal clinic, and she had not seen the new (2015) GDM guidelines. Although she had been to the antenatal clinic regularly, but she stated not seeing the GDM guidelines.

“...I don't know because ... second deputy (nurse in-charge) but sometimes going there in the clinic and sometimes will go in another clinic... I don't know...I didn't see this...”

[NI2C1 interview]

The second deputy nurse in-charge (NI2C1) should have been aware of new rules, regulations, and the national clinical guidelines for GDM screening as it was part of her responsibilities as an administrator, but in PHC1, NI2C1 stated that she was unaware of the new GDM guidelines. I showed her the GDM screening (2015) flowchart and asked her if she had seen it before, to which she replied that the nurses complained that they found it confusing. I found that the NI2C1 contradicted herself during the interview as it was unclear if she was unaware of the GDM guidelines, or she had some confusion about its interpretations.

In addition, the GP2C1 stated that the GDM screening flow chart had not been adequately introduced to the HCPs, instead, she said that she just found it in the clinic.

“Aisha: in this health centre when did they introduce the new guidelines to you... or how they introduce it to you?”

GP1C1: I found it in the clinic”

[GP1C1 interview]

GP1C1 stated that she assessed pregnant women in the antenatal clinic but was aware that some women were diagnosed with GDM with borderline OGTT results. For example, after the OGTT the 75 g 2 hours post blood glucose of borderline ≥ 8.5 mmol/l (GDM guidelines screening (2015) stated that diagnostic criteria for GDM is an OGTT using FBS ≥ 5.1 mmol/l and 75 g 2 hours ≥ 8.5 mmol/l), in which circumstance some GPs diagnosed the woman with positive GDM and some did not. GP1C1 also mentioned no uniformity between the specialist clinic and secondary healthcare institution in terms of GDM diagnosis. For example, two participants in PHC1 said that the obstetrician in-charge in the SHI1 (SHI1 is the first line referral for pregnant women to be examined by an obstetrician) sent fax containing different GDM diagnostic criteria, contradicting the national standards of GDM screening. Moreover, some women were referred to a specialist clinic (this is a tertiary antenatal clinic run by the obstetrician's consultants).

"I saw (mmm) different patients (mmm) pregnant ladies diagnosed with GDM with high ... or border... borderline reading ... at specialist clinic considered this is GDM... at the secondary healthcare institution she said no still not to diagnose..."
[GP1C1 interview]

According to the GP1C1, this showed apparent inconsistency amongst the GPs who were diagnosing the women with GDM as well as a lack of clarity around using the GDM guidelines.

7.2.2.1.1. Summary

Three of the female interviewees (one nurse, one nurse in-charge and one GP) articulated a lack of awareness of the 2015 GDM guidelines, but the other two interviewees (one male GP in-charge and one nurse) were aware of the national guidelines for GDM screening, in comparison with PHC2, all the interviewees stated

that they were well aware of the national GDM guidelines. None of the interviewees stated that she/he was given the GDM 2015 guidelines as a complete package. Instead, the main discussion during the interviews was about the existence of the GDM screening flow chart. The following subtheme pertains to the poor understanding of the guidelines among HCPs in PHC1. In contrast, the HCPs in PHC2 felt confident in their understanding of the guidelines and did not complain of any difficulties in implementing GDM guidelines.

7.2.2.2. Theme three: subtheme B: poor understanding of the GDM guidelines

In the extract below, N1C1 discussed their lack of understanding of the 2015 GDM guidelines. N1C1 explained that, from her perspective, the new GDM guidelines were complicated, and that the flowchart provided was difficult for the HCPs to follow.

“...the way that they write it is not clear, if you want to understand you have to read every day and one by one but most of them, they still they are feeling difficult to understand this one... maybe it is how they are writing this one is difficult...”
[N1C1, interview]

In her role as a nurse, N1C1 is responsible for all aspects of work in the antenatal clinic, such as maintaining the records of pregnant women and training the new staff nurses joining the clinic. In addition, she completed some necessary specialist training, including the updating of antenatal care manuals and procedures at the MoH. Her role is that of a focal point, and a reference or consultant for all nurses working in the antenatal clinic. This means that she has the responsibility of understanding the new GDM guidelines and explaining them to the nurses who work in the antenatal clinic. During the interview, she said that no explanation was provided regarding the 2015 GDM guidelines to her and her colleagues, which meant that they lacked the confidence to implement the guidelines because they did not fully understand them.

“... it is not clear like this... this I typed it I retype it again (referring to diagram which contains the summary of the GDM guidelines (2015) till now most of the staff they don't know they didn't understand it this one” [N1C1, interview]

N1C1 showed me the flow chart of the 2015 GDM screening protocol that she received from a secondary healthcare institution (SHI1) by fax. This SHI1 is an institution comprising of a standalone obstetrics unit that consists of obstetricians who look after all women referred from the primary healthcare institution for further antenatal management. The head of the obstetricians in the SHI1 (who are responsible for communicating policy changes to the PHC1) communicated with the GPs and nurses working in the antenatal clinic in the PHC1 and conveyed circulars and letters from MoH concerning the 2015 GDM guidelines. N1C1 said the 2015 GDM screening guidelines were not clear and that she did not receive electronic or hard copy of the document. Therefore, she decided to retype the flow chart and printed one copy and stuck it on the wall in PHC1. N1C1 stated that the copy of the flow chart received from SHI1 was not clear as the font was too small, and she showed me the amended version that she had retyped. She also mentioned that she felt proud of taking this initiative.

“...the staff most of them start to read this and they feel like there is something they missed, and they don't understand when the client is getting her GTT like this, so they felt difficulty to understand this...” [N1C1, interview]

The N1C1 mentioned blood sugar profile (BSP). N1C1 described this process as being like a “cyclone” meaning that they went around in circles with no end in sight. She felt disappointed because despite the efforts she made, the GDM guidelines were still, challenging to understand and confusing for her colleagues.

“... so, this GTT and BSP and all GDM now I feel still it is like a cyclone... we don't know what our responsibility is and what is hospital responsibility”
[N1C1, interview]

GP1C1 expressed her worries about a lack of clarity in the 2015 GDM guidelines. GP1C1 said that all her colleagues, and herself were confused about the right way to implement the GDM guidelines. She added that nurses and GPs felt that the GDM guidelines were confusing.

“...this is still not clear... really not clear...” [GP1C1 interview]

“Maybe not from the guidelines but the staff still having confusion”
[GP1C1 interview]

GP1C1 added that she did not feel confident enough to use the GDM guidelines in the case of diagnosing a pregnant woman who has borderline OGTT that is 75g 2hours plasma glucose ≥ 8.5 mmol/l. She therefore consulted her colleagues before making such a diagnosis, and sometimes, they too were unable to clarify the diagnosis.

“... sometimes for me ... all doctors... my colleagues can confuse... even I if ...came to me ... the pregnant ladies came to me at ... at my office sometimes I need to discuss this case with my colleagues ... my seniors because I am not sure this is right or not”
[GP1C1 interview]

NI1C1 reported that nurses working in the antenatal clinic were confused and did not understand the new GDM guidelines.

“...sometimes they are telling sometimes it is confusing... they complaining it is confusing...”
[NI1C1 interview]

Confusion and poor understanding of the GDM guidelines may well lead to poor quality of care and low self-confidence amongst the HCPs.

7.2.2.2.1. Summary

From the interview data, it appears that confusion and poor understanding of all the GDM screening guidelines, including those from 2010 and 2015, was the main challenge faced by HCPs in PHC1. This included a general lack of awareness and poor understanding of the new (2015) GDM screening guidelines. The above mentioned subthemes illustrated one aspect of poor understanding of GDM guidelines in the PHC1. While the HCPs in PHC1 were aware of the guidelines, they felt disappointed and worried that they would not be able to accurately implement the 2015 GDM screening guidelines because of the difficulties in understanding them.

7.2.3. Conclusion

The above sections presented the barriers that HCPs faced in PHC1 and PHC2 in Muscat. These sections considered the confusion and lack of understanding amongst the HCPs regarding the implementation of the GDM guidelines. This was presented in the discussion about the level of awareness in both clinics. This was followed by a discussion of the organisational barriers which contributed to poor implementation of GDM guidelines. This included the discrepancy between the 2015 guidelines and the current practice, lack of time, shortage of staff and work overload. Finally, poor communication among the HCPs exacerbated these problems, and there was a lack of continuity of care for women in both clinics and poor examples of evidence-based practice. The following sections will present the facilitators for implementing GDM guidelines between the HCPs and both clinics.

7.3. Section two: Facilitators

7.3.1. Introduction

This section presents the facilitators found among the healthcare professionals in both clinics that may aid in implementing the GDM guidelines in Oman. An examination of facilitators is the second major theme in this thematic analysis. Three themes and subthemes related to facilitators are presented in section two as follows:

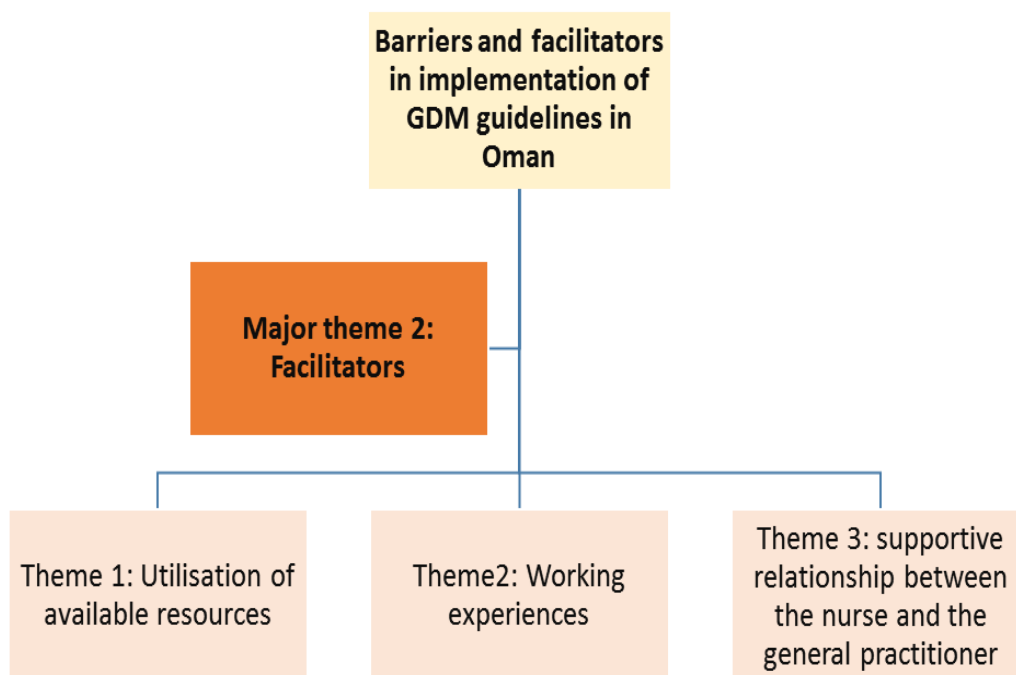


Figure 7-2 Map of major theme 2

The above figure 7-2, demonstrates the three themes developed from the data set:

1. Theme one: Utilisation of the available resources.
2. Theme two: Working experiences.
3. Theme three: Teamwork amongst professionals

The themes consist of the following subthemes:

- 1) Theme one: subtheme A: the existence of the 2015 GDM guidelines
Subtheme B: continuous staff development
Subtheme C: leadership support
- 2) Theme two: subtheme A: completion of two years and more of experience
Subtheme B: positive attitudes towards implementation of GDM guidelines
- 3) Theme three: subtheme A: availability of the nurse and GP in one room
Subtheme B: collaboration among the HCPs in the health centre in the care of pregnant women

7.3.1.1. Theme one: Utilisation of the available resources

There are many resources available in the workplace used by the HCPs in the PHC including 2015 GDM guidelines, continuous education through workshops and availability of facilities. The following section presents the explanation of the following subtheme.

7.3.1.2. Theme one: Subtheme A: the existence of the 2015 GDM guidelines

The hard copy of the 2015 GDM screening flow chart was available in the antenatal clinic, dietician's room, and health educator room. The majority of the interviewees were aware of the availability of the 2015 GDM guidelines in both health centres. N1C1 and N2C1 showed me the flow chart that they followed during the screening of the GDM women in the antenatal clinic. However, the lack of understanding of these guidelines has been discussed in section one (see theme one).

N1C1 and N2C2 stated that new GDM guidelines (2015) were introduced to healthcare professionals last year. The HCPs were aware of the new 2015 GDM guidelines and

they also had the hard copy of the GDM screening flow chart in their health centre. The interviewees referred to the GDM screening flow chart as a diagram throughout the interviews.

“It is new one... last year we got that one policy and guidelines of new GDM”.

[N1C1 interview]

“The new one last year March”

[N2C2 interview]

NI2C2 stated that the GDM screening flow chart was available. The support provided by leadership in the PHC2 raised awareness and understanding of the 2015 GDM guidelines. This was shown by how they encouraged discussion with the HCPs, to enable them to be implemented accurately.

“We are discussing about the diagram and to tell all doctors and staff to go read the guidelines”

[NI2C2 interview]

Similar findings were confirmed by N2C1. She had confirmed the presence of the 2015 GDM guidelines in their health centre.

“Aisha: so, when did receive the new guidelines.

N2 C2: new guidelines only last year “ [N2C1 interview]

The GPI1C1 confirmed that the GDM flow chart was available on the notice board in the antenatal clinic, meaning that it did not have to be memorised; it could simply be read and acted upon accordingly. In addition, workshops were available to familiarise HCPs about the GDM guidelines 2015 to be enforced in the primary healthcare sectors.

“... we are posting I mean this chart we are posting in each clinic so no need to memorise anything you can look on it there so they can do the needful”
[GPI1C1 interview]

The following quotation illustrating ways of working with the new guidelines comes from GP2C2. GP2C2 stated that she attended a workshop about the implementation of the 2015 GDM guidelines. The workshop focused on answering the queries of the HCPs regarding the implementation of the GDM guidelines. She also said that another workshop was planned to discuss the implementation of GDM guidelines in greater depth and that expertise from the MoH would be available.

*“It was general but also it was focused on implementation of guidelines 2015 because it was new to everyone and needed clarifications and it has been discussed in a higher workshop”
[GP2C2 interview]*

The HCPs who worked in PHC2 spoke positively about their knowledge and understanding of the GDM guidelines. N2C2 stated that the GDM guidelines were available in almost all rooms used by pregnant women including the antenatal care, GP room and dietician and health educator room. The HCPs working in these rooms could easily access the flowchart, which explained the process to follow when screening women for GDM. N2C2 also mentioned that the HCPs refer to these guidelines whenever they were in doubt or had queries. N2C2 added that the head of the general practitioners regularly facilitated discussion on GDM guidelines during the routine morning meetings, answering staff inquiries on the implementation of GDM guidelines.

“...in each room there is guidelines we stick it there in the room... yah... we are keeping one copy for each room... any doubt or anything... they are following that one ...they have also discussion also with our head daily ... any doubt or anything they have discussion in early morning...”

[N2C2 interview]

N2C2 said that when new GDM guidelines were released last year, the healthcare professionals attended an introductory session organised by the Directorate of General Healthcare Services and provided by the Wilayat (DGHS).

“...new protocol came since last year... we had a class about that ... the GDM new protocol and this one ... then... they introduced that one... we attended the class in the Wilayat based”.

[N2C2 interview]

This was supported by the nurse in-charge of NI2C2. She stated that the new GDM guidelines were discussed in the morning meetings and that the HCPs were allowed to take the guidelines home if they wanted and were given ample time to understand how they worked.

“...we are discussing about the diagram and to tell all doctors and staff to go read the guidelines and take it home at least to see what is there... what is the need...”

[NI2C2 interview]

The nurses and midwives who work closely with the women at the antenatal clinic were well prepared to follow the GDM guidelines. This was supported by the GP2C2, who said that recurrent discussion of the GDM guidelines had become a habit during the routine morning meetings, which encouraged greater understanding.

“...we plan to train our staff and we kept the guidelines in front of them and always in each meeting we stressed on these guidelines, so it will be a habit with them they so every time they will practice, and they will know the guidelines...”

[GP12C2 interview]

GDM guidelines were introduced to the HCPs in the PHC2 and the importance of them understanding how they should be implemented was stressed at the routine morning meetings and when attending the workshops arranged by the DGHS in the MoH.

7.3.1.2.1. Summary

In PHC2, the HCPs were given the opportunity to read the GDM guidelines and attend workshops. The GPs at PHC2 and the nurses/midwives who worked closely with the

pregnant women in the antenatal clinic were supported by the GPI2C2, who answered their queries and made time to discuss the GDM guidelines at morning meetings. This was demonstrated by their understanding of the GDM guidelines and the confidence they expressed in practising the GDM guidelines. The 2015 GDM guidelines were available in both clinics. However, some HCPs only had access to the flow chart and not the entire set of guidelines. The Ministry of Health in Oman ensured that all primary healthcare institutions had a hard copy of the new GDM guidelines. The rationale was to assist HCPs in the early detection, diagnosis, treatment, and monitoring of GDM women. However, the interpretation of these guidelines amongst HCPs remained a challenge.

7.3.1.3. Theme one: subtheme B: continuous staff development

The staff development department in both clinics collaborated with the Department of Continuous Education in the Ministry of Health to ensure that every healthcare professional had attended the organised workshops. The heads of GPs in both clinics stated that all the HCPs were encouraged to attend the workshops related to introducing the 2015 GDM guidelines.

The GPI2C2 said that all HCPs had to be aware of the policies and guidelines in the health centre. She added that every year there was one week devoted to training the HCPs about antenatal care. After attending this training, every HCP was responsible for preparing sessions to train the other HCPs who did not have the chance to attend the workshop.

“First of all, they have to know the guidelines so they have to read the manual and we have workshops through the directorate of health services... each year there is a workshop regarding antenatal for around one week this will train the staff... so they are going in turn every time we are sending the nurses and doctors to this workshop and then anything we are having presentation in the health centre itself training the staff and teaching them through these presentation”

[GPI2C2 interview]

GPI1C1 revealed that an introductory workshop was prepared for the HCPs who work in the antenatal clinic. After the introductory week, each GP was advised to read the policies and manual procedures in the antenatal clinic to encourage the HCPs to understand how the antenatal clinic runs and the proper way to monitor pregnant women.

“First of all, ... I mean they should go through a workshop ... any new general practitioner should go for a workshop and then on hand training in the health centre... and also, they should go through manuals ... Certain manuals regarding antenatal clinic... there is antenatal manual... Omani national guideline regarding antenatal and regarding post... postnatal and ... birth spacing... So, they should go, and they should I mean read about it and should be clear and in the first few days they should also sit with one of them ...one of the doctors surround the clinic so they will look the work probably and to understand what things to be done”

[GPI1C1 interview]

The GPI2C2 said that the staff development department within the health centre encourages the HCPs to attend on-going workshops using the credits system where they are required earn specific credits every year. These credits help in improving their annual appraisals and increase their confidence in caring for pregnant women in the antenatal clinic.

“We do have staff development so there are credits for each staff they should reach this is yearly there is credit for the staff so they are actually should reach these through going workshops through the year”.

[GPI2C2 interview]

This indicated that administrators in the health centres were motivated to develop the knowledge and skills of healthcare professionals in order to improve the healthcare service.

7.3.1.3.1. Summary

Healthcare professionals had a great deal of preparation to equip them to work in an antenatal clinic. This began with their attendance at the introductory week and continuous support from the administration in the health centre. Continuous staff development is a vital way to ensure that HCPs in antenatal clinics are up-to-date with their knowledge and skills. The GPs in both clinics were keen that the HCPs kept their knowledge up to date through these workshops. With motivation and support from the health centre, the HCPs were given the strength to implement the GDM guidelines accurately.

7.3.1.4. Theme one: Subtheme C: leadership support

There are different ways in which the leader in any healthcare institution can support the healthcare providers. The following quotations from both clinics provided us with an insight into the follow-up procedures. GPI2C2 stressed the importance of supporting the GPs in the health centre through discussion about updated research in the field, highlighting the effort that they made as administrators to support the GPs, by holding these discussions during routine morning meetings. Unfortunately, the GPI2C2 did not mention any similar efforts made for the nurses/midwives in the health centre. This might be seen as the responsibility of the head nurse.

“Actually, we are as doctors the topics that we are discussing always we always try to be updated one we always try to search for more studies so those are involve in our meetings”
interview] *[GPI2C2*

However, the fact that GPI1C1 sometimes argued with specific information proved how much he wanted to make the HCPs feel supported at all times.

“GPI1C1: I am asking always I am asking the staff nurse... I am asking the general practitioner who is sitting in the ANC clinic if there are any difficulties ... any confusion... any suggestion regarding this one and if there is any also, I mean comments regarding the reading or the result of such investigation and if there is any suggestion to improve it.

Aisha: right... and what is their feedback.

GPI1C1: the feedback... I mean sometimes we are doing for example by our glucometer this RBS and FBS ok... But some doctors they prefer to send it to local hospital for accurate reading ... now how to implement it and this one so we served it I mean internally “ [GPI1C1 interview]

GPI1C1 showed his curiosity and concern that the HCPs running the antenatal clinic had no difficulties or confusion in monitoring the pregnant women under their care. This was clear because he asked the HCPs about any challenges they faced during the implementation of the guidelines and if they had any suggestions to improve the practice. When I asked him about the feedback of the HCPs, he said that some of them preferred to use the glucometer for OGTT results whilst others sent the sample to the local hospital laboratory to have an accurate result. He also said that the HCPs were trying their best to implement the GDM guidelines accurately.

7.3.1.4.1. Summary

The collected data revealed that the HCPs were supported by their superiors, who ensured that they were safe and able to manage the challenges that they faced in the workplace. This was shown through the continuous support from the administration.

7.3.2. Theme two: working experiences.

One of the main positive aspects I found whilst extracting the data from the HCPs, was that all of the interviewees worked in the primary healthcare institutions for at least two years or more. During the interviews, they showed their interest in finding out the differences between the 2010 and 2015 GDM screening guidelines. Additionally, they

identified the positive changes that came with the 2015 GDM guidelines and ensured that they followed them accurately.

7.3.2.1. Theme two: subtheme one: completion of two years of experiences or more in the profession

Nurses who work in the antenatal clinic hold a diploma in nursing qualification, and a few of them have completed a post-basic diploma midwifery programme. The MoH strategy is that all newly graduated nurses and midwives should work in a tertiary hospital immediately after graduation for at least two years to gain clinical experiences before transferring them to the primary and secondary healthcare institutions. Midwives should work in a maternity unit for at least two years to gain experience before moving to the primary healthcare sector. The following comment comes from a nurse who completed about 17 years working in a primary healthcare institution.

The N2C2 stated that she became the focal point of the antenatal clinic on account of her years of experience. In the interview, the N2C2 expressed her worries that younger Omani nurses were not given a chance to work in the antenatal clinic due to a lack of knowledge and experience. However, as the number of Omani nurses increases, there is a greater chance of them being assigned to an antenatal clinic, thereby increasing the level of skilled staff in the clinic. She stressed that Omani staff nurses used to act as helpers in antenatal clinics. However, the situation has changed, and they are now contributing actively to the care of pregnant women in the antenatal clinic.

“N2C2: I am a staff nurse... I start job in 99 in 1999 first I work in tertiary Hospital antenatal ward then I start after two years I join to health centre now year total about 17 years now in (smile)”

Aisha: tell me about your experiences in the ANC.

N2C2: ...I was not focal point only I am as helping only in antenatal but I am now focal point of antenatal clinic... of course changes big changes (laugh)... because it was before expatriate only working in ANC now we are Omani we are working there... before there were not allowing us... now all Omani we can work there but I am a part of the ANC I am a focal

point and I am training all the staff about booking and everything.”
[N2C2 interview]

A non- Omani staff nurse/midwife in the following quotation stated the differences she found in terms of caring for GDM women throughout her work experience in the PHC1. The N2C2 had worked in antenatal clinics for 23 years, so she was aware of the GDM guidelines and said that she implemented them accurately.

“I studied general nursing and I have now 23 years’ experience... Last 23 years in Oman... I have been working in antenatal clinic and also treatment room...”

[N2C2 interview]

She also pointed out the differences in GDM screening before and after 2015, stressing that the Ministry of Health is giving far greater importance to GDM screening nowadays. Previously, the OGCT was a routine test for all pregnant women at 22-24 weeks of gestation. However, at present, the women at high risk of GDM should be offered the OGTT at registration, meaning that a diagnosis of GDM in early pregnancy. The data led me to believe that having several years of experience working in an antenatal clinic enables a person to get the correct picture of the development and improvement of GDM screening on pregnant women.

“Actually... this GDM screening now it is important more than the olden times because that time we were screening separately for GDM. Like that only... oral glucose challenging test was a routine for five months... now we are selecting the cases who is high risks to get GDM... So, from booking time itself we are screening to do GTT and diagnose them whether they are diabetes, or it is normal for them... or who is close relative diabetes or history of GDM in past pregnancy and or obese patients or previous macrosomic child... Like that... High risk criteria that we are selecting and to do the GTT in booking time itself to find the diabetes...”
[N2C2 interview]

Amongst the interviewees, GP2C2 has the least working experience in the health centre. She mentioned that she worked in another health centre for one year only,

where she used the previous GDM guidelines 2010. She had completed a further two years at the current health centre, using her skills acquired from the former health centre. Therefore, she was able to appreciate the differences between both GDM guidelines (2010 and 2015). She said that she had attended a workshop about a year ago in which the new GDM guidelines 2015 were discussed.

“I am a medical officer I work as a GP here in this health centre I also work in ANC clinic, and I started diabetic training then antenatal clinic for two years now. I was working in other health centre as GP also at antenatal PHC2 year other than these two health centres no”

[GP2C2

interview]

GP2C2 stated that during the workshop, all the attendees were advised to start implementing the new GDM guidelines 2015 and that they should focus on women with risk factors such as BMI more than 30kgs/², previous GDM, and the high-risk women. The data led me to understand that there were many women at risk of GDM who were being missed due to poor practice in implementing GDM guidelines. The workshop concluded that each HCP should understand how to use the guidelines and look after the women with GDM.

“Usually, they gave us the guidelines and they advised to start practice these guidelines and start to look for more high-risk patient because lots of high risk pregnant was missed not each point, we were taking about the high-risk patient, but this is the whole message to look after the GDM women”

[GP2C2 interview]

7.3.2.1.1. Summary

HCPs with different levels of experience in ante-natal clinics shared their experiences about the screening of GDM women. The interviewees highlighted the importance of professional experience in understanding the necessary changes in the GDM screening guidelines. They also shared the experiences gained from practising the

GDM screening guidelines from 2010 through until the present day. This included highlighting the differences between the GDM screening guidelines 2010 and 2015.

7.3.2.2. Theme two: subtheme B: positive attitudes towards implementation of GDM guidelines

The HCPs in the PHC2 felt that their skills in implementing GDM guidelines were good, as were their attitude towards the process. The meeting was because of continuous support from their superiors and ongoing meetings in which the 2015 GDM guidelines were discussed.

N2C2 stated that the HCPs in the health centre were implementing the GDM guidelines accurately. If a woman missed her GDM screening by chance, it would have been an accident as everyone followed the GDM guidelines without fail.

“We are following maximum if somebody missed without anybody notice like that only otherwise no adjustment as a protocol we are following”
[N2C2 interview]

Additionally, the GP2C2 stressed the importance of early screening, pointing out that the new GDM guidelines 2015 recommended an early screening of GDM, which would mean an early diagnosis. The GDM guidelines reflected on the less well-known maternal and foetal complications during pregnancy and at birth, such as shoulder dystocia.

“of course, these guidelines make a tight control to the patient so early screening of GDM... following up early follow up and picking up of GDM from beginning yani also patient will not go for complications like big baby... or having obstructed labour or shoulder dystocia so this thing will pick up early so the patient will not go for theses complications”
[GP12C2 interview]

The GP2C2 also commented positively on the new GDM guidelines 2015 saying that the new guidelines offered a more accurate reading of blood glucose values than with the previous GDM guidelines.

“Positive it is more accurate most patient when I was working in another health centre first it was old guidelines and most of the patient was diagnosed as GDM and she was clearly normal, and all her reading was normal so now I feel more accurate regarding the reading”

[GP2C2 interview]

7.3.2.2.1. Summary

The HCPs in the PHC2 emphasised the importance of implementing the GDM guidelines accurately. They stated that following the new GDM screening guidelines supported early detection. They had mentioned that following the new GDM screening guidelines supported the early detection of women with GDM and enabled them to manage the cases well. Moreover, they pointed out that following the guidelines increased their confidence to make an early diagnosis of women with GDM and enabled them to manage the cases well. Moreover, they pointed out that following the guidelines increased their confidence in making an early diagnosis of GDM.

7.3.3. Theme three: professionals' teamwork

The aim of the primary healthcare institution in Oman is to provide the optimum care for pregnant woman. This can be through the collaborative work of the HCPs who work in the primary healthcare institution, such as the GP, nurse, midwife, dietician, health educator and the paramedical team, including the laboratory technicians and pharmacists. If required, the pregnant women are referred to specialists for further management. To achieve the above aim, the PHC2 ensured that the nurse and the GP were available in one room and that the HCPs continue to work collaboratively.

7.3.3.1. Theme three: subtheme A: availability of the nurse and GP in one room

During the interview, I found that in the PHC2 the GP and the nurse/midwife were seeing the pregnant women in the same room. The head of nurses assumed that making the antenatal clinic team available in one room was to ensure that they worked towards improving the continuity of care for women care during pregnancy. NI2C2 said that the doctor and the staff nurse/midwife sat in the same room in the antenatal clinic. She considered the room as the first line for maintaining the privacy of the pregnant women.

“There is in a separate room for antenatal ... doctor she is sitting with the staff ... everything for the antenatal ... they are doing in that room only...Yah... nobody is entering here and there ... like privacy...”
[NI2C2, interview]

NI2C2 also added that within the antenatal clinic room, the nurse/midwife was responsible for collecting the medical, obstetric, and family history from the woman and entering her personal details in the antenatal register book. Then, the nurse/midwife checked the woman’s height, weight and she would be referred to the GP (who is sitting in the same room) for a physical examination. The GP should record the woman’s data in the electronic record health system and give the woman an appointment for subsequent visits.

“...when the woman come ... she is opening her a card for a first time giving the ANC number doing the registration. Taking history if there is any if she is primi or multi and she is fell that card... part of the card. The data of the patient until that after that she will give to the doctor then she will enter the computer later... the vital signs of the lady...”
[NI2C2 interview]

NI2C2 added that women at-risk or high-risk for diabetes during pregnancy underwent blood investigations to screen for GDM. If the results for initial blood glucose were abnormal, the women underwent OGTT. If the OGTT results were also abnormal, the woman should be referred to the specialist clinic for further management.

“The woman who is at risk they are doing special investigations for her like random blood sugar... will see if it is from... will do first fasting blood sugar if it is high, they will give appointment for GTT and after that if it is high will refer to the specialist clinic”
[NI2C2 interview]

7.3.3.2. Summary

The GP and the nurse/midwife served the pregnant women and ensured continuity of care throughout pregnancy. The role of the GP was distinguished from that of the role of the nurses and midwives. The expected outcomes were the improvement of both the pregnant women and their unborn child's health status. This was achieved by the GP and nurses/midwives working co-productively.

7.3.3.3. Theme three: subtheme B: collaboration among the HCPs in the health centre around the care of pregnant women

There was a consensus amongst all interviewees that they were collectively responsible for caring for the pregnant women. The collaborations were between the nurse/midwife, GP, dietician, health educator, and obstetrician in the specialist clinic. The NI2C2 explained the role of the nurse/midwife in the antenatal clinic. One of their responsibilities was to check the weight and height of the woman to calculate their BMI. Once the nurse/midwife obtained the woman's BMI category, the referral made to the dietician and the obstetricians easier.

“This was started from the ANC registration until giving they are checking height and weight after that to check her BMI according to the BMI in which line birth”
[NI2C2 interview]

The N2C2 stated that the purpose of referring the pregnant woman to the dietician was to support her in managing her food and drink intake. She further added women with a

borderline risk of GDM was still referred to the dietician. This referral helps them for a better understanding of the food they should avoid during pregnancy.

“We are referring to the dietician and about the diet control and only that one and glycaemic profile prepare” [N2C2 interview]

The GP2C2 stated that pregnant women should be referred to the dietician to ensure that their blood glucose level is kept within normal range. If the woman was diagnosed with GDM, she should start the diabetic diet before being referred to the specialist. Moreover, the woman should be equipped with her BSP report before being seen by the specialist in the secondary healthcare institution.

“before referring if she is GDM I have here to send her to the nutrition and I have to start her diabetic diet from here because the appointment will be delay till Wattaya poly clinic as I said and we have to review her BSP and because her appointment for BSP after two weeks of diabetic diet if her BSP is normal I will continue on the same diabetic diet until she goes to specialist clinic because appointment” [GP2C2 interview]

The health educator also had an essential role in caring for pregnant women during the interview. N2C1 expressed her opinion regarding the continuity of care. She stated the health educator's role was to provide pregnant women with information regarding the importance of screening for GDM. Also, she helped the woman understand the importance of regular visits to the dietician if she had been diagnosed with GDM.

“Aisha: beside you and the dietician who else will see this woman.

N2C2: and health educator also

Aisha: health educator so what is the role of health educator in that...

N2C2: she will give her what information during first trimester and how to prepare herself ...also both need to see the patient or client” [N2C2 interview]

One of a good practice mentioned by the GPI1C1 was the provision of individual health education for each woman. This health education contains advice on the importance of screening for GDM and preventing maternal and foetal complications.

“Personal health education for each one and they are educating them about the importance of doing such investigation and such screening in order to I mean prevent complication either maternal or fetal complication”
[GPI1C1
interview]

7.3.3.3.1. Summary

Teamwork is one of the most important practices that HCPs should ensure every day at the primary healthcare institution. The previous quotations made it clear that pregnant women receive care from the GP, nurse/midwife, dietician, health educator and obstetricians. PHC2 made available both a GP and a nurse to ensure that the pregnant woman received the best possible care in ANCs. This level of care was maintained for the pregnant women by following the plan provided by the HCPs.

7.4. Conclusion

The majority of the interviewees in the above discussion outlined the resources available for ensuring the best implementation of GDM screening. They acknowledged the availability of the GDM screening flow chart in their clinics. Also, they stressed the importance of teamwork within the health centre. The referral system followed by the HCPs for GDM screening ensures the possibility of early detection of GDM amongst women.

Chapter 8. Discussion

8.1. Introduction

This study aimed to determine compliance with the 2010 GDM guidelines in PHC institutions in Oman and explore any barriers and facilitators to their implementation. This chapter discusses the results obtained from the retrospective review of case records (chapter 5), face-to-face semi-structured interviews conducted with the HCPs in two governmental healthcare centres (PHC1 and PHC2) (Chapter 7) and synthesizes with evidence supported by the available literature. In this chapter, I will summarise the study findings and discuss the differences and similarities between PHC1 and PHC2. Finally, I will map the barriers and facilitators identified from the interview data to the COM-B model. Implications for future research and practice will then be presented.

8.2. Summary of study

A mixed-methods study was conducted to strengthen the research and expand its application (see Chapter 4). The methodological approach used for this study was a convergent parallel mixed-methods design. The sections (8.2; 8.3 & 8.4) will address the following objectives of this thesis:

- to explore practice in the screening and diagnosis for GDM in Oman.
- to compare practice in Oman with evidence-based recommendations.
- to examine the relationships between the screening of socio-demographic risk factors for GDM and clinical features of women.
- to explore the barriers and facilitators involved in implementing GDM guidelines in Oman.

8.2.1. Retrospective review of case records

The first objective was to explore practice in the screening and diagnosis of GDM in Oman. A retrospective review of case records was conducted to examine the compliance with GDM screening guidelines amongst HCPs in two governmental healthcare institutions (PHC1 and SHI1) in Muscat. There are similarities in the NICE (2008) and WHO (2013) guidelines for screening in terms of their suggested assessment of the risk factors for GDM. NICE (2008) recommended selective screening, in which women with the following risk factors should be offered testing for GDM; BMI above 30 kg/m², a previous macrosomic baby weighing 4.5 kg or above, previous GDM, family history of diabetes (first degree relative with diabetes) and a minority ethnic family origin with a high prevalence of diabetes. Similarly, WHO (2013) recommends that women with identified risk factor(s) of BMI >30 kg/m², history of GDM or glucose intolerance, family history of type 2 diabetes in first degree relatives, and those with a previous macrosomic baby weighing ≥ 4 kgs, should be offered screening for GDM at registration of the pregnancy.

The 2010 Oman GDM guidelines advocated universal screening in which the focus was on the blood and urine investigations and not the risk factors for GDM. As discussed earlier in chapter 5, women were asked about any history of GDM, previous macrosomic baby, and previous neonatal death at the antenatal registration day. However, this information had not then used to inform the screening of individual women. Screening using OGCT or/and/ OGTT was not applied for all women. Consequently, data from the OGCT / OGTT could not be identified for 265 women, so it was impossible to determine whether this group of women had been screened. The researcher searched within the healthcare institution for other reasons for this missing data. However, none of the healthcare professionals was able to provide an answer, so the only remaining option was to collect the data from the secondary healthcare institutions. Although some data were found, there were still some missing.

OGCT should not be used to assess the development of GDM in pregnancy (NICE 2008) because of the low sensitivity and specificity of OGCT (NICE 2015; WHO 2013; Brown and Wyckoff 2017). However, there are some differences in diagnostic tests between WHO 2013 and NICE guidelines 2008. WHO (2013) used OGTT to confirm the diagnosis of GDM, FBS ≥ 5.1 mmol/l and after 2 hrs post glucose is ≥ 8.5 mmol/l. Whereas NICE, 2008 recommended OGTT to confirm the diagnosis of GDM, results should be FBS ≥ 7.0 mmol/l, and 2 hrs post glucose is ≥ 7.8 mmol/l. NICE guidelines were updated in 2015, the diagnosis of GDM is confirmed if FBS ≥ 5.6 mmol/l and 2 hrs post glucose ≥ 7.8 mmol/l. The (2010) Oman GDM guidelines specified diagnostic criteria of GDM using OGTT with 75 g oral glucose of FBS ≥ 5.5 mmol/l, and 2 hours post 75 g oral glucose load ≥ 7.8 mmol/l. The value of FBS in the Oman GDM guidelines (2010) was not in line with NICE or WHO guidelines, but 2 hours post 75 g oral glucose load paralleled the NICE (2008) guidelines.

In this study, OGTT results were not always available due to data missing from the records at the antenatal clinic. The same data might have been recorded in maternal health cards, which were kept by the women during pregnancy and after delivery. However, these records were not available to the researcher because ethical approval had not been obtained to contact the women directly. This was because the time to complete this Ph.D. was limited, and if some of the women had changed their contact details, it would have taken far longer to track them down and obtain their approval.

NICE (2008) guidelines recommend selective screening, which was found to contribute directly to improved cost-effectiveness in the screening, diagnosis, and treatment of GDM (Simmons et al. 2010). The reason for using selective screening was to identify women with a high risk of GDM, which would reduce the cost of screening whilst avoiding the adverse effect of screening (Hakama et al. 1979). WHO (2013) GDM guidelines recommended either universal screening or risk factor-based screening at the first antenatal visit and then universal screening using OGTT at 24-32 weeks of

gestation to confirm the GDM diagnosis. However, this should be determined by individual countries and their health services. The decision should be made to tailor the screening coverage according to the prevalence of glucose intolerance in the population, resources, and priorities.

8.2.1.1. Evidence-based risk assessments

The second objective was to compare practice in Oman with evidence-based recommendations. NICE guidelines (2008) recommend a risk assessment for GDM at registration in ANC. Women should be aware about the risk assessment to enable them to make choices as to whether to have testing for GDM. Some women with GDM may be able to monitor and control the elevation in blood glucose by diet and exercise but most will need oral antidiabetic medications or insulin therapy, (Magon and Seshiah 2011; WHO 2016; Sweeting et al. 2016). Good management and control of blood glucose levels leads to a reduction in adverse pregnancy outcomes such as macrosomia (Vanky et al. 2004; Landon et al. 2009) and birth outcomes such as shoulder dystocia (Horvath et al. 2010).

Oman's (2010) GDM guidelines were to apply universal screening using RBS at registration (see chapter 5, page 136). If the RBS test results were abnormal, women should be referred for OGCT and if OGCT results were abnormal women were then referred for OGTT. During data collection it was discovered that PHC1's ANC registry book did have a column in which to enter any risk factors during pregnancy. However, the data regarding the family history of close relatives and BMI was available in the Al-Shifa healthcare system programme. NICE (2008) and WHO (2013) guidelines recommend that the BMI of all pregnant women be measured as a matter of routine during registration, in order to identify any risk factors for GDM, and to use $\geq 30 \text{ kg}^2$ as the criterion for risk. Although the 2010 Oman GDM guidelines did not distinguish between women who were at low risk and women who were at high risk during

pregnancy, the midwife/nurse at PHC1 recorded the BMI of all pregnant women. In this study, no association was found between BMI and screening of GDM.

8.2.1.2. The available records of risk factors for GDM

The third objective was to examine the relationship between the screening of socio-demographic risk factors for GDM and the clinical features of women. In this study, less than 40% of the women who had a close family history of DM2 and BMI \geq 30 kgs/m² attended the screening for GDM. They were either not offered the screening or refused it. In the current study, no association was found between family history of DM2, raised BMI, and the screening for GDM using OGTT.

Inferential statistics were analysed using ANOVA to evaluate the association of both risk factors on the likelihood of OGTT. The findings showed that $n = 319$ women who had a family history of DM2 were more likely to be screened using OGTT $p < 0.001$ than women who had raised BMI $p = 0.966$. This finding is consistent with Chitme et al. (2016), who identified a significant relationship between GDM and family history in both groups ($p < 0.001$).

ANOVA was also run to evaluate the impact of other risk factors, including previous GDM, previous stillbirths, previous neonatal deaths, previous congenital abnormalities, previous macrosomia, and screening using OGTT. This section presents an examination of these findings.

Of 63 women who had GDM in a previous pregnancy (30.8%) had recurrent GDM in their current pregnancy. Women who developed GDM during their first pregnancy are more likely to have it again in their second pregnancy (OR, 13.2; 95% CI, 12.0–14.6) comparing to women with no previous history of GDM (Getahun et al. 2010). Oman GDM guidelines (2010) were not in line with international GDM guidelines (NICE 2008; WHO 2013). Instead, women who had pre-gestational blood glucose ≥ 7.8 mmol/l were

referred for OGTT. In this retrospective review of case records, of 697 multigravida women, 63 (9.0%) had previous GDM. Out of these 63, there were 49 women well (77.8%) who also had one or more additional risk factors and 13 women who had the previous GDM only. Of these 13 women, nine were screened using OGTT and were diagnosed with GDM. This result indicates that there was poor compliance to GDM guidelines 2010.

Although NICE (2008) and WHO (2013) both recommend screening women with a history of stillbirth, the data uncovered in this study indicated that records of women with a history of stillbirth were not maintained in the ANC registry book. Therefore, the Al-Shifa healthcare system was checked to obtain this information for the registered women, with 0.4% (n = 17) found from the whole sample. Of the 17 women, 13 (76.5%) had one or more additional GDM risk factors, and four had a history of previous stillbirths alone. Out of these four, only one (25.0%) was screened using OGTT and was diagnosed with GDM. There were no records found for the other three women who had a history of previous stillbirths alone. This result raised a question regarding the quality of care that these women received. Although two women out of these four registered their pregnancy at 12 weeks of gestation, neither were offered an OGTT or OGCT, as both had normal RBS results.

A previous macrosomic baby weighing > 4 kgs is considered a risk factor for GDM by both NICE (2008) and the WHO (2013). In the present study, the number of women having a previous macrosomic baby was 1.2% (n = 11). Two of these women were screened using OGTT, and the result was normal. All 11 women in this pregnancy had a normal vaginal delivery, and two (20.0%) gave birth to a baby > 4 kgs. Women with previous macrosomia were more likely to be screened using OGTT $p = 0.031$. There were no records found in either the ANC registry book or the electronic record health system regarding the pregnancy outcome, i.e., whether there was shoulder dystocia or Erb's Palsy.

Oman's (2010) GDM guidelines did not state the importance of screening these women. However, it was found that out of the 942 women whose records were screened, 12 women (1.3%) had a history of previous neonatal death, 10 (83.3%) had one or more additional risk factors of GDM. Only 2 (0.2%) were screened using OGTT, and the OGTT results were normal. All these women gave birth to live babies.

It would appear that in Oman between 2010 and 2014, it was not standard practice to focus on the importance of screening for those women with other risk factors of GDM such as previous stillbirth, previous neonatal death, previous macrosomia, and previous congenital abnormalities of the fetus. The situation in Oman before the change in the GDM guidelines in 2015 appeared to be even more alarming.

8.2.1.3. Compliance to GDM guidelines

In this retrospective review of case records, the findings revealed that the HCPs partially adhered to the GDM 2010 screening guidelines. The results indicate that universal screening was implemented accurately by all HCPs, as all (942) women were screened for GDM prior to registration using random blood sugar (RBS). However, the GDM screening was interrupted using OGCT and OGTT (see Chapter 5, page 154). This study aimed to determine the extent to which the practice screening of GDM in Oman in 2014 performed in line with Oman's (2010) GDM screening recommendations. The findings of this study showed that out of 942 women who registered their pregnancy in PHC1, 27.6% (n = 260) women were screened using OGCT, 52.9% (n = 498) women were screened using OGTT, and 8.7% (n = 82) women had both tests. Hence 10.8% (n = 102) either missed the OGCT/OGTT screening or was not offered or rejected. Of the 91.3% (n = 860) women who had normal RBS results, 71.2% (n = 612) of women either missed the OGCT screening or were not offered it or rejected the test. This study demonstrated that compliance with 2010 guidelines was poor, as all n = 942 women in the sample should have had an

OGCT if the RBS result was normal or an OGTT if the RBS result was highly abnormal. These findings support previous studies conducted in Thailand (Ruengkachorn et al. 2006), Sweden (Persson et al. 2009), New Zealand, Ireland, and the UK (Murphy et al. 2016) that report a poor rate of compliance with risk-based screening for GDM.

The paper-based register at PHC1 was found to include incomplete records for blood glucose investigations. This may be because some women in the sample were referred to obstetricians at SHI1 for antenatal care, where they may then have had an OGCT or OGTT. This resulted in results being split between two sites; 20% of the OGCTs were conducted in PHC1 while 75% of OGTTs were conducted in SHI1. A request was made to access the records held by the antenatal clinic at SHI1. Unfortunately, there was no network connection between PHC1 and SHI1. Moreover, about 25% of women with a high-risk pregnancy were referred to specialists for further management. The specialist clinic is situated in the same governorate but 90 kilometres away from the PHC1 and SHI1. These women usually continued their ANC with the specialists, although they might occasionally return to PHC1 at 36 weeks for a follow-up and later after giving birth, to attend the two weeks of postnatal care (PNC) visit.

According to the local and 2010 national standards, women who had a normal result of RBS without a family history of DM or raised BMI should then have been referred for an OGCT at 22-24 weeks of gestation. However, of the 860 (91.3%) women who had a normal RBS result, only 248 (28.9%) had an OGCT, and 80 (9.3%) had both OGCT and OGTT. This might be because some women presented with a risk factor for GDM, but the rationale for screening with OGCT or/and OGTT was not made clear in the antenatal registry book. Of the 82 women with an abnormally high result for RBS (65.5%) $n = 19$ were screened using OGTT. This result indicates that HCPs were partially adherent to the GDM 2010 screening guidelines. The data indicates that the antenatal healthcare professionals did not follow the correct screening pathway

described in section 5.13.3, suggesting that this aspect of the guidelines was not implemented accurately.

Oman's national GDM guidelines (2010) stated that routine urinalysis should be offered to all pregnant women at registration and on subsequent visits to test for urinary glucose (glycosuria) (Directorate of Health Affairs 2010). The majority (99.6%) of women were offered urinalysis at registration, which indicated a high degree of compliance with the guidelines. Of 15 (1.6%) women who had glycosuria, 5 (33.3%) underwent OGTT screening, while of 26 (2.8%) women who had ketonuria underwent OGTT screening. 4 (15.4%) women who had glucose and ketones in their urine, underwent OGTT screening. However, out of 261 women who had OGCT screening, two women had glycosuria, and ten women had ketones.

The records of women who had abnormally high RBS results showed that none of these women were offered OGTT within two weeks of registration. The women might have been offered the OGCT or an OGTT, but the records were not maintained in the antenatal clinic registry book and computer health programme. This showed poor record keeping.

Therefore, a qualitative study was conducted to examine the reasons for partial adherence to GDM screening guidelines among HCPs. The qualitative chapter findings identified barriers and facilitators that were faced by HCPs during GDM screening. The aim was also to answer the research question: What barriers do healthcare professionals face that limit the implementation of GDM screening guidelines?

8.2.2. Face-to-face interviews

The fourth objective of this thesis was to explore the barriers and facilitators to implementing GDM guidelines in Oman. Thematic analysis of the interview data found challenges faced by HCPs in both clinics, include organisational constraints, poor inter-professional communication, confusion, and lack of understanding about GDM

screening guidelines. During the semi-structured interviews, there were many similarities and differences were presented by participants from both clinics. The majority of the participants had presented themselves with confidence during the interviews. They gave honest feedback on how accurately they felt that implementing the GDM screening guidelines. For example, in PHC2, all participants showed awareness of the GDM guidelines but did not show how accurately they used them. Whereas, for all participants in PHC1, their uncertainty when implementing the guidelines was obvious. Therefore, I decided to explore these differences and similarities to understand the process they used to implement these guidelines (see appendix N; figure 8-1) and identify the facilitators mentioned during the interviews and how these could best use to overcome the barriers. Based on the findings of the interviews, the similarities, and differences between these two clinics to be discussed in the following section (8.5) as discrepancies were found between PHC2 and PHC1.

8.2.2.1. Organisational constrain

This qualitative study found a discrepancy between the ideal and the actual reality of the situation in the clinic, including a lack of resources, work overload, and a shortage of HCPs. The majority of the participants in this study highlighted that evidence-based practice was not used, as being a key barrier to GDM screening. Congruent with previous research by Buckley et al. (2011) and Wilkinson et al. (2013), a lack of evidence-based practice in GDM screening is considered a barrier for effective GDM screening in Europe. An additional barrier is a lack of consensus in GDM screening guidelines for the detection and diagnosis of GDM. To use the best practice when developing and implementing GDM guidelines is essential to identify the gaps in the research and understand the implication of GDM on women's health. The fact is that a gap exists between current and best practices is a consistent finding within health services research (Grol and Wensing 2004). To bridge the gap between scientific

evidence and client care, it is necessary to understand the barriers and incentives to achieve change in practice (Grol and Wensing 2004).

In two cross-sectional studies, about 40.0% of the HCPs reported a lack of encouragement from administration to attend EBM courses because of insufficient time (Albarrak et al. 2013; Ammouri et al. 2014). From the perspective of participants, this workload was most significantly impacted by their lack of available time. Similar issues were identified in two systematic reviews on the barriers and facilitators to implementing shared decision-making in clinical practice, as perceived by healthcare professionals (Hagbaghery et al. 2004; Gravel et al. 2006; Légaré et al. 2008). A systematic review conducted by Gravel et al. (2006) reported what health professionals perceived to be the barriers and facilitators to implementing shared decision-making within their clinical practice. The findings revealed that out of 28 studies on barriers and facilitators, 18 (64.3%) studies cited lack of time as a barrier to implementing shared decision-making in clinical practice. (Gravel et al. 2006). Similarly, in Légaré et al. (2008), 22 out of 38 studies (57.9%) studies included lack of time as the most cited barrier to implementing shared decision making in clinical practice across different cultural and organisational contexts.

Linked to the PHC in Oman, the HCPs attributed an increased workload and lack of time to poor application of GDM guidelines. A grounded theory study by Hagbaghery et al. (2004) investigated the experiences, views, and perceptions of Iranian nurses about factors facilitating and inhibiting effective clinical decision-making in nursing. The authors found that nurses could not engage effectively in decision-making and independent nursing interventions for their clients because of work pressures and lack of time. Lluch (2011) conducted a systematic review between December 2009 and January 2010 in England. They found that for HCPs, the healthcare organisational system is task-focused. This finding is similar to the findings of my study that in PHCs in Oman. work pressures, lack of time, and delay in the work process were considered

to be amongst the barriers faced by HCPs. The organisational strategy in the PHC was task-oriented rather than goal-oriented. This was due to a shortage of experienced nurses and physicians and a general inability to understand GDM guidelines. In the current study, the GP and GPI of both clinics were the decision-makers, with nurses only partially involved in decision-making. All referrals to the dietician, health educators, and specialist clinic were made by GPs, with the midwives and nurses granted only minimal authority. This was due to insufficient autonomy amongst midwives/nurses in the PHCs, with GPs being the only healthcare professionals authorised to make decisions. The findings of this study indicate that a shortage of staff in the antenatal clinic contributed to work pressures. During the interviews, the general workload of the midwives/nurses was described. They complete more than seven new registrations in one day, in addition to following up on pregnant women and postnatal women and facilitate family planning services in the same clinic. Also, they are responsible for conducting the OGTTs, including taking the necessary blood samples. The findings of the current study are consistent with those found by Sanders et al. (2016), who conducted descriptive qualitative research in a public health agency in England. They used online discussion forums to identify student midwives, midwives, and midwifery support workers' current knowledge of and involvement. They found that lack of time and resources were key barriers mentioned extensively in most groups. These barriers have been frequently identified as compromising the effectiveness of the quality of care delivered by public health workers.

A systematic review conducted by Bach-Mortensen et al. (2018) aimed to identify and synthesise existing research on what barriers and facilitators influence the implementation process of third sector organizations (TSOs) delivering evidence-based interventions (EBIs). Thirty-one studies were included, most of which were conducted in North America. The most prevalent themes identified as impeding implementation revolved around resources (e.g., lack of time, finances, and staff), followed by

organisational culture (e.g., conflict with EBI). The findings recommend investing in the necessary organisational infrastructure and ensuring that organisations have the technical expertise to implement an EBI.

The culture in the health centre in Oman dictates those nurses carry out the orders from the GPs without discussion. This practice is not unique to Oman. Hagbaghery et al. (2004) identified a similar situation in Iran, where although nurses are competent in their profession, i.e., knowledgeable, skilful, and with good experiences in the workplace, they lack the self-confidence to make decisions, due to the dominance of the medical model. The relationship between the nurses and the clients diminished when the nurse-client ratio is not balanced; nurses ignore their job description and follow the doctor's orders (Hagbaghery et al. 2004).

In this study, participants highlighted the reasons for the limited use of EBP include the poor attendance of ongoing workshops and the lack of on-job training on the correct use of the GDM screening guidelines. The literature argues that nurses globally face industrial and organisational challenges (Hagbaghery et al. 2004; Jackson et al. 2007). These challenges include shortages of experienced nurses, excessive workload, lack of professional autonomy, and other organisational constraints (Jackson et al. 2007). In the current study, staff shortage and excessive workload were the most pressing issues in both clinics.

8.2.2.2. Poor inter-professional communications

Poor communication is one of the major challenges within healthcare settings in Oman. This barrier was found among the HCPs in both clinics. The findings of my study indicated there to be poor communication between professionals, who should be working together to care for pregnant women. Several studies highlight the issue of poor communication amongst healthcare professionals and the consequences this can have on the quality of work (Darker et al. 2018; Stuebe et al. 2010). Darker et al.

(2018) found that lack of communication led to unnecessary confusion and uncertainty within the National Clinical Practice (NCP) network. Stuebe et al. (2010) found that 54.6% of obstetrical care providers (OBCPs) and primary care providers (PCPs) identified lack of communication to be a major barrier when following up women with GDM.

Lack of consistency among the HCPs in both clinics can lead to serious consequences for women's' health. It is essential to establish a good rapport with the woman at registration to gain her trust, so that she attends the antenatal clinic visits regularly and report anything unusual as early as possible. Moreover, if the nurse or midwife who works in the antenatal clinic followed the GDM guidelines accurately, she would have a better understanding of the type of care offered by the dietician, health educator, and obstetricians and could direct women correctly according to the guidelines.

Many possible factors may contribute to poor implementation of evidence-based practice in healthcare institutions. Buckley et al. (2011) suggested that poor implementation of clinical screening guidelines might be due to a lack of evidence for the clinical effectiveness of screening. The lack of universal acceptance of evidence-based practice on screening also meant there was little enthusiasm among the HCPs to implement screening recommendations. McEwan Dysart and Tomlin (2002) conducted a survey in the USA to examine how occupational therapists' access and use clinically relevant research results. They reported that more than half (59%) of the participants stated that they had insufficient time, with the requirements of the job being a major barrier to implementation of the guidelines. They suggested that they were so busy completing their tasks that they had no time to read updated articles or attend training. This may also mean that they lacked the skills to access appropriate resources and could only conduct inadequate literature searches and offer a limited critique. Dysart and Tomlin (2002) also found that (38%) of participants reported that they lacked the confidence to use the internet as a search tool and critically appraise

the quality of research studies. In addition, 59% reported that they had difficulty in using electronic databases. The gap between evidence and practice arises because the HCPs were not up to date on implementing the GDM recommended guidelines (Handley et al. 2016).

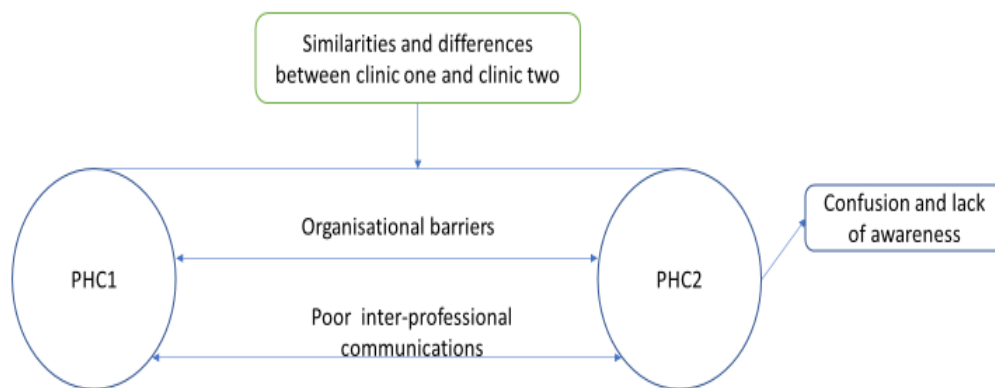


Figure 8-1: findings of similarities and differences between PHC1 and PHC2

Figure 8-1 explains the findings of similarities and differences that exist between PHC1 and PHC2. Attempt to change healthcare professional behaviour is a complex intervention, so it is necessary to understand why people behave the way in which they do (Fishbein et al. 2001). This can be related to the cultural background of an individual or his/her ability to accept change. The attitudes and feelings of people can make change difficult, either directly or indirectly (Johnson and Paton 2007). A survey conducted in Denmark by Van Dam et al. (2008) aimed to identify what aspects of their

daily work related to employees' resistance to organisational change. The result of the survey showed a significant relationship between resistance to change and three change process characteristics: the provision of information, opportunities for participation and trust in those managing the change.

8.3. Mapped facilitators

Facilitators were more evident in PHC2, so by mapping these facilitators (Figure 8.2), a plan was made to apply the COM-B model in order to change the behaviours of the HCPs in both clinics. All the participants in PHC2 were happy to share their positive experiences in the clinic, but only a few of the participants from PHC1 were ready to do so. While transcribing the interviews, I felt confident about the information they gave me, and I mapped and applied this information to the COM-B model to come up with some valid recommendations for the healthcare services in Oman.

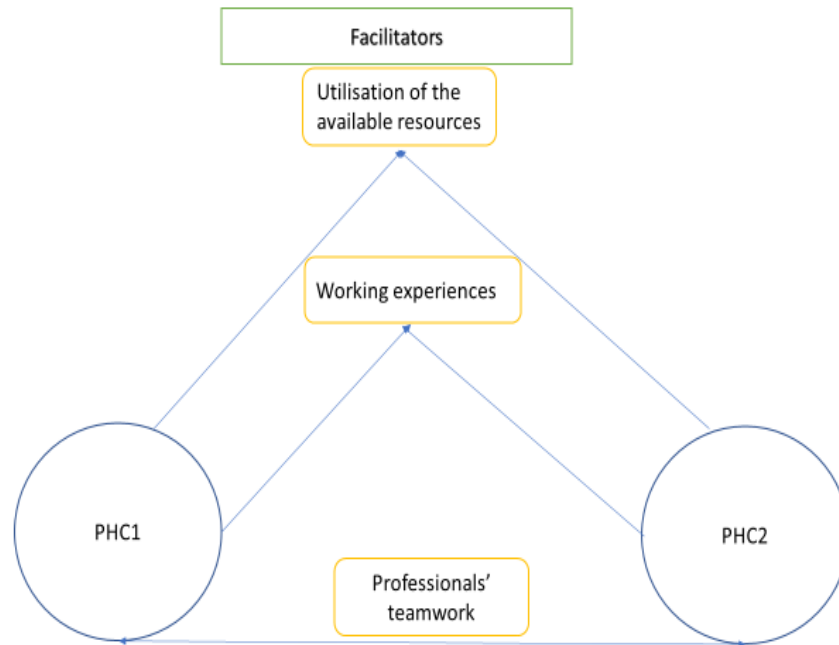


Figure 8-2: Mapping the facilitators.

8.3.1. Utilisation of the available resources

WHO (2010) recommended the utilisation of available resources efficiently in order to improve the healthcare services within the country. Guidelines are developed to standardise care and provide clear recommendations on how they should be implemented but do not always address the issue of adaptation and modification (Hanson et al. 2009; Burgers et al. 2013; Bach-Mortensen et al. 2018).

For example, the Expanded Programme on Immunisation, developed by MoH Oman, was followed effectively in 2017, with immunization coverage of more than 99% for all vaccine types at the Omani national level (MoH 2017). The rationale for this is unknown, but it might be because the immunisation nurse is assigned to only work on immunisations and not have any other commitments within the health centre. The nurses who work in the immunisation programme in the PHCs were given the opportunity to attend current workshops about immunisation nationally and

internationally. However, the nurses working in the antenatal clinic were struggling to attend any GDM guidelines updates, because the authority in MoH dictated that one nurse or one GP should attend the workshop and then be responsible for disseminating the information to their colleagues. HCPs need a clear understanding of their role in the antenatal clinic. In addition, it is important to adhere to the job description and not offer services outside of their remit.

Leadership support improved GDM screening. The importance of leadership to facilitate organisational change and quality improvement was widely recognised by participants. According to Johnson and Paton (2007), the change agent is the person who should lead, support, and manage the organisational change.

8.3.2. Working experiences

Healthcare professionals' knowledge and clinical experience in providing the proper care for pregnant women were greatly appreciated. All participants included in this study had two years or more clinical experience caring for pregnant women in PHC. This professional knowledge and years of experience in clinical settings empower the HCP with the self-confidence and competence to run the antenatal clinic. Knowledge and acquired skills are a vital part of making quality decisions in clinical settings.

Flexible, rational staffing patterns (norms) were developed for local hospitals and health centres, and the Ministry circulated these to all concerned as the guidelines for staffing primary health care institutions.

8.3.3. Professional teamwork

In this study, the HCPs in both clinics used the referral process to effectively communicate the procedure of the GDM screening within the clinic and the speciality clinic. They discussed the importance of screening with the women and engaged

collaboratively, with the aim of promoting habitual screening use with women at risk of GDM. Miller et al. (2000) found that engaging nurses in communication that nurtures relationships may develop support resources for the team that helps minimize job-related stress and improve the quality of work life. Communication between the dietitian and health educators working in the PHC1 is also relevant. Moreover, trust is vital among HCPs when making decisions to ensure the highest quality of care for the women in their care.

8.3.4. Summary

In summary, after the completion of separate analysis of both retrospective case records and face to face interviews, a convergent analysis of both sets of findings was undertaken, after which some common findings began to emerge. Beyond the themes already identified separately from each data set, some consolidated; overarching themes were noted and found to be in line with the convergent parallel approach. The themes are interpreted using the COM-B model and existing literature. The three overarching themes for the barriers are:

- 1) Poor compliance with GDM guidelines due to work overload and lack of time.
- 2) The gap between the current practice and evidence-based recommendation.
- 3) Poor understanding of GDM guidelines due to a lack of awareness and confusion.

On the other hand, after the analysis of face-to-face interviews was completed, some facilitators were found that may overcome the barriers that were evident in this study. After scrutiny of the face-to-face findings, concerning facilitators, the following four themes emerged that could potentially be used to improve the implementation of GDM guidelines:

- 1) Leadership support
- 2) Positive attitudes of HCPs toward the implementation of GDM guidelines

-
- 3) Collaboration between the HCPs would improve the quality of care for GDM women.
 - 4) Importance of lifelong learning for the HCPs.

8.4. Implementation science

“Implementation science is the systematic study of how to design and evaluate a set of activities to facilitate successful uptake of an evidence-based health intervention” (Handley et al. 2016). To improve the process of implementation, the focus should be on the mechanism of change (Handley et al. 2016). The findings provide clear evidence that HCPs urgently require a planned programme to help them overcome these barriers.

8.4.1. The COM-B model

The capability-opportunity-motivation behaviour (COM-B) model (Michie et al. 2011) is an approach to understanding behaviour in context as a system with interacting elements (Michie and West 2013; see Chapter Two, Figure 2.6). Previous studies have emphasised using the COM-B model to develop interventions and address barriers to screening, including GDM, stroke, cancer, and preventative health checklists for children (McCutchen et al. 2016; Connell et al. 2016; Alexander et al. 2014; and Handley et al. 2016). In addition, the model can be used to facilitate an understanding of barriers to aid in promoting screening. The COM-B model was used to understand how the identified barriers and facilitators both impeded and supported the implementation of the GDM guidelines in the PHC settings in Oman (Handley et al. 2016).

Mapping my data onto this model highlighted an imbalance between facilitators and barriers, resulting in the current status quo of poor compliance and inadequate implementation of the guidelines.

8.5. Applying the COM-B model to the barriers to screening for GDM in Oman

The COM-B model is used to analyse whether the GPs, nurses/midwives have the capability, opportunity, and motivation to perform a particular behaviour. In this study, the COM-B model was used to explore the barriers and facilitators encountered by practitioners who influence their knowledge and behaviours of implementing GDM guidelines in Oman. I analysed the findings (barriers and facilitators) from the interviews with the HCPs in PHC using COM-B model, to improve the degree of accuracy of implementation of GDM screening guidelines. The findings of the study made it clear that many barriers prevent the correct implementation of the GDM guidelines. Figure 8-3 presents the main barriers that HCPs might face in the implementation of GDM guidelines, which are as follows:

8.5.1. Physical capability

One theme that emerged from the quantitative and qualitative components of this research was that poor compliance to GDM guidelines was often due to work overload and lack of time (physical capability). Healthcare professionals are expected to deliver a high quality of care for pregnant women in primary healthcare institutions. This, in turn, might mean that they do not ensure guidance is correctly implemented and also increase their levels of stress (Mathole et al. 2005). Nurses and midwives are rotated within the antenatal clinic, which negatively affects the continuity of care provided to the women, as the HCPs are not always familiar with their role. In this study, findings showed that HCPs were not interested in keeping up to date on MoH policies,

guidelines, and procedures. They generally felt quite unaware of what was happening in the ANC.

Additionally, the findings showed that the HCPs ability to perform their duties is affected by the relatively limited number of times they are assigned to work in the ANCs. Some nurses stated that they might only work in ANCs four days in a month, meaning that they were generally uninterested in keeping up to date with events in that area. Each ANC has their unique way of operating, according to the local management systems followed. For example, in some clinics, the HCPs provide antenatal services for the first three days of the week. The remaining two days would be devoted to the services of family planning and infertility. However, some clinics might provide antenatal services for four days leaving one day for family planning and treating infertile women.

Work overload in ANCs leads to poor communication between the HCPs and the pregnant women. During ANC registration, the HCPs would take the woman's history and list the danger signs during pregnancy that would mean the woman should report immediately to the hospital and have her vital signs checked (temperature, pulse, and blood pressure). The physical and abdominal examination would be done by either the midwife or the GP, but not the nurse, as she lacked the skills. The psychological status of the women is the last consideration and is generally ignored or neglected because of work overload.

8.5.2. Psychological capability

The theme of psychological capability emerged, in which the fact that the HCPs had too much work meant that they were unable to find time to read the guidelines, meaning that their understanding of the guidelines was poor. This led to frustration and confusion as to what was the proper implementation of the guidelines. Furthermore,

there is a lack of clarity around job descriptions for both nurses and midwives who work in ANCs, which means that they often do work outside of their remit. The GPs usually took the opportunity to examine the women physically and collect the blood for glucose tests, as MoH protocol dictates. However, in some ANCs, GPs are very busy so requested that the nurses and midwives conduct the investigations for GDM. The fact that nurses and midwives had to multi-task resulted in poor communication with the women. Also, because of the rotation within health centre clinics, midwives were uncertain about working beyond their area of expertise, (Yates et al. 2013; Colvin et al. 2013) especially if they had worked in general clinics for longer periods. Some nurses and midwives would work in the ANCs after two month rotation within the health centre, so they would not have been familiar with any changes made in the ANCs, for example, GDM screening guidelines. This is in line with the Australian phenomenology study conducted by Yates et al. (2013) which aimed to explore the experience of midwives who work in rural hospitals in a dual role as both nurse and midwife. The findings showed that midwives were frustrated and experienced conflict whilst caring for women, as they had to use both the midwifery care model and the nursing care model. So, maintaining competency is a challenge faced by midwives who rotated within other clinics in the health centre. Dehring et al. (2018) conducted a cross sectional study in Australia, which aimed to investigate the impact of shift work schedules and the organisational climate on the health of nurses. A survey using the Work Environment Scale – Real (WES-R) consists of 90 statements requiring a “yes” or “no” response, and the General Health Questionnaire (GHQ-28) assessed the general wellbeing of participants. One hundred and eight HCPs participated in this study, 98 female and 10 males. They were from different categories, staff nurses, supervisors, and managers, all of whom had been in the organization for more than three years and worked the three shifts (morning, afternoon, and night). The findings showed that the rotating shift workers exhibited the highest levels of psychological distress and that the more focused nurses are at work, the more efficient they are in

completing the tasks as part of their role and the less impact there will be on their social functioning. Several authors describe policy and legal contexts for midwifery care and nurses and midwives' performance skills evaluation, as barriers (Colvin et al. 2013; Byrskog et al. 2019).

8.5.3. Physical opportunity

There was a general lack of time to complete the tasks (physical opportunity) due to multi-tasking and lack of clarity regarding job descriptions. As stated earlier (see chapter 7), there is no clarity regarding the role of nurses and midwives in the ANCs, when it comes to implementing the GDM guidelines. This made these individuals feel frustrated and anxious when medical goals and knowledge conflicted with the women's' personal goals. Similar findings were found when Hörnsten et al. (2008) conducted a focus group interviewing 17 nurses about their caring experiences for patients with diabetes. They were divided into two focus groups and interviewed according to Kitzinger's principles (Kitzinger 1995). The results showed that the nurses were frustrated by clients who were either non-compliant or questioned their expert knowledge.

Additionally, the HCPs focused on completing their tasks in the clinic within the allotted time span which lowered the quality of care received by the women. Another aspect that needs to be highlighted is that the model of care used in the clinic is the 'medical care model' and not the 'midwifery care model'. In this study, the findings revealed that the GP was usually the dominant professional in ANCs and that the nurse/midwife was expected to carry her responsibilities and that of the GPs. The findings of the current study are consistent with a study by Collins et al. (2000), who conducted a pilot project on midwives in Quebec, Canada. The researchers interviewed the midwives, family physicians, obstetrician, gynaecologists, neonatologists, and nurses individually. In addition, a focus group interview was conducted with nurses and midwives. The

findings revealed that midwives were poorly integrated into the health system. This is due to the medical care model followed in the healthcare institution in which the physicians are dominant in providing care for the clients. The researchers also found that professional responsibility and the client-provider relationship were stated to respond to client expectations, which many physicians translate as the demand for a “perfect baby”. However, midwives did not give that expectation to their clients instead, they assure their clients that to provide sufficient knowledge and preparation and to involve them in decisions making.

The findings of the current study are consistent with those of Colvin et al. (2013), who conducted a systematic review to synthesise qualitative research on task-shifting among midwives to identify barriers and facilitators to their successful implementation. Thirty-seven papers were included in their review, and most were from the perspectives of midwives. Some additional papers included health workers and supervisors. They found the doctors are using medical care model to manage the pregnant women at risk for a disease and not as the pregnancy is normal phenomena. Therefore, when the nurses and GPs talked to women about the GDM guidelines, they considered it a disease or pathological state (Collin et al. 2000; Colvin et al. 2013). The midwifery care model focuses on pregnancy being a natural event and not an illness. The pregnancy outcomes depend more on the woman’s trust in her own abilities than on the technical equipment available in hospitals (Collin et al. 2000; Colvin et al. 2013). Generally, to introduce new tasks for the HCPs, it is vital to ensure ongoing supervision, support, and adequate training and careful Integration into clinical protocols and the broader delivery of care (Colvin et al. 2013).

8.5.4. Social opportunity

Another theme emerging from both a quantitative and qualitative approach is the discrepancy between the current practice and evidence-based recommendation (social

opportunities). This was found in the poor practice when screening for GDM in the quantitative study (see chapter 5, pages 154-158) and the shortage of staff (see chapter 7, Theme two: subtheme B: poor uptake of “continuing education” workshops etc.). According to WHO (2006), there is a shortage of 2.4 million midwives, nurses, and physicians in a total of 57 countries. The rotation system applied in the clinic led to a shortage of staff. In this study, the participants complained about the limited number of staff who worked in the antenatal clinic. Generally, in the PHC, there are a limited numbers of midwives working in ANC as well as a staff nurse and a GP. Additionally, there is a general lack of space because the antenatal clinic is a standard size room in each health centre shared by the GP and a midwife/nurse. The GP must also use this room to do any ultrasonography scans and abdominal examinations, which means that the nurse must take the pregnant woman to another room to conduct the blood glucose test.

Similar findings were found by Al Alawi et al. (2019), who conducted a qualitative study across five health centres in Oman/Muscat. The study aimed to explore any challenges and discuss opportunities to improve diabetes management in clinics in primary health care centres in Oman. Semi-structured interviews were conducted with the HCPs working in the diabetic clinic as well as non-participant observations of diabetic clients and care providers during diabetic service provision in order to identify challenges and discuss opportunities for improvement. The findings revealed there to be a lack of resources such as a lack of computers, insufficient support from leadership and shared rooms. The physicians revealed that within the diabetic clinic, the role of the nurse is ill-defined, which led to relationship lack of trust with the physicians and subsequently led to the nurses being underutilized. The nurses often suffered from low self-esteem because they had to work on rotation in the other clinics within the health centre. The nurses also explained that the clients always ask for the doctors and do not listen to what the nurse has to say. A major challenge faced by the HCPs in these health

centres is the necessity to share rooms within the clinic. It is not clear how dealing with the client in one room with two providers could lead to client well-being. Some physicians decided to use a single provider approach in most cases and faced inefficient management because they know that all nurses are well educated and prepared to work in the clinic. The shortage of care providers, mainly qualified nurses, led to unwanted outcomes at the clinic.

8.5.5. Automatic motivation

Poor understanding of GDM guidelines is due to confusion and a general lack of awareness. (Automatic motivation). In the current study, the participants insisted that they need to attend structured workshops to have the guidelines explained. Stuebe et al. (2010) found that most clinicians understood that women with GDM were at high risk of developing T2DM, but that knowledge around the necessary follow-up appointments and understanding of GDM guidelines generally was poor. A pregnancy registration begins at the ANC by the nurse/midwife who deals directly with the pregnant woman. The nurse/midwife should develop a rapport with the woman, attempting to answer all her questions relating to the pregnancy. If the nurse/midwife were unable to answer any of these questions because of her lack of knowledge, the pregnant woman would no longer have faith in her ability to do her job.

8.5.6. Reflective motivation

In this study, four participants from both clinics reported that there was poor communication among the HCPs. HCPs highlighted their struggles to understand the interpretation of GDM guidelines. Poor communication and coordination among HCPs are a barrier reflecting weakness in the healthcare system in PHC2. According to Colvin et al. (2013), leaders and managers usually state that effective communication

and coordination of teamwork are major training needs. One of the most significant barriers is a lack of leadership in supporting clinical practice guidelines, which creates confusion and uncertainty, leading to a loss of interest in using the guidelines effectively (Jun et al. 2016). Al Alawi et al. (2019) found that nurses lacked education in diabetes management. Therefore, the doctors preferred to manage their clients alone, which undermined the role of nurse/midwife in the ANCs.

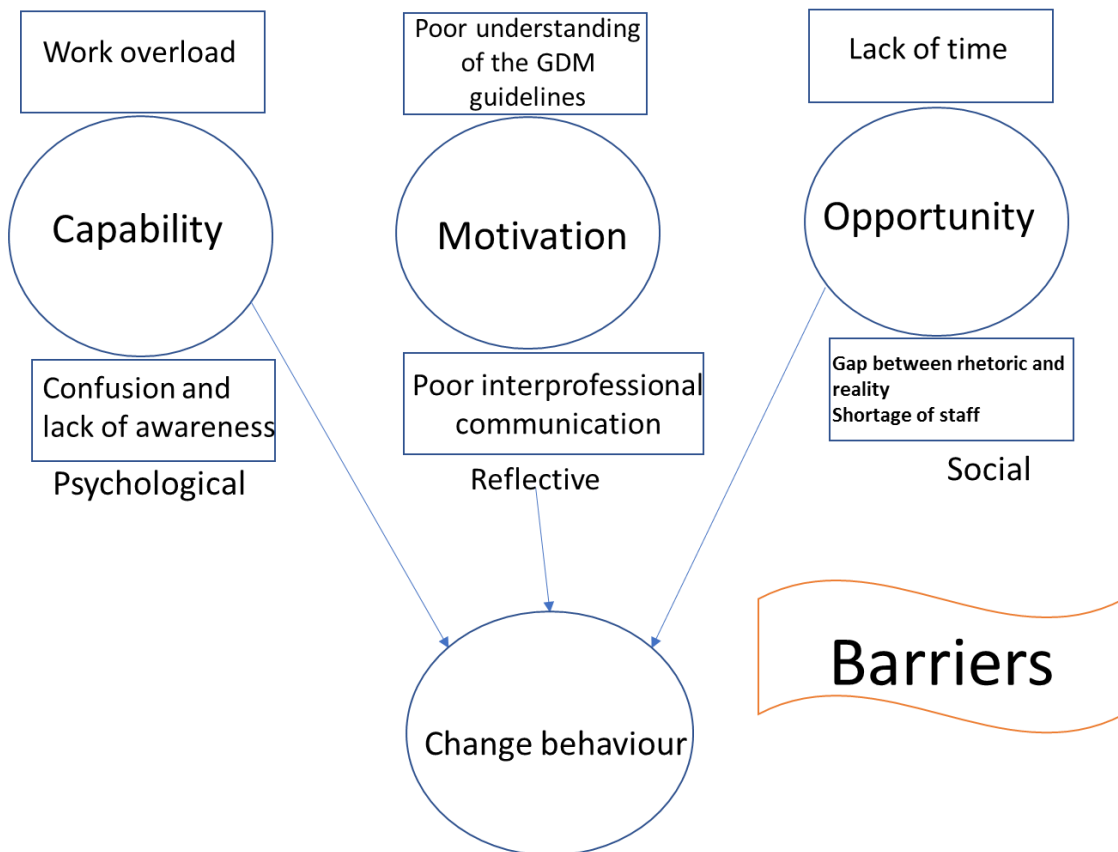


Figure 8-3: Applications of COM-B model on the barriers in implementation of GDM guidelines

The findings reported in figure 8-3, provided empirical support for the barriers faced by the HCPs which limited implementation of the GDM screening guidelines in the PHC.

8.6. Facilitators

As with barriers, this section highlighted the facilitators that to support the implementation of GDM screening guidelines. The COM-B model was used to understand the facilitators' findings that were generated in this study as follows:

8.6.1. Physical capability:

The HCPs had many years of experience of working in the antenatal clinic (physical capability). In this study, there were different degrees of clinical knowledge and experience amongst the participants. The work experience duration among HCPs ranged between 2 and 23 years, some of these HCPs having worked in the same ANCs for many years. Working in one place for many years had several benefits. These include expanding the knowledge and skills of HCPs which reflected in increase their motivations to provide a high quality of care (.Freund et al. 2015).

In this study, the HCPs who worked in ANCs for more than two years (especially PHC1) were keen to understand the GDM screening guidelines and were confident in implementing the guidelines. Additionally, one of the participants in PHC1 was the main person in the ANC, as she took it on herself to explain any policies and protocols and ensure that high work standards were kept in the health centre. She was also responsible for feeding back to the primary healthcare unit for the Wilayat. The fact that one person took on these responsibilities is something that could be replicated in PHC2.

8.6.2. Psychological capability

Experiences gained at work would build up positive attitudes toward implementing the GDM guidelines (Psychological capability). For instance, it is to be expected that a nurse who has worked in ANCs for more than five years should understand GDM

screening guidelines and their implementation. Also, it enables the nurse to identify the effectiveness of the implementation of GDM guidelines. The fact that HCPs had different skills reduced conflict and increased the chances of using shared decision making. Shared decision making takes place when the GPs and nurses discussed the woman's care together, and both contribute to the provision of that care. A descriptive qualitative study conducted by Hunter and Warren (2014) in the UK found that workplace adversity was an issue among senior midwives (who had completed 15 years in the profession). They suggest that resilience is a learned process facilitated by a range of coping strategies, including accessing support, developing self-awareness and protection of self. The data in this study indicated that coping strategies that were used in the above study might foster positivity and resilience in HCPs in Oman in their workplace.

8.6.3. Physical opportunity

The provision of a shared room by the GP and the nurse/midwife was to stimulate the continuity of care for the pregnant woman. The fact that they shared a room meant that they had to discuss GDM guidelines together, thereby ensuring their implementation (physical opportunities). Women tend to spend a longer time with the nurse/midwife than with the doctors in ANCs, receiving more explanation about their condition. (Laurant et al. 2018). The healthcare system in Oman advocates one-to-one care in the ANCs, so one woman at a time should be with the HCPs to ensure privacy and confidentiality. In this study, HCPs in clinic two were more satisfied with the implementation of GDM guidelines, as they pointed out that discussion regarding the implementation of the guidelines was regularly continuing between the GP and nurse. The fact that both GP and nurse/midwife were physically in the same room made it easy to exchange information regarding the women. Furthermore, both the GP and

nurse/midwife would be able to work collaboratively to provide the best possible care for the woman.

8.6.4. Social opportunity

The collaboration between HCPs would improve the quality of care received by women in the clinic (social opportunity) by improving communication and coordination. The nurse/midwife would follow up with any woman referred to a health educator or dietitian. In some cases, it is difficult to ensure that the pregnant woman receives the necessary follow up care because the nurses/midwives have moved on to work in another clinic, thereby interrupting the continuity of care. In addition, women preferred to have follow up appointments with the same staff because they would already be aware of any physical or psychological issues, so there would be no need to explain it at every visit continually. Women also felt comfortable when they dealt with the same HCPs each time, providing continuity of care.

8.6.5. Automatic motivation

Continuous support from the leadership team in the clinic would motivate the HCPs to follow the guidelines accurately (automatic motivation). Planned workshops, frequent short meetings to discuss the implementation of GDM guidelines and evaluate the process of current screening of GDM can contribute effectively to the proper implementation and interpretation of GDM screening guidelines. Nurse leaders, administrators, and managers enable others, create enthusiasm, foster a supportive culture, and provide clear goals of care for all colleagues. Furthermore, they can improve their nurses' use of clinical practice guidelines by creating a supportive environment that facilitates communication between nurses and other disciplines (Jun et al. 2016).

8.6.6. Reflective motivation

Planned workshops, easy access to GDM guidelines and effective communication between the HCPs and the authorities in MoH is supported by continuous staff development (reflective motivation) (see figure 8.4). A descriptive qualitative study was conducted by Graner et al. (2010) in Vietnam. The aim of the study was to explore what midwives, assistant physicians and medical doctors thought about the quality of maternal health care in rural Vietnam. The findings revealed that the implementation of continuing in-service training for health care professionals at all levels is essential to safeguard the clinical competence required to meet all clients' needs.

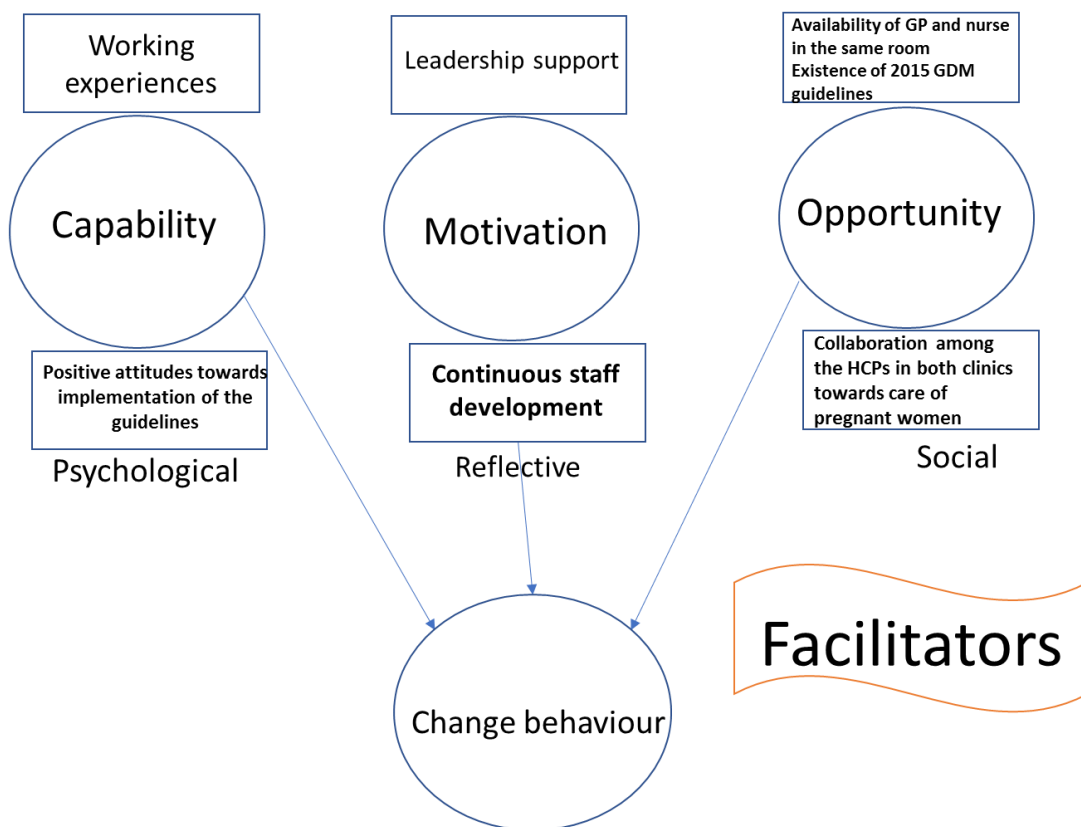


Figure 8-4 Applications of COM-B model on the facilitators in the implementation of GDM guidelines

Application of the COM-B model on the barriers and facilitators of the behavioural analysis showed that all subthemes were identified and relevant to implementing the GDM screening guideline.

8.7. Overall summary

Using the COM-B model to highlight the barriers and facilitators was appropriate in this study. This chapter has presented and discussed the four overarching themes amongst facilitators which have emerged following the convergent analysis of a retrospective review of case records and data obtained from face to face interviews. Findings were interpreted in relation to other empirical studies, including literature around barriers and facilitators.

The retrospective review of case records provides evidence that there is poor compliance with GDM screening guidelines. The findings of this survey are supported by face-to-face interviews, indicating that healthcare professionals have faced barriers when attempting to implement GDM guidelines. The potential risk of poor compliance in the implementation of these guidelines appears to have been negated by the effective use of the facilitators. In the Omani context of the primary healthcare settings covered by this study, the convergent analysis has therefore provided an in-depth demonstration of how HCPs tend to implement GDM guidelines.

8.8. Originality of the research

To the best of my knowledge, there is no other study that has explored the compliance of GDM screening guidelines in Oman; hence this study filled a gap in our understanding about this vital aspect of care for pregnant women. This study sought to explore the implementation of gestational diabetes mellitus screening guidelines within

primary healthcare institutions in Oman. The study has made a unique contribution to the body of knowledge on how to best utilise the facilitators available within the healthcare system in order to improve the implementation of GDM screening in Oman. This study found a discrepancy in the implementation of GDM guidelines between two PHC institutions in Muscat. There is a lack of clarity around the job descriptions of nurses and midwives, which meant that they tended to take on tasks that were the responsibility of the GP, because they were unsure as to what their role actually was. The study also explored the consequences of staff rotation within different clinics in the health center that has a direct effect on the continuity of care provided for pregnant women. There is the potential for improving the compliance with GDM guidelines implementation by HCPs if they are provided with a clear interpretation of these same guidelines.

8.9. Beneficiaries of the research

The result of the study may benefit the maternity services in Oman through revising the current implementation of the screening and diagnosis of gestational diabetes. In addition, the study will contribute to understanding the importance of the GDM screening process in maternal and child healthcare.

8.10. Strengths and limitations of the study

8.10.1. Strengths

The sample size of 942 registered pregnant women from January to December 2014, was able to provide the generation of in-depth data about screening for GDM. The study did not go beyond screening to consider the treatment of GDM during the

antenatal period, which was appropriate for this type of study. This is the first study to investigate the compliance with GDM screening guidelines in Oman.

8.10.2. Limitations

The study sample was drawn from one primary healthcare institution in Muscat Governorate; this might limit the generalisability of findings to other geographical areas. Moreover, the inclusion of many primary healthcare centres from different parts of Muscat Governorate (rural and urban areas) may contribute to the generalisation of the study results. It was not possible to know if the women were offered OGCT or/and OGTT and declined or whether no screening was offered in the first place.

8.11. Implication for future practice

This mixed-method study recommends evaluating the implementation of GDM guidelines in large geographical areas in Oman to achieve the generalizability of the findings.

Enhance the pre-conception care of women with previous history of GDM in the Omani healthcare system with the aim of early detection of GDM and a reduction of its complications.

Based on the findings of this study, managers and policymakers are advised to develop a strategic plan for their own organisation to facilitate the implementation process of change in their healthcare institution.

Moreover, it is recommended that there be a change in the GDM screening guidelines after having assessed the knowledge, capabilities, and clinical practice skills of HCPs in the antenatal clinics.

Identify the opportunities available in the PHC which could improve the quality of collaboration among the HCPs in order to achieve the optimum care for pregnant women.

It is also recommended that staff be encouraged to keep themselves up to date with best practice and be given positive feedback from managers, which will support the transition process.

Leadership support and active involvement of the HCPs in decision making process based on their knowledge and clinical skills should be continued, in order to improve adherence to the GDM guidelines.

I suggest that each HCP who attended any workshop relating to the updating of the national guidelines or policies should plan a meeting or presentation to disseminate the updated information amongst all the HCPs. It is still the responsibility of the HCPs to keep themselves updated about any changes.

GPs in-charge and nurses' in-charge play a crucial role in the process of the implementation of change in the PHC. This can be facilitated by engaging the HCPs actively in workshops and making good use of the resources.

This study suggests that the current distribution of HCPs within the PHCs should be considered. The distribution of midwives in primary healthcare centres should be considered.

8.12. Implication for future research

Further research would be required to evaluate the implementation of GDM guidelines across the primary healthcare institutions in Oman.

Further research should be conducted to evaluate the effective compliance of the GDM guidelines among pregnant women.

Further research should be conducted to explore other barriers and facilitators that healthcare professionals face across primary healthcare institutions.

8.13. Conclusion

The retrospective review identified the nature of the screening of GDM and the implementation of 2010 GDM screening guidelines. The nature of the in-depth semi-structured interviews provides the honesty and reality of the practice in PHC1 and PHC2. Data was collected from a primary and a secondary healthcare institution in Muscat which limited the generalisability of the findings. Although the data was incomplete, the main purpose of the study was to investigate whether GDM guidelines were implemented accurately in PHC institutions. Therefore, although the cross-sectional survey could not be completed as intended because of missing data, the retrospective review data was sufficient to investigate the standards of application of GDM screening guidelines.

The findings from the in-depth semi-structured interviews revealed the lack of awareness and inadequate understanding of the GDM screening guidelines amongst some HCPs in PHC1. Similarities and differences in PHC1 and PHC2 were explored and discussed within the context of planning for behavioural change.

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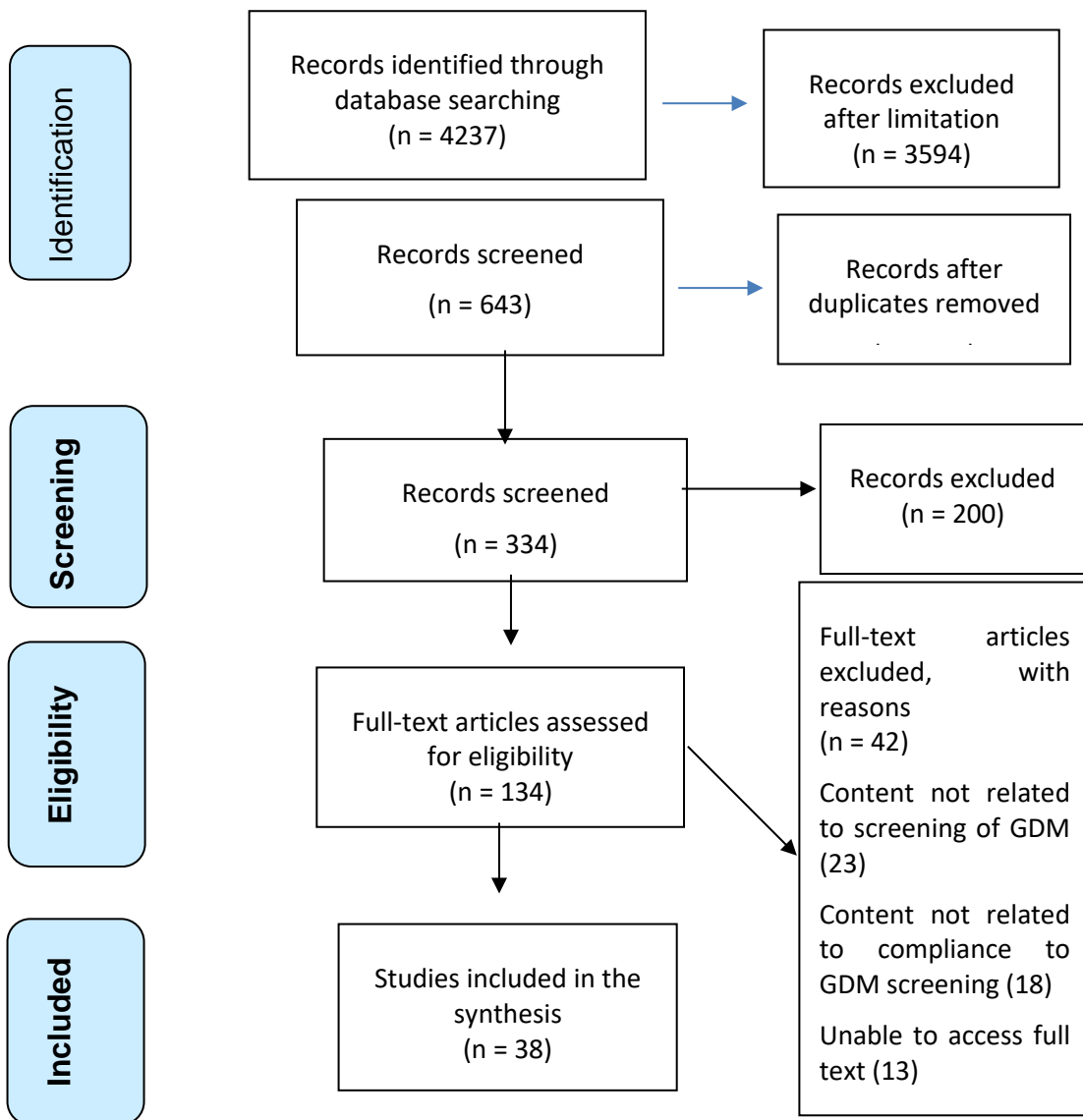
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Appendices

Appendix A: PRISMA Flow diagram



Appendix B: Grid Table

Surveys

#	Code	Author, year, location	Title of the study	Aims	Study design/ Methods	Study sample/ size	Findings	Strength & Limitations
1.	Organisation constrains work overload	Flack et al. (2010) Australia	Recommended changes to diagnostic criteria for gestational diabetes: Impact on workload	To assess the impact on health professional workload, specifically management of the number of additional women who would be diagnosed with GDM, should the newly	Quality Assurance project	all pregnant women screened for GDM in six hospitals: Banks town, Fairfield, Liverpool, Campbelltown, Camden, and Bowral. In two time periods; initially	These data indicate that just lowering the fBGL level. would have a significant increase in expected workload for the management of GDM. In a high-risk population examined in two-time periods, the estimated increase in workload was 29.0%	Limitations: This study is records based data. No explanation was given why they collected the data from two

				recommended diagnostic criteria be adopted in Australia.		November 2005 to August 2007, and later September 2007 to August 2009.	(based on November 2005 to August 2007 data) and 31.9% (based on September 2007 to August 2009 data). Data from Northern Sydney indicated a 21.7% increased workload (based on September 1998 to July 2009 data).	areas in Australia. Who collected the data and collection data procedure was not identified? No evidence provided on sample size calculation .
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#	Code	Author, year, location	Title of the study	Aims	Study design/ Methods	Study sample/ size	Findings	Strength & Limitations
2.	Organisation constrains work overload	Flack and Ross 2016 Australia	Survey on testing for gestational diabetes mellitus in Australia	to ascertain the extent to which services managing GDM have adopted them	Survey	one-page questionnaire was sent to all 96 members of the National Association of Diabetes Centres (NADC) by the NADC secretariat	piecemeal adoption of recommended changes, with cessation of the 50 g glucose challenge test (GCT) universal, early screening implementation. common, but by varied methodologies, and new diagnostic criteria acceptance far from complete with significant workload increases almost universal.	Failed to maintain anonymity

#	Code	Author, year, location	Title of the study	Aims	Study design/ Methods	Study sample/ size	Findings	Strength & Limitations
3.	Barriers	Stuebe A., Ecker J., W. Bates D , Zera C., Bentley-Lewis R., Seely E., . (2010) Boston	Barriers to Follow-up for Women with a History of Gestational Diabetes	to measure the effect of the barriers through a survey of obstetrics and gynaecology care providers (OBCPs) and PCPs within a large health care system in Boston, Massachusetts	Survey	A total of 478 providers obstetrician-gynaecologists , certified nurse-midwives, primary care physicians, and nurse-practitioners.	Found most clinicians knew that women with GDM were at high risk of developing type 2 diabetes, but knowledge of follow-up guidelines was poor. participants identified limited communication between OB and PCPs, and to a lesser extent lack of provider awareness of guidelines, as major barriers to screening.	<u>Strength:</u> Researchers discussed the validity and reliability of the instruments used as they stated that they developed the survey questions based on previous survey conducted in their institutions.

#	Code	Author, year, location	Title of the study	Aims	Study design/ Methods	Study sample/ size	Findings	Strength & Limitations
							Documentation of GDM history in the electronic problem list was poor.	
4.	Barriers and facilitators	Wilkinson et al. 2013 Australia	Barriers and enablers to translating gestational diabetes guidelines into practice	Describes an evidence–practice gap diagnosis which informs the implementation and evaluation of an evidence-based dietetic model of care including a schedule of dietitian visits, in a tertiary	Survey Data collection was via hospital records, clinic observation, and staff surveys.	_ Routinely collected hospital data from women accessing the Mater Mothers' Hospital (MMH) GDM clinics were obtained from the MMH electronic database ('Mater Matrix')	*Approximately one-fifth of women required insulin, oral hypoglycaemic agents use was minimal, and approximately three-quarters of women received dietary advice for blood glucose control. * Inadequate dietitian resources to enable all GDM women to be reviewed according to	For the validity& reliability of the study, the researcher followed the outline recommended by French et al. (2012) that involved four steps to assess influencing factors

			<p>hospital's setting.</p> <p>Outline the systematic approach taken to identify barriers and enablers, the design, and the implementation of this model of care, and the planned evaluation.</p>		<p>from the years 2009–2011. Mater Matrix data are entered prospectively.</p> <p>-Baseline staff surveys were conducted during the first three months of the project and pre-implementation phase included 44 clinic staff.</p> <p>Clinic</p>	<p>Nutrition Practice Guidelines were identified.</p> <p>* Most staff believed regular dietetic contact could influence diet, but fewer believed contact could influence BGLs, pharmacotherapy requirements, and care costs, and only about half felt dietitian contact could influence gestational weight gain or macrosomia.</p> <p>* Lack of staff 'belief' in benefits of seeing a dietitian or</p>	<p>and design of implementation strategies in a translational research project. The study was guided by using Theoretical Domains Framework</p>
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						<p>GDM/benefits of on-going dietetic support/importance of dietary modification.</p> <p>Staff who were non-adherence to best practice have been identified through a systematic, evidence-based approach.</p> <p>-Observation and team discussion</p> <p>during the first three months of the project planning and pre-implementation were guided by the National Institute of Clinical Studies</p>	<p>Women's lack of awareness of the benefits of scheduled contact with a dietitian was identified. Barriers other than insufficient dietitian resources included lack of dedicated clinic space, lack of appointment scheduling system and process for nutrition &</p>
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#	Code	Author, year, location	Title of the study	Aims	Study design/ Methods	Study sample/ size	Findings	Strength & Limitations
						barriers and enablers tool.	dietetics, and absence of the dietitian from the clinical care pathway that outlines the multidisciplinary best practice schedule of visits.	
5.	Acceptance	Pintaudi et al. 2016 Italy	Level of implementation of guidelines on screening and diagnosis of gestational diabetes: A	To describe the degree of diffusion and acceptance of national guideline on screening and diagnosis of gestational diabetes (GDM)	Group structured a national survey,	122 diabetologists of 122 different diabetes centres of all the Italian regions	* Almost one in five centres preferred a universal screening procedure, the others executing a selective risk factors-based screening. * In patients at high risk for GDM the OGTT was performed at 16–18 weeks' gestation in 84.0% of the cases; only 6.5% of respondents	A major strength of the study was they were able to collect data of all the Italian regions, this permitted knowledge of the level of application of national guidelines both in

			national survey	among Italian diabetes centres and to detect possible areas for benchmarking.		completed the questionnaire.	preferred to execute it as soon as possible; and 9.5% used to wait until 24–28 weeks' gestation. * In the case of fasting plasma glucose (FPG) ≥ 5.1 mmol/l (92 mg/dl), two third of respondents used to proceed with the execution of the complete diagnostic OGTT, the others considering sufficient the FPG value for the diagnosis.	territorial centres and hospitals.
#	Code	Author, year, location	Title of the study	Aims	Study design/ Methods	Study sample/ size	Findings	Strength & Limitations
6.	Compliance to Guidelines	Bell et al. 2018	Implementation of national screening guidelines For gestational diabetes: A	To explore national implementation of guidelines for screening,	Survey Monkey (online questionnaire)	212 responses were received from 113 NHS Trusts.	A descriptive thematic analysis of the free text responses was carried out. All data were open coded by two authors.	84% giving a response rate of the number of Trusts offering NHS maternity services in England at the

			<p>national survey of maternity units in England</p>	<p>diagnosis and postnatal follow up.</p> <p>among maternity units in England, and barriers to implementation of screening guidelines relating to maternal BMI.</p>			<p>Most of the respondents who were BMI compliant did not report barriers associated with implementation (n = 83, 78%). There was a similar Pattern of implementation barriers to the respondents between Trusts that were not compliant.</p> <p>Limited capacity of staff and clinics to meet the demand when there was a high prevalence of obesity.</p> <p>compliance was very high (90%) with the long-standing NICE 2h threshold, but much lower (60%) for the</p>	<p>time of the survey which increases the validity of the findings and representativeness.</p> <p>The study findings could be used with caution because it was conducted by an online questionnaire that considered as one of the limitations as healthcare professionals may provide a general desirable answer.</p> <p>The study did not have an intervention but conducted to</p>
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#	Code	Author, year, location	Title of the study	Aims	Study design/ Methods	Study sample/ size	Findings	Strength & Limitations
							fasting value. A	assess the clinician's compliance to GDM screening.
7.	Barriers and facilitators	von Treuer et al. 2018 Australia	Organizational factors associated with readiness for change in residential aged care settings	To examine the effect of organizational climate and leadership variables on organizational readiness for change across	Survey Questionnaire	255 employees of 21 residential aged care facilities	compared to senior staff, junior staff reported significantly higher autonomy (M= 3.50 versus 3.84, t [253] = - 3.67, p < .001) and transactional	Study design was not mentioned, the process of recruitment of participants was not

				21 residential aged care facilities.			leadership behaviour (M= 2.57 versus 2.92, F[253] = - 4.36, p < .001). lack of understanding of the contextual factors affecting the success of change in aged care. environments	
#	Code	Author, year, location	Title of the study	Aims	Study design/ Methods	Study sample/ size	Findings	Strength & Limitations
8.	Compliance to GDM	Agarwal et al.	Gestational diabetes:	To highlight the differences	Survey	2337 pregnant women	Lack of awareness The university/	The study methodology was

		(2015)	differences between the current international diagnostic criteria and implications of switching to IADPSG.	between eight international expert panel diagnostic criteria (either current or outdated but in use) for the diagnosis of gestational diabetes mellitus (GDM) and implications of switching to the International Association of Diabetes in Pregnancy	questionnaire)		academic physicians were not any more aware compared with non-academic physicians of either the HAPO study or IADPSC recommendations.	not reported which affect credibility and transferability of the finding. The rationale for selecting 2337 records of women who had attending the antenatal clinics underwent a diagnostic 2-h, 75-g OGTT were not provided. The cost implication of switching from the two-step to the
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				Study Groups (IADPSG) criterion				one-step using the universal 75-g OGTT as recommended by the IADPSG was not addressed.
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#	Code	Author, year, location	Title of the study	Aims	Study design/ Methods	Study sample/ size	Findings	Strength & Limitations
9.	Process for determining cases for GDM.	EDWARDS et al. (2014) Australia	Improving health service delivery for women with diabetes in pregnancy in remote Australia: survey of care in the Northern Territory Diabetes in Pregnancy Partnership	To assess current health service delivery for NT women with diabetes in pregnancy (DIP) by surveying healthcare professionals' views and practices in DIP screening and management.	cross-sectional survey using survey Monkey. The survey contained 43 questions across five themes: communication; care-coordination; education, orientation, and guidelines; logistics and access; and information technology. from September to November 2012.	116 of the respondents met the eligibility criteria of providing clinical care to pregnant women (GPs, Midwives and Nurses).	* 66% of the healthcare professionals responded to screen for GDM in the first antenatal visit. * The majority of respondents (81%) reported routinely screening for diabetes in the second or third trimester. * The majority of screening (95%) occurred at the recommended interval of 24–28 weeks. * Midwives were more likely than GPs to report that they were confident (or extremely confident) in managing DIP (midwives 76%, GPs 52%, P = 0.04).	*The adherence to GDM screening was not assessed. *Although the healthcare professionals were highly confident in managing the GDM women but how the guidelines were implemented was not available.

Randomised Control Trials (RCTs)

#	Code	Author, year, location	Title of the study	Aims	Study design/ Methods	Study sample/ size	Findings	Strength & Limitations
10.	Process for determining cases for GDM.	Utz et al. (2017). Morocco.	Knowledge and practice related to gestational diabetes among primary health care providers in Morocco: Potential for a defragmentation of care?	To assess knowledge and practices of GPs, nurses and midwives working at primary health care facilities in Morocco regarding screening and management of gestational	Structured interviews	*100 doctors, midwives, and nurses *At 44 randomly selected public healthcare centres	* Public primary healthcare providers have a basic understanding of gestational diabetes, but screening and management practices are not uniform. * 56.8% of the doctors had some pre-service training on gestational diabetes. * Most nurses and midwives lack pre-service training. * 69.9% of providers	* Findings of this study will be used to pilot a model of GDM screening and initial management through the primary level of care. No consensus on one international GDM guidelines. It is still hesitated to use universal

				diabetes (GDM).			perceived the necessity of using universal GDM screening and 30.1% stated that only women with risk factors should be screened. * 88.5% of providers refer patients to specialists After diagnosing GDM, and 11.5% treat them as outpatients	screening or selective screening.
#	Code	Author, year, location	Title of the study	Aims	Study design/ Methods	Study sample/ size	Findings	Strength & Limitations
11.	Consensus for treatment	Crowther et al. (2005) Australia	Effect of treatment of gestational diabetes mellitus on pregnancy outcomes.	To assess whether the treatment of gestational diabetes would reduce perinatal complications	Randomised control study Eligible women who had singleton or multiple pregnancy	1000 pregnant women from 14 hospitals. 490 were assigned to the intervention	No significant difference was found in the rates of shoulder dystocia and a bone fracture or nerve palsy between the intervention and routine-care groups which	Limitations: An ethical aspect of the study design arises in that women in the routine care group were not

			(ACHOIS)	and to assess the effects of treatment on maternal outcome, mood, and quality of life	between 16 and 30 weeks gestation, had one or more risk factors for GDM on selective screening were included in the study.	group and 510 to the routine-care group. September 1993 and stopped in June 2003	significantly showed reduction from 4% to 1%. Significantly fewer infants (10%) in the intervention group had macrosomia compared to 21% in the routine care group. This evident that pregnancy outcomes include macrosomia and birthweight > 90th percentile were significantly reduced.	informed of their diagnosis of GDM during the study. A performance bias was detected as no treatment was provided for women with GDM in routine group. Healthcare professionals were not aware about the diagnosis of the women in routine care group.
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#	Code	Author, year, location	Title of the study	Aims	Study design/ Methods	Study sample/ size	Findings	Strength & Limitations
12.	Suitable screening, diagnosis test and examination	Luoto et al. (2011) Finland	Primary Prevention of Gestational Diabetes Mellitus and Large-for-Gestational-Age Newborns by Lifestyle Counselling: A Cluster-Randomized Controlled Trial	to examine whether gestational diabetes mellitus (GDM) or newborns' high birthweight can be prevented by lifestyle counseling in pregnant women at high risk of GDM.	A cluster randomised control trial (RCT) Pregnant women who were eligible to enter the study should be 8-12 weeks of gestation and recruited between 1 October 2007 and 31 December 2008.	A total of 399 women in 14 municipalities. 219 in intervention group and 180 in control group	There were no significant differences between the intervention and the usual care group at a baseline or at 26-28 weeks gestation in glucose intolerance measurements. The proportion of large-for-gestational-age (LGA) newborns was lower in the intervention group (12.1% versus 19.7%, p=0.042) in the control group. 15.8% of women in the intervention group and	Good randomisation process. Furthermore, the calculation for the cost effectiveness of RCT was maintained during the trial. The power calculation of to sample was presented in detail.

							<p>12.4% in the control group developed GDM (95% confidence interval CI 0.71-2.62, $p=0.36$)</p> <p>In subgroup analysis, adherent women in the intervention group ($n = 55/229$) had decreased risk of GDM (27.3% versus 33.0%, $p=0.43$) and LGA newborns (7.3% versus 19.5%, $p=0.03$) compared to women in the control group.</p>	
#	Code	Author, year, location	Title of the study	Aims	Study design/ Methods	Study sample/ size	Findings	Strength & Limitations
13.	Treatment for GDM	Landon et al. (2009)	A Multi-centre, Randomized Trial of	to determine whether treatment of	Randomised control trial Women	a total of 958 women, divided into	The frequency of large-for-gestational-age infants (7.1% vs. 14.5%), RR	<u>Limitation</u> lacked sufficient

		United States of America	Treatment for Mild Gestational Diabetes	women with borderline GDM reduces perinatal and obstetrical complications	between 24 weeks and 30 weeks 6 days of gestation and blood glucose concentration between 7.5 and 11.1 mmol/l (1 hour after 50 g glucose loading test) were invited to participate in the study.	two groups (485 treatment group and 473 control group)	0.49 (97%CI, 0.32-0.76, $p < 0.001$), birth weight greater than 4000 g or greater (5.9% vs. 14.3%) RR 0.41 (97% CI, 0.26-0.26, $p < 0.001$), shoulder dystocia (1.5% vs. 4.0%), RR 0.37 (97% CI, 0.14-0.97, $p = 0.02$), and caesarean delivery (26.9% vs. 33.8%), RR 0.79 (97%CI, 0.64-.099, $p = 0.02$) were significantly reduced in the treatment group as compared with the control group. This indicates that there was a significant reduction in the rate of caesarean delivery among the women who were treated for mild gestational diabetes mellitus, as compared	power to detect significant differences in uncommon adverse outcomes such as injury to the brachial plexus. Some women had incomplete outcome data because they were either excluded (due to no delivery data; or missing laboratory data) or lost to follow up in both the treatment and the control groups.
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							with the rate among the women in the control group.	
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Retrospective cohort study

#	Code	Author, year, location	Title of the study	Aims	Study design/ Methods	Study sample/ size	Findings	Strength & Limitations
14.	Natural History of the gestational diabetes mellitus condition	Riskin-Mashiah et al. (2009) Israel	First-Trimester Fasting Hyperglycaemia and Adverse Pregnancy Outcomes	To evaluate the associations between first-trimester fasting plasma glucose level and adverse pregnancy outcomes	Retrospective cohort study data were extracted into a computerized database.	7,126 women were enrollees of Clalit Health Care Services	There were associations between the first trimester fasting maternal plasma glucose level, below those diagnostic of diabetes, and adverse pregnancy outcome including development of	The compliance to the GDM guidelines was not assessed. The study was conducted in one healthcare centre which increase the bias.

					<p>Data collected from all deliveries between June 2001 to June 2006.</p>		<p>GDM, LGA and/or macrosomia, and primary caesarean delivery. They found were strong, graded associations between fasting glucose level and primary outcomes but not preterm birth or neonatal intensive care admission. The frequency of GDM development increased from 1.0% in the lowest glucose category to 11.7% in the highest OR 11.92 (95% CI 5.39–26.37). The frequency of LGA neonates and/or macrosomia increased from (7.9 to 19.4%) OR 2.82</p>	
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#	Code	Author, year, location	Title of the study	Aims	Study design/ Methods	Study sample/ size	Findings	Strength & Limitations
							(1.67–4.76). Primary caesarean section rates increased from (12.7 to 20.0%) OR 1.94 (1.11–3.41).	
15.	Compliance with GDM guidelines	Persson et al. (2009). Sweden	Surprisingly, low compliance to local guidelines for risk factor based. screening for gestational diabetes mellitus - A population-based study	Investigate the compliance with local guidelines of screening for GDM. The outcomes of pregnancy and birth in relation to risk factors of GDM and	population-based retrospective cross-sectional study Data were gathered between January 1 st , 2002, through April 30 th ,	822 participants,	257 (31.3%) women fulfilled at least one criterion for being exposed to screening for GDM according to the local clinical guidelines. However, only 79 (30.7%) of these women were exposed to OGTT and of those correctly exposed for screening, Seven women were	The study did not investigate the possible causes to the low compliance to the local guidelines of screening for GDM

				<p>whether exposed to oral glucose tolerance test (OGTT).</p>	<p>2002. Data collected using questionnaire and medical records</p>	<p>diagnosed with GDM. Women developing risk factors for GDM during pregnancy had a substantially increased risk of giving birth to an infant with macrosomia.</p> <p>Family history with diabetes was reported by (61.0%) followed by BMI \geq33 (38.0%), previous infant with Macrosomia was (14.0%) and previous history of GDM was (1.0%).</p> <p>About one third of women had at least one risk factor of</p>	
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#	Code	Author, year, location	Title of the study	Aims	Study design/ Methods	Study sample/ size	Findings	Strength & Limitations
							GDM which is considered a public health issue of women.	
16.	Importance of health issue	Abu-Heija et al. (2015) Oman	Gestational and Pre-gestational Diabetes Mellitus in Omani Women: Comparison of obstetric and perinatal outcomes	To assess the prevalence of gestational diabetes mellitus (GDM) and pre-gestational diabetes mellitus (PGDM) among pregnant women in Oman and	Retrospective study Data collection was carried out from the patient records in Sultan Qaboos Hospital.	A total of 5,811 Omani women who gave birth between January 2009 to December 2010.	Of 5,811 women, there were 639 had diabetic (11.0%). Of these diabetic women, 581 had GDM (90.9%) while only 58 had PGDM (9.1%). Caesarean sections (CS) were significantly higher in women with PGDM compared to those with GDM (60.3% vs	The limitation of the study that it was conducted in one referral hospital, so this is limited the generalisability. Strength: Universal screening was carried out during the study period. Pregnant women who had a history of

				compare their obstetric and perinatal outcomes		<p>27.9%; $p < 0.001$).</p> <p>There were no significant differences in mean of the parity between the two group (31.3% vs 39.6%; $p = 0.237$).</p> <p>The incidence of shoulder dystocia was the same in both groups (1.7% vs 1.7%; $p > 0.999$).</p> <p>There were no significant differences in mean birth weight < 2,500 g (8.8% versus 13.6%; $p = 0.231$).</p>	<p>recurrent macrosomia, miscarriages, fetal malformation or unexplained intrauterine death or family history of diabetes, previous GDM, or glucosuria on at last two occasions were considered with high risk of GDM so 2hrs 75 g OGTT was performed.</p>
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#	Code	Author, year, location	Title of the study	Aims	Study design/ Methods	Study sample/ size	Findings	Strength & Limitations
							The incidence of Macrosomia ≥ 4 kg, (4.9% vs 10.3%; $p = 0.120$) between the two groups.	
17.	Compliance with GDM guidelines	Murphy et al. 2016. Auckland, New Zealand, Adelaide, Australia; Cork in Ireland and the UK (Manchester, Leeds, and	Compliance with National Institute of Health and Care Excellence risk-based screening for Gestational Diabetes Mellitus in nulliparous women	to investigate compliance with risk-based screening for GDM.	A prospective international cohort	A total of 2432 nulliparous women with singleton pregnancies were recruited to a prospective cohort between May 2007 and February 2011.	Compliance with screening in the UKs centres was less compared with the Irish centre (42% vs 71%). The obese women in the Irish cohort were correctly screened compared with women in the UK (78% vs 49%). Women who reported first degree family relative with	This study was a prospective international cohort that reports on healthy nulliparous women with singleton pregnancies were recruited between May 2007 and February 2011 through continuous registration. Eight settings were

		London)				<p>diabetes were not screened in 33% (n = 106) of cases. 29% (n = 88) of obese women (BMI \geq 30 kg/m²) were not screened from the whole population.</p> <p>The authors identified the barriers for the screening that lack of motivation among the HCPs and women, and fear to diagnosis of GDM. However, the facilitators were to include the HCPs and women in health education regarding the risk of undiagnosed GDM</p>	<p>selected by systematic sampling; however, for the purpose of the study it was restricted to Ireland and UK centres, where risk factor screening is performed. The SCOPE studies</p> <p>The response rate was 99.9% which is like the calculated sample size.</p> <p>Sampling criteria were not clearly explained which might affect the generalisation of the findings as it was a nulliparous, primarily Caucasian cohort, the results may not apply to high risk</p>
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							and the benefits of appropriate screening.	populations.
#	Code	Author, year, location	Title of the study	Aims	Study design/ Methods	Study sample/ size	Findings	Strength & Limitations
18.	GDM	Koning et al.	New diagnostic	To evaluate	retrospectiv	4431 women with	the women who had	The study was

	diagnoses	2018. Netherlands	criteria for gestational diabetic mellitus and their impact on the number of diagnoses and pregnancy outcomes	the possible impact on the number of GDM diagnose and pregnancy outcomes when applying the new WHO 2013 criteria instead of the older WHO	evaluation of data on testing for GDM Between January 2011 and September 2016 in the Groningen area	risk factors of GDM	undergone an OGTT and were subsequently found to have normal glucose tolerance (NGT) also had a rate of large gestational age (LGA) neonates higher than that of the women receiving treatment after being diagnosed with GDM based on the WHO 1999 criteria for 2HG (18.0% vs 15.4%). Although this finding was not statistically	approved by the Medical Ethical Review Committee of the UMCG. The data was analysed retrospectively and all requirements for patient anonymity agree with the regulations of the ethical committee of both hospitals for publication of patient data. Therefore, no informed consent was deemed necessary.
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							significant, it was a large difference compared with the incidence of LGA neonates in the general obstetric population (18% vs 11%).	
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Prospective studies

#	Code	Author, year,	Title of the	Aims	Study design/	Study	Findings	Strength &
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		location	study		Methods	sample/ size		Limitations
19.	Cost effectiveness of the GDM screening	Duran et al. (2014) Spain	Introduction of IADPSG Criteria for the Screening and Diagnosis of Gestational Diabetes Mellitus Results in Improved Pregnancy Outcomes at a Lower Cost in a Large Cohort of Pregnant Women: The St. Carlos Gestational Diabetes Study	to evaluate the cost effectiveness of one-step IADPSGC for screening and diagnosis of GDM compared with traditional two-step Carpenter-Coustan (CC) criteria.	Prospective cohort study A semiquantitative questionnaire was used to evaluate adherence to these recommendations and is displayed in Supplementary	1,750 pregnant women from April 2011 to March 2012 using CC and in 1,526 pregnant women from April 2012 to March 2013 using IADPSGC between 24 and 28 weeks of	The use of IADPSGC resulted in an important increase in GDM rate (35.5% vs. 10.6%) and an improvement in pregnancy outcomes, with a decrease in the rate of gestational hypertension (4.1 to 3.5%: 214.6%, P < 0.021), prematurity (6.4 to 5.7%: 210.9%, P < 0.039), caesarean section (25.4 to 19.7%: 223.9%, P < 0.002), small for gestational age (7.7 to 7.1%: 26.5%, P < 0.042), large for gestational age (4.6 to 3.7%: 220%, P < 0.004), Apgar 1-min score <7 (3.8 to 3.5%: 29%, P < 0.015), and admission to neonatal intensive care unit (8.2 to 6.2%: 224.4%, P < 0.001). Estimated cost savings was of V14, 358. 06 per 100 women	This study had no intervention but conducted by questionnaire. confounding factors were not reported. The study highlighted the importance of using IADPSGC that was associated with an improvement in pregnancy outcomes. The findings could be considered

						gestation.	evaluated using IADPSGC versus the group diagnosed using CC.	acceptable because the study findings showed that costs go down, as pregnancy outcomes improve, the rate of caesarean sections decreases, and the number of neonate intensive care unit admissions is reduced.
#	Code	Author, year, location	Title of the study	Aims	Study design/ Methods	Study sample/ size	Findings	Strength & Limitations

20.	Improve GDM birth outcomes using IADPSG	KALTER-LEIBOVI CI et al. (2012) Israel	Screening and Diagnosis of Gestational Diabetes Mellitus	To study the implications of implementing the International Association of Diabetes in Pregnancy Study Group (IADPSG) recommendations for screening and diagnosis of gestational diabetes mellitus (GDM) in Israel and explore alternative methods for identifying women at risk for adverse pregnancy outcomes.	prospective cohort study	Of 25,505 pregnant women recruited, (3,345 were from Israel)	A total of 277 Israeli HAPO participants (8.3%) met the IADPSG criteria for GDM. The prevalence of FM among these women was 16.4% compared with 8.1% among IADPSG-negative women. Implementing the IADPSG recommendations in Israel will substantially increase the proportion of women diagnosed with GDM. Evidence from randomized trials showing benefit from interventions in mild GDM support the adoption of the IADPSG recommendations. Universal use of OGTT for GDM screening may impose excessive burden, especially where	This study provides pertinent information for making locally relevant and evidence-based decisions on screening and diagnosis policy in GDM.
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#	Code	Author, year, location	Title of the study	Aims	Study design/ Methods	Study sample/ size	Findings	Strength & Limitations
21.	Recognition of early and latent symptoms	Sweeting et al. (2016) Australia	Gestational diabetes mellitus in early pregnancy: evidence for poor pregnancy outcomes despite treatment	To determine the prevalence, clinical characteristics, and pregnancy outcomes among high-risk women in whom GDM was diagnosed before 24 weeks of gestation and	Prospective cohort study	4,873 women attending ANC between 1991 and 2011 were studied	<p>Nearly one-third of GDM diagnosis occurred prior to 24 weeks of gestation (27.4%) (early GDM).</p> <p>The earlier the diagnosis of GDM, the more likely that insulin therapy was required (75.0%, 59.1%, and 42.7% (P, 0.0001) respectively,</p> <p>Despite this intensive treatment regimen, our results demonstrate a continuum of risk for adverse maternal outcomes according to the type and timing of diabetes diagnosis.</p> <p>The adverse outcomes associated with early GDM diagnosis are not</p>	<p>resources are scarce.</p> <p>the efficacy and compliance of glycaemic intervention throughout pregnancy was not assessed.</p> <p>the similarly low rates of neonatal hypoglycaemia among the cohorts of women with ,12 weeks of gestation and later GDM, as an index of perinatal glycaemic exposure,</p>

				among women with pre-existing diabetes compared with women in whom GDM was diagnosed after 24 weeks of gestation,			due to an over-representation of diabetes mellitus in pregnancy in this cohort.	
#	Code	Author, year, location	Title of the study	Aims	Study design/ Methods	Study sample/ size	Findings	Strength & Limitations
22.	Suitable screening, diagnosis test and	the HAPO study cooperative research group, (2008) Metzger BE, Lowe	Hyperglycaemia and adverse pregnancy outcomes.	To clarify the risks of adverse outcomes associated with various degrees of maternal	prospective observational epidemiological study	A total of 25,505 women at 15 centres in nine countries (North	The analysis was conducted after adjusting multiple potential confounders	It consisted of large numbers of participants from nine countries. The

	<p>examination</p>	<p>LP, Dyer AR, Trimble ER, Chaovarind U, Coustan DR, Hadden DR, McCance DR, Hod M, McIntyre HD, Oats JJ, Persson B, Rogers MS, Sacks DA. 2008.</p>		<p>glucose intolerance less severe than that in overt diabetes mellitus.</p>		<p>American, European–Caribbean, Middle Eastern–Asian, Australasian, Regional Centres, clinical Coordinating Centre, Data Coordinating Centre, Steering Committee, Data and Safety</p>	<p>and these associations were independent of other known risk factors for these outcomes. There were no significant associations between clinical neonatal hypoglycaemia with the fasting plasma glucose level and the 2-hour PG level.</p>	<p>data collection and utilisation of a centralised laboratory tests were inconsistent with each other. The data results were blinded to the HCPs. The results of this study can have some amount of generalisation because it involves large sample size from different countries.</p>
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						Monitoring Committee, Data and Safety Monitoring Committee, Consultants)		
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Qualitative studies

#	Code	Author, year, location	Title of the study	Aims	Study design/ Methods	Study sample/ size	Findings	Strength & Limitations
23.	Barriers	Hannes et al. (2010),	Exploring barriers to the	To explore the obstacles to	Qualitative descriptive	A purposive sample of 39	Five major clusters of problems related to	Strengths: The study findings

		Belgium	implementation of evidence-based practice in Psychiatry to inform health policy: a focus group based study	evidence-based practice experienced by Belgian Dutch-speaking psychiatrists.	study	psychiatrists participated in five groups between September 2004 and September 2006.	the implementation of evidence-base practice. Characteristics of evidence, psychiatry, patients, commercial partners, government.	appear to be consistent with international literature.
#	Code	Author, year, location	Title of the study	Aims	Study design/ Methods	Study sample/ size	Findings	Strength & Limitations
24.	Barriers	Mersereau et al. (2011), Georgia, USA	Barriers to managing diabetes during pregnancy: the	To investigate the concerns of healthcare practitioners	Qualitative study. Focus groups in	An inconvenience sample of 53 participants	Women reported that most pregnancies were unplanned. Practitioners grouped	Strengths: The recruitment process was written in details.

			<p>perceptions of healthcare practitioners</p>	<p>who care for women with a history of diabetes during pregnancy and their perceptions of attitudes and barriers to achieving a good glycaemic control.</p>	<p>December 2003.</p>	<p>divided into six groups.</p>	<p>their perceptions into three: lack of knowledge, awareness, access, and attitudes barriers such as lack of compliance.</p> <p>Some practitioners stated they had no formal guidelines, some of them stated that they had internal checklist and others stated that they used the internet to find information and they recommend it to their</p>	<p>The analysis of data showed rigors of the study.</p> <p>Limitation:</p> <p>No consistent GDM guidelines found.</p>
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#	Code	Author, year, location	Title of the study	Aims	Study design/ Methods	Study sample/ size	Findings	Strength & Limitations
25.	Barriers	Wilkinson et al. (2019), Queensland, Australia	Implementing a best-practice model of gestational diabetes mellitus care in dietetics: a qualitative study	To describe the experience of stakeholders involved in implementation of best practice MNT and identify learnings to inform implementation at other sites.	Qualitative descriptive study, semi-structured interviews	A purposive sample of practitioners. Eight participants from two regions.	<p>clients.</p> <p>Four main themes were divided with reference to the study:</p> <p>Catalyst for positive change in the local delivery of GDM services.</p> <p>Managing project logistics as some participants expressed uncertainty about their project roles and methods and processes. Work overload, lack of time,</p>	<p>Limitations:</p> <p>The participants were not well distributed as five from one region and three from the other. This indicated poor generalisability.</p> <p>All interviews were conducted by telephone and lasted between 9-37 minutes which indicated very short interview with some</p>

						<p>and lack of understanding the project.</p> <p>Overcoming barriers include resourcing constraints, and communication processes within sites.</p> <p>Achieving change as they acknowledged improved clinical practices within the boarder model of care. the changes adopted within the project improved patient outcomes. The participants found that inclusion of dieticians in a stronger team approach was well appreciated. The</p>	<p>participants in which might be the participant was not ready to answer the questions or the questions were hard to answer them honestly.</p>
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							participants stressed the importance of regular communication with all stakeholders during site engagements.	
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#	Code	Author, year, location	Title of the study	Aims	Study design/ Methods	Study sample/ size	Findings	Strength & Limitations
26.	Barriers and facilitators	Darker et al. 2018, Ireland	The barriers and facilitators to the implementation of National Clinical Programmes in Ireland: using the MRC framework for process evaluations	To determine the enablers and barriers to implementation of the National Clinical Programs (NCPs).	Qualitative study	Thirty three NCPs (comprising 22 males, 11 females) Face-to-face Semi-structured interviews. purposive sampling	-The Clinical Lead was identified as an important key driver for change. -Effective leadership is important to facilitate organisational change and quality improvement. -Lack of communication process led to unnecessary confusion within NCP networks.	Small sample size. The data collection process was well explained by the researchers. Ethical approval obtained, written informed consent taken, anonymity on both the recorded interview & transcripts, confidentiality, privacy was

								<p>Adequately considered.</p> <p>A detailed description of data analysis process was provided and enhanced by researcher's triangulation to confirm the interpreted data that will improve the credibility & trustworthy of the findings.</p>
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Systematic review

#	Code	Author, year, location	Title of the study	Aims	Study design/ Methods	Study sample/ size	Findings	Strength & Limitations
27.	Barrier s	Légaré et al. (2008), Canada	Barriers and facilitators to implementing shared decision-making in clinical practice: Update of a systematic review of	To update the systematic review on barriers and facilitators to implementing shared decision-making in clinical practice as	Systematic review	38 articles included	Time constraints was the most cited barriers for implementing the decision-making across many different cultural and organisational context. A consensus on lack of resources. Lack of agreement on applicability with shared	Gaps in knowledge are still exist and no consensus was made to reduce the gap in implementation of decision-making implementation within the clinical practice.

			health professionals' perceptions	perceived by health professionals			<p>decision-making due to clinical situation.</p> <p>Lack of awareness, lack of confidence, and lack of self-efficacy.</p> <p>Facilitators that were identified include motivation of the healthcare professionals, shared decision-making leads to positive impact on the patient's outcomes and on clinical process.</p>	
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#	Code	Author, year, location	Title of the study	Aims	Study design/ Methods	Study sample/ size	Findings	Strength & Limitations
28.	Barrier s and facilitat ors	Jun et al. (2016), USA	Barriers and facilitators of nurses' use of clinical practice: an integrative review	To appraise and synthesize the current literature on barriers to and facilitators in the use of clinical practice guidelines by registered nurses.	Systematic review: Integrative review	16 articles (7 quantitative, and 9 qualitative).	Nurses had lack of motivation in using the clinical guidelines. Increase in the working experiences among nurses led to non-adherence to the guidelines. Nurses had an agreement that balanced nursing care in different situation was important than adhering to the clinical guidelines. Lack of leadership support	The findings of this study supported the findings of many other studies that poor adherence to clinical guidelines.

							<p>led to create confusion and uncertainty in which reduced the adherence to the guidelines.</p> <p>Lack of administrative support, lack of feedback from the managers led to poor adherence to the guidelines.</p> <p>Facilitators:</p> <p>Continuing education increase knowledge of clinical guidelines among HCPs, increase motivation through demonstrate the evidence for effectiveness of clinical practice guidelines,</p>	
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#	Code	Author, year, location	Title of the study	Aims	Study design/ Methods	Study sample/ size	Findings	Strength & Limitations
							and positive environment via facilitation of communication among the HCPs increase the implementation of clinical guidelines.	
29.	Availability of facilities for diagnosis and treatment of	Buckley et al. (2011) Europe evidence from (Austria, Belgium, Denmark, Finland, Italy, Ireland, the Netherlands, Poland, Spain, Switzerland, and the UK)	Gestational diabetes mellitus in Europe: prevalence, current screening practice and barriers to	To assemble and consider the best evidence for the prevalence of gestational diabetes in Europe, current screening practices and barriers to screening to provide an up-to-date overview of the	Systematic Review	185 separate sources of information from 23 countries, including peer-reviewed research papers,	Screening practice and policy is inconsistent across Europe, hampered by lack of consensus on testing methods, diagnostic glycaemic thresholds, and the value of routine screening. Poor clinician awareness of gestational diabetes, its diagnosis and local clinical guidelines further undermine detection of GDM. Lack of evidence to support screening as an effective strategy for preventing pregnancy adverse	Limitation Majority of the literature that included in the study were observational and retrospective studies. The prevalence of 2-6% of women might have GDM in the study is not applicable in Oman

	GDM		screening. A review.	context within which the DALI programmer will be conducted, its interventions developed and its findings interpreted.		guideline publications and reports from professional and statutory bodies and national registers. From 2000 to 2009	outcomes or improve maternal and child health.	<p>as the culture and lifestyle are different.</p> <p>Some of the European countries include France, Germany, Hungary, Lithuania, Bulgaria, and Sweden are not using a standard screening and diagnosis tests or their protocol of GDM screening was not clear.</p> <p>Strength:</p> <p>Universal screening identifies greater</p>
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								number of women with GDM than selective screening.
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30.	Treatment for GDM	Poolsup et al. (2014), Thailand	Effect of Treatment of Gestational Diabetes Mellitus: A Systematic Review and Meta-Analysis	To assess the efficacy and safety of treating pregnant women with gestational diabetes mellitus in comparison to usual antenatal care.	Systematic review and meta-analysis. A literature search was conducted using electronic databases together with a hand search of relevant journals and conference proceedings.	10 studies met the inclusion criteria involving 3881 participants	Treatment of GDM remained controversial mostly due to the lack of a uniform standard for defining glucose intolerance during pregnancy. The dietary intervention along with glucose monitoring as the primary therapeutic choice in all the studies meeting Perinatal/ Neonatal Outcomes: Infants born to GDM mothers in the treatment group were at significantly lower risk for macrosomia	Strengths: Early screening and treating the GDM women reduce adverse pregnancy outcomes.
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							<p>(RR, 0.47; 95% CI, 0.38–0.57, p-value,0.00001), Large for Gestational Age birth (RR, 0.55; 95% CI, 0.45–0.67, p-value,0.00001) and shoulder dystocia (RR, 0.42; 95% CI, 0.23–0.77, p-value=0.005) as compared to routine care non-significantly so, in the treatment group as compared to control (RR, 0.65; 95% CI, 0.36–1.18). Similarly, infants born to GDM mothers in the treatment group were non-significantly at a lower risk for birth trauma (RR, 0.37;</p>	
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						<p>95% CI, 0.11–1.28) and preterm births (RR, 0.88; 95% CI, 0.65–1.18) The risk for neonatal hypo-glycemia slightly but non-significantly increased in the intervention group (RR, 1.15; 95% CI, 0.90–1.46).</p> <p>Maternal Outcomes:</p> <p>The risk for caesarean section (RR, 0.90; 95% CI, 0.80–1.00) was less likely in the intervention group (non-significant).</p> <p>Nonsignificant increase in the risk for pre-eclampsia</p>	
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							(RR, 1.14; 95% CI, 0.24–5.45) and labour induction (RR 1.17; 95% CI, 0.90–1.51), in the intervention arm	
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#	Code	Author, year, location	Title of the study	Aims	Study design/ Methods	Study sample/ size	Findings	Strength & Limitations
31.	GDM screening	Horvath et al. 2010	Effects of treatment in women with gestational diabetes mellitus: systematic review and meta-analysis	to assess the effects of specific interventions for gestational diabetes on the risk of pregnancy, perinatal, and long term complications in pregnant women with carbohydrate	Systematic review	Pool A: 5 Randomised controlled trials, 2999 Pool B: 14 articles on screening and treatment	-A pregnancy outcome complication such as shoulder dystocia is significantly reduced for women who diagnosed and treated for GDM. -There is a significant reduction of macrosomic babies for well treated GDM women. -GDM women who received treatment reported low maternal and fetal complications.	The results cannot be generalised because the literature studied from North America, Europe, and Australia and non-included from Asia or Africa.

				intolerance identified by a glucose tolerance test.				
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Cross-sectional studies

#	Code	Author, year, location	Title of the study	Aims	Study design/ Methods	Study sample/ size	Findings	Strength & Limitations
32.	Implementation of EBP	Ammouri et al. (2014) Oman	Evidence-Based Practice Knowledge, attitudes, practice, and perceived barriers among nurses in Oman	To describe nurses' practices, attitudes, knowledge/skills, and perceived barriers in relation to evidence-based practice (EBP) in Oman	Descriptive and cross-sectional design using self-report questionnaires. Questionnaires were distributed to participants in four major governmental hospitals. Between February 2012 and November 2012.	responses were received from 414 (69.0%) participants. power analysis using regression analysis was conducted.	Most of the participants (89.6%) were female. Of the participants, 47% were Indian, 31.4% were Omani, 13.3% were Filipino and 8.3% were of another nationality. Nursing diploma was the highest level of professional education for 267 (65.4%) of the participants, while 141 (34.6%) held a baccalaureate degree in nursing. Nurses' attitude	The study findings could be used with caution because it was conducted by a self-reporting questionnaire that considered as one of the limitations as healthcare providers may provide a socially desirable answer. The sample is considered representative as

						<p>regarding EBP had the highest mean score (6.63 ± 1.18) followed by the knowledge/skills subscale (4.97 ± 0.86) and then the practice subscale (4.92 ± 1.25).</p> <p>For the practice subscale, the two most frequently reported practices were sharing information with colleagues (5.68 ± 1.46) and evaluating the outcomes of their practice (5.45 ± 1.52).</p> <p>On the attitude's subscale, the top two attitudes among the nurses were that EBP was fundamental to professional practice</p>	<p>the researchers were able to achieve (69%) which is the appropriate response rate based on sample size calculation</p> <p>The participants were nurses.</p> <p>working on all three shifts in the participating that would enable answering the research questions and achieve its aim.</p> <p>The findings of this study were consistent with findings of other studies. Some of</p>
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							<p>(6.14 ± 1.37) and that nurses welcomed questions on their practice (5.82 ± 1.46).</p> <p>The top two items among the nurses for the knowledge/skills subscale were the sharing of ideas and information to colleagues (5.68 ± 1.08) and the ability to review their own practice (5.44 ± 1.10).</p> <p>The barriers that faced by nurses in implementing EBP were the difficulty in finding research reports (3.85 ± 0.92) and insufficient time to find research reports (3.51 ± 0.97).</p>	<p>the findings could be applied in PHC setting with caution. The study validity increased with the use of Developing Evidence Based Practice Questionnaire and the positive response rate.</p>
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							<p>The lowest scored barriers were not knowing how to find and difficulty in finding organisational information, e.g., guidelines of protocols (3.13 ± 1.07 and 3.15 ± 1.02, respectively).</p> <p>Insufficient resources to change practice (3.64 ± 0.99) and insufficient time at work to implement changes in practice (3.53 ± 0.97) were identified as the two greatest barriers to changing practice. The least significant barrier to changing practice was a lack of confidence about beginning to</p>	
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							<p>change practices (3.07 ± 0.85).</p> <p>Nurses who had more years of experience reported more frequent use of EBP ($\beta = 0.170$; $P < 0.01$), more positive attitudes towards EBP ($\beta = 0.197$; $P < 0.001$) and fewer barriers to finding and reviewing research ($\beta = -0.162$; $P < 0.01$). Meanwhile, nurses with baccalaureate degrees in nursing reported fewer barriers to finding and reviewing research than nurses with diplomas only ($\beta = -0.198$; $P < 0.001$).</p>	
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#	Code	Author, year, location	Title of the study	Aims	Study design/ Methods	Study sample/ size	Findings	Strength & Limitations
33.	Importan t of health issue	Chitme et al. (2016) Oman	Risk Factors and Plasma Glucose Profile of Gestational Diabetes in Omani Women	To identify the risk factors of GDM and the extent of their association with the incidence of GDM compared to the normal control group.	cross-sectional case-control study using pregnant women diagnosed with GDM. Study was carried out from February to July 2015. Data collected through: Face to face interview Retrospective chart review of GDM cases	A total of 591 women enrolled in the study. 291 were diagnosed with GDM and made up the case group and 300 women without GDM made up the control group.	a significant relationship between GDM and a family history (p< 0.001). The odd ratio of patient having a mother with diabetes was 1.2 (CI 0.6-1.9), and father was 1.0 (CI 0.3-1.7). Almost 84% of patients with GDM in the study had a family history of GDM compared to 16% of low-risk cases. A higher number of pregnancies was associated with a higher number of successful deliveries.	Method of the study was not clear as it was stated in the abstract “a cross- sectional case- control study” but in the method section details it was stated “a multicentre systematic randomized case-control study”. there was paucity in the studies that measured the risk factors and

						<p>A significant ($p < 0.010$) relationship with a likelihood ratio of 52.6 and linear-by-linear association of 32.9.</p> <p>The risk of developing GDM was relatively higher in women with a history of ≥ 3 live births.</p> <p>A significantly higher level of plasma glucose was found in women with GDM cases compared to women in the control group. The mean fasting plasma glucose level with GDM women was 5.7 mmol/l ($p < 0.050$) and 5.3 mmol/l in the control group.</p>	glucose profile related to the disorder in Oman.
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#	Code	Author, year, location	Title of the study	Aims	Study design/ Methods	Study sample/ size	Findings	Strength & Limitations
							Random plasma glucose, two hours OGTT ($p < 0.001$), and two hours postprandial glucose ($p < 0.001$) were significantly higher compared to the control group.	
34.	Knowledge and attitude of healthcare professionals towards	Albarrak et al. 2013 UAE	Evaluating factors affecting the implementation of evidence based medicine in	To assess the current evidence based medicine (EBM) knowledge, attitude, and perceptions of physicians at Dubai Primary	Cross-sectional study	88 participants (48 physicians responded to questionnaires and 13 physicians were interviewed)	The physicians who attended EBM courses reported 70.30% using EBM and showed statistical significance ($p = 0.002$) from those who did not attend the EBM courses. 65.0% believe that 50–75% of the patients can participate in clinical decision while 71.8% disagreed that the concept of EBM is not applicable to their culture, they showed significance ($p = 0.03$) between physician	The study was conducted in the summer where majority of physicians were on annual leave. The available physicians gave excuses the lack

	EBM		primary healthcare centres in Dubai	Health Care Sector (PHCS). Further to evaluate barrier and facilitator factors toward implementing the EBM practice.			beliefs with regard to patient capacity to take decisions. About 67.0% of the family physicians were knowledgeable and followed systematic review as the strongest evidence. * They had no access to the EBM resources (37.0%) and had no time to practice	of time for interviews.
#	Code	Author, year, location	Title of the study	Aims	Study design/ Methods	Study sample/ size	Findings	Strength & Limitations
35.	Tests that the population find acceptable	Gayet-Ageron et al. (2008) France	Specific information about the WHO guidelines for	To evaluate the impact of specific information on World Health Organization	Non-randomised interventional control trials. 'Before the implementation of the WHO guidelines' (period I) in April–October 1999, and 'after the	A total of 664 pregnant women were participated in the study. (333 pregnant women in period one and	The proportion of women who were screened significantly increased between period I and period two (0.9% in period I, 59.1% in period two, P < 0.0001). *The screening test was realized in accordance with guidelines for 80% of women in period two.	Strengths: The acceptance of the WHO screening by patients was evaluated by using a questionnaire that was distributed at days 1–2 after

	ble		gestational diabetes screening improves clinical practices	(WHO) guidelines for gestational diabetes mellitus (GDM) screening on clinical practices and to estimate its acceptance by women.	implementation of the WHO guidelines' (period II) in April– October 2001. Data were collected retrospectively from medical charts.	345 in period two).	*The acceptability of the test by women was estimated at 98%. Furthermore, 90% of them would accept to be screened again during another pregnancy.	delivery. The HCPs accepted the WHO guidelines and modified their practices after the implementation of these guidelines. <u>Comments:</u> The adherence to GDM guidelines was assessed among the women and not the
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								healthcare professionals.
36.	Compliance to GDM guidelines	Ruengkachorn et al. 2006 Thailand	Non-Compliance to Clinical Practice Guideline for Screening of Gestational Diabetes Mellitus in Siriraj Hospital	To evaluate the rate of non-compliance to Clinical Practice Guideline (CPG) for screening of Gestational Diabetes Mellitus (GDM) and related factors in Siriraj Hospital	descriptive cross-sectional study	One-hundred-and-fifty-nine pregnant women with at least one clinical risk factor for GDM. The exclusion criteria were overt DM, gestational age at first ANC over 24 weeks of gestation, and received antenatal care by physicians who do not work.	The rate of non-compliance to GPG for screening of GDM at Siriraj Hospital was 22% (95%CI 16.3%-29.1%). *The rate was highest among women who had Ante-Natal Care (ANC) at a private clinic (82.1%), followed by the private cases in the hospital (40%). Those who received ANC at the hospital had the lowest non-compliance rate of 6.6%. The most common neglected risk factor was maternal age > 30 years. Significant higher	Authors put an assumption for non-compliance to clinical guidelines is the negligence of the physicians. However, it was not explained in detail neither were proved with evidence.

						at Siriraj Hospital.	compliance was found among women with 2 or more clinical risk factors compared to those with only 1 risk factor (p = 0.028).	
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An audit:

#	Code	Author, year, location	Title of the study	Aims	Study design/ Methods	Study sample/ size	Findings	Strength & Limitations
37.	Compliance to GDM guidelines	Moses et al. (2003) Australia	Gestational diabetes mellitus: Compliance with testing	To determine the proportion of women being tested for GDM to determine	An audit	1648 births that were considered at the three hospitals over the 6-month period. 7 women with	Of these 130 women, 45 presented late and effectively had no prenatal care, 21	The adherence to GDM guidelines among

				how effective a policy of universal screening could be.		diagnosed type 1 and type 2 diabetes mellitus were excluded. Women who were tested for GDM (n = 1518). [Either they had a GTT (n = 1502) or a negative glucose challenge test (GCT) (n = 16)].	refused to have a test and eight women delivered their babies before a test could be arranged. The high compliance with testing by all obstetric care providers is a pleasing outcome.	healthcare providers was not assessed. No consensus in GDM screening
#	Code	Author, year, location	Title of the study	Aims	Study design/ Methods	Study sample/ size	Findings	Strength & Limitations
38.	Cost effectiveness	Jacklin et al. (2017)	A cost-effectiveness comparison of the NICE 2015 and WHO 2013 diagnostic criteria	To compare the cost-effectiveness (CE) of the National Institute for	A decision analytical framework	6221 patients from four of the Hyper glycaemia and Adverse Pregnancy Outcomes (HAPO) study centres (two UK, two	In a population of pregnant women from the four HAPO study centres and using NICE-defined risk factors for GDM, diagnosing GDM	The methodology was not clearly stated but the

			for women with gestational diabetes with and without risk factors	Health and Care Excellence (NICE) 2015 and the WHO 2013 diagnostic thresholds for gestational diabetes mellitus (GDM).		Australian), 6308 patients from the Atlantic Diabetes in Pregnancy study and 12 755 patients from UK clinical practice.	using NICE 2015 criteria had an NMB of £239 902 (relative to no treatment) at a CE threshold of £30 000 per QALY compared with WHO 2013 criteria, which had an NMB of £186 675. NICE 2015 criteria had a 51.5% probability of being cost-effective compared with the WHO 2013 diagnostic criteria, which had a 27.6% probability of being cost-effective (no treatment had a 21.0% probability of being cost-effective). For women without	researchers. The study can be representative for the UK women with similar characteristic as the analysis showed the NICE 2015 guidelines using selective screening are more cost-effective than
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							NICE risk factors in this population, the NMBs for NICE 2015 and WHO 2013 criteria were both negative relative to no treatment and no treatment had a 78.1% probability of being cost-effective.	WHO 2013 guidelines that use universal screening.
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Appendix C Ethical approval from Cardiff University

School of Healthcare Sciences
Head of School and Dean Professor Heather
Waterman

Ysgol Gwyddorau Gofal Iechyd
Pennaeth yr Ysgol a Deon Yr Athrawes Heather Waterman



20 January 2016

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Eastgate House
13th Floor
35 – 43 Newport Road
Cardiff CF24 0AB
Tel Ffon: +44 (0)29 20 688559
Email E-bost HCAREEthics@cardiff.ac.uk

Prifysgol Caerdydd
13^{ed} Llawr
Ty Eastgate
35 – 43 Heol Casnewydd
Caerdydd CF24 0AB

Ms Aisha Al Mamari
Floor 12, Eastgate House
35 – 43 Newport Rd
CF24 0AB

Dear *Ms Al Mamari*

Expanding the midwife's role in screening for gestational diabetes in primary health care in Oman

At its meeting of *19 January 2016* the School's PGT Research Review and Ethics Committee considered your research proposal. The decision of the Committee is that your work should:

Pass –and that you proceed with your Research after discussing the reviewers' comments with your supervisor

The Committee has asked that the lead reviewers' comments be passed onto you and your supervisor, please see below.

1. Social or scientific value; scientific design and conduct of the study e.g.

- Is there evidence present in the proposal of the use of accepted scientific principles and methods, including statistical techniques, to produce reliable and valid data?
- Is the research question important and necessary?
- Is the research design and proposed qualitative or statistical analysis able to answer the question?
- Is there involvement of patients, service users, and the public, in the design, management, and undertaking the research?
- Is there a clear aim for the study?

Reviewers comments/issues for discussion

This is an important study that has the potential to improve outcomes for pregnant women and their children. The research design is appropriate, and clear aims for the research are stated. There is no evidence of the involvement of patients, service users or the public in this research.

Will the interviews be conducted in Arabic and the data translated into English? The process needs clarification.

It would be advisable for the researcher to have a second coder for analysis of the 2nd stage of the study. This will help ensure the validity of identified patterns and construct categories.

Cardiff University is a registered charity, no. 1136855
Mae Prifysgol Caerdydd yn elusen gofrestredig, rhif 1136855

2. Recruitment arrangements and access to health information and participant selection

- Does the proposal provide evidence of appropriate inclusion and exclusion of potential research participants? The benefits and risks of research should be distributed fairly among all social groups and classes, taking particular account of age, disability, gender, race, religion or belief and sexual orientation, as well as economic status and culture.
- How are research participants recruited?
- How does participation impact on their clinical care?
- Are compensation arrangements in place? Insurance (negligent/ non-negligent harm).

Reviewers comments/issues for discussion:

The research participants are 8-10 health care professionals from anti-natal clinics at 2 centres in Oman. A range of HCPs has been included to ensure the data are collected from the perspectives of different disciplines. This sample is appropriate for the purpose of the research. Potential participants will be given an information sheet about the study and if interested in being interviewed will be asked to sign a consent form. Both forms have been provided in the appendix, and contain the necessary information for informed consent.

3. Favourable risk benefit ratio; anticipated benefits/risks for research participants (present and future) e.g.

Reviewers comments/issues for discussion:

It is stated that there is no benefit or risk for the research participants. I believe it is necessary to consider how the HCPs participating in the study might perceive their involvement, e.g. it is possible that they may feel that their clinical practice/proficiency is being questioned, and they may wonder whether their current practice (if not aligned to current GDM guidelines/recommendations) may have contributed to poorer outcomes for pregnant women and their babies. It will be important to reassure them that the research is not being undertaken to assess their practice.

4 Care and protection of research participants; respect for potential and enrolled research participants' welfare & dignity. Does the proposal and accompanying participant information sheets & consent forms consider:

*permitting withdrawal from the research
*informing participants of newly discovered risks or benefits
*maintaining welfare of participants
appropriate indemnity and insurance

* protecting privacy through confidentiality
* informing participants of results of research
*what will happen at the end of the study *provision of

- Has the proposal outlined data protection & research participant's confidentiality?
- Where and how (anonymised/coded) and for how long will data be stored?
- What purpose will be served by the data?
- Who will access?
- Are research participants informed that access to their medical notes may be required?
- Have arrangements been made to deal with incidental disclosure?
- Has the Cardiff University guidance been acknowledged?

Reviewers comments/issues for discussion:

See above.

The researcher has adequately considered and addressed issues relating to confidentiality, data protection, incidental disclosure etc.

5. Informed consent process and the adequacy and completeness of research participant information e.g.

Reviewers comments/issues for discussion:

The informed consent process and participant information are appropriate and have covered all relevant issues.

The researcher's first language is not English and she will need to ensure that all documentation is adequately proof read because there are many grammatical errors. (I am assuming that the documentation will be provided to participants in Arabic? – this needs clarification).

6. Suitability of the applicant and supporting staff e.g.

Comments/issues for discussion:

The applicant and supporting staff are suitably qualified with experience in the research topic. Does the applicant work with the potential participating HCPs or has she worked with them in the past? If so, there needs to be a discussion about how this might affect the collection and interpretation of data.

7. Suitability of supporting information

E.g., interview schedules, questionnaires, lone working policies, letters of access etc.

Comments/issues for discussion:

Lone working should not be an issue but this depends on the location and venue of the interviews.

8. Other general comments.

As mentioned above, the researcher's first language is not English and although I commend her command of the English language, she will need to ensure that all documentation is adequately proof read because there are many grammatical errors.

Please note that if there are any subsequent major amendments to the project made following this approval you will be required to submit a revised proposal form. You are advised to contact me if this situation arises. In addition, in line with the University requirements, the project will be monitored on an annual basis by the Committee and an annual monitoring form will be despatched to you in approximately 11 months' time. If the project is completed before this time you should contact me to obtain a form for completion.

Please could you obtain a letter confirming that you have permission to access information from Oman and send it to HCAREEthics@cardiff.ac.uk

Please do not hesitate to contact me if you have any questions.

Yours sincerely



Mrs Liz Harmer – Griebel
Research Administration Manager

Cc: Julia Sanders, Shantini Paranjothy

Appendix D: Ethical approval from the Centre of Studies & Research MoH Oman on 21 July 2016

Sultanate of Oman
Ministry of Health
Directorate General of Planning
and Studies



سلطنة عمان
وزارة الصحة
المركزية للدراسات والبحوث
والدراسات

Ref. : MoH/DGPS/CSR/PROPOSAL_ APPROVED /24/2016

Date : 21.7.2016

الرقم :

التاريخ :

الموافق :

Aisha Al-mamari
Principal Investigator

Study Title : "Expanding the midwife's role in screening for gestational diabetes in primary health care in Oman"

After compliments

We are pleased to inform you that your research proposal "Expanding the midwife's role in screening for gestational diabetes in primary health care in Oman " has been approved by Research and Ethical Review & Approve Committee, Ministry of Health.

Regards,



Dr. Ahmed Mohamed Al Qasmi
Director General of Planning and Studies
Chairman, Research and Ethical Review and Approve Committee
Ministry of Health, Sultanate of Oman.

Cc
Day file

Appendix E: A request letter to the Director of DGHS

Date: 25/07/2016

To: Director of Directorate of Muscat Governorate

CC: Superintendent of Medical officers at DGHS
Superintendent of Nursing at DGHS

RE: Permission to Conduct Research Study

Dear Madam,

I am writing a request for permission to conduct a research study at your institution. My name is Aisha Salim Al-Mamari. I am currently undertaken a Doctorate in Nursing Philosophy (PhD) course at Cardiff University in Wales (UK), and I am in the process of writing my PhD Thesis. The title of the study is "**Expanding the midwife's role in screening for gestational diabetes in primary health care in Oman**". The aims of the study are to determine the current implementation of the GDM guidelines in primary health care institution, and to develop a midwifery service model for the screening, and diagnosis of pregnant women with gestational diabetes mellitus in Oman. The study has three phases: phase 1, A cross sectional **quantitative** survey of current practice in screening and diagnosis of GDM will be collected from two health centres in Muscat governorate by using convenience sampling. The sample for this study will be all women who booked for ANC in [REDACTED] for a period from (January 2014 to December 2014). This will be followed by a **qualitative study** to reveal the current practice of the health care providers in screening of GDM and implementation of GDM guidelines. Qualitative interviews with health professionals will be conducted to explore current practices and the development of an educational package to address identified weaknesses in the current system. Eight to 10 health care providers, both Omani and non-Omani, will be interviewed including a staff nurse, midwife, medical practitioner, Nurse-in-Charge, and medical officer-in-charge. My supervisors, who will guide me throughout the coming three years, [REDACTED]

The Interviews will be undertaken in a Seminar room or other quiet setting on your organisation, hoping to get your permission and co-operation to reserve a room to undertake the interview in June/ July 2016. The interview process should take no longer than (30 – 60 minutes). Participants are expected to undertake interview on their day off to avoid work interruption and commitment. No costs will be incurred by either your organisation or the individual participants.

Your approval to conduct this study will be greatly appreciated. I will follow up with a telephone call after one week and would be happy to answer any questions or concerns that you may have at that time. You may contact me at my email address: [REDACTED] or contact me in this telephone number [REDACTED]. If you agree, kindly submit a signed letter of permission on your institution's letterhead acknowledging your consent and permission for me to conduct this study at your institution.

Sincerely,

Name of Researcher:

Aisha Salim Al-Mamari

Signature: [REDACTED]

Enclosures

Appendix F: A health data request form



Department of Planning
Directorate General of Planning
Ministry of Health, Sultanate of Oman

Name: Aisha Salim Al-Mamari

Staff No: [REDACTED]

Designation: Tutor/PhD student

Department: Directorate of Education and Training

Section: Nursing

Contact phone No; [REDACTED]

e-mail id: [REDACTED]

Health Information Data request form

1. Data request Information
2. Which level requested report is required?

(Report will be provided at the lowest level if more than one level is selected)

Governorate level	Wilayat level	Institution level	yes	Hospital	EHC	Hospital & EHC	PHC	yes
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In case of school health reports, if you need the report for particular schools, please mention the name of the schools.

3. **Year & month data required:** Year from 1ST January 2014 to 31ST December 2014,
(For school health reports, please mention the academic year)

1. Data required (please tick the report you needed)

1	OPD visits		24	EYE morbidity report (hospital/EHC)		47	Outpatient deaths report
2	OPD visits (Working days)		25	Mental health report (Total visits)		48	Inpatient morbidity report for hospital deaths
3	OPD visits (weekend days)		26	Mental health report (New cases)		49	Inpatient morbidity report of discharge patients (hospital)
4	Total OPD visits month wise		27	Rehabilitation report (EHC)		50	Inpatient morbidity of discharge report (hospital)_Male
5	Total OPD visits day wise		28	STI report (hospital/EHC)		51	Inpatient morbidity of discharge report (hospital)_Female
6	Total OPD visit hourly basis		29	Diabetes -new cases		52	Number of hospital admissions
7	OPD Morbidity (New cases)		30	Diabetes -new cases_Omani		53	Number of hospital discharges
8	OPD Morbidity_new cases (Male)		31	Diabetes -new cases_ non omani		54	Number of hospital deaths
9	OPD Morbidity -new cases (Female)		32	Diabetes -new cases		55	Bed occupancy rate
10	OPD morbidity external causes		33	ANE clinic death report		56	Mean length of hospital stay by discharged patients
11	OPD morbidity external causes		34	Brought death report		57	School health Appraisal report
12	OPD morbidity external causes (male)		35	Child nutrition report		58	School health EAR report
13	OPD morbidity external causes (Female)		36	Nutrition clinic visits report		59	School health EYE report
14	Dental Morbidity		37	Child immunization report (EPI)		60	School health Dental report
15	Dental Morbidity (Male)		38	Diagnostic radiological procedure report		61	School health environmental report
16	Dental Morbidity (Female)		39	Laboratory procedures report		62	OPD visits -Private health establishment
17	Dental Management		40	Hospital delivery report		63	Number of schools as per INFO BANK database
18	Dental Management (Male)		41	Antenatal & Post natal report		64	Number of private health estab. as per INFO BANK database
19	Dental Management (Female)		42	ANC register survey report	yes	65	Total midyear population of Muscat Governorate
20	Non communicable disease screening \geq 40yrs)		43	Infertility report		66	Age wise midyear population of Muscat Governorate
21	EAR Health care (PHC level)		44	Birthspacing -First visits		67	Total midyear population of Wilayat
22	EYE Healthcare (PHC level)		45	Birthspacing -Revisits		68	Quarterly report on Manpower
23	EAR morbidity report		46	Maternity report		69	Number of MOH health institutions in Muscat Governorate

2. Please indicate in which format you need the report: PDF format/ Print out.

6. Please mention briefly aim in seeking the report.

The request is to get the accurate number of all booked pregnant women to antenatal clinic in [REDACTED] and [REDACTED] from 1st January 2014 to 31st December 2014. The purpose is to fulfil the requirement of the undertaken PhD study at Cardiff University. The aims of the study are to determine the current implementation of the GDM guidelines in PHC and to develop a midwifery service model for the screening, and diagnosis of women with gestational diabetes mellitus in Oman.

Thank you.

Signature of the requester [REDACTED]
Muscat

Director of the department/Wilayat

Note: Please send your request to Director of Planning, Department of planning, DGHS, Muscat or e-mail to mct-he-info@moh.gov.om and a copy of request to mct-sh-his@moh.gov.om. Any request without endorsement from the Director won't be reviewed for the feasibility of the report.

Appendix G: Sociodemographic characteristics of the women

	Variables	Statistical test
Socio-demographic characteristics	Age (in years)	Descriptive analysis Ratio data: Mean, standard deviation (SD) and range
	Nationality: Omani Non-Omani	Nominal (categorical) data: Number and percentage
	Religion: Muslim Non-Muslim	Nominal (categorical) data: Number and percentage
	Educational level: Primary Secondary Advanced	Nominal (categorical) data: Number and percentage
	BMI at booking	Interval data: Mean, standard deviation (SD) and range
	Family history: first relative (father, mother with history of diabetes)	Nominal (categorical) data: Number and percentage
	Gravida: Number of pregnancies	Ratio data: Number and percentages of women who have had 1 pregnancy or more
	Para: Number of previous births	Ratio data: Number and percentages of women who have had 1 previous birth or more
	Previous birth outcomes: Macrosomic (> 4000 grams) previous stillbirth previous neonatal death	Nominal (categorical) data: Number and percentage

	Previous GDM	Nominal (categorical)data: Number and percentage
	Number of gestational weeks at booking	Ratio data: Number and percentage
	Variables	Statistical test
	Type of current pregnancy: Singleton Multiple	Nominal (categorical)data: Number and percentage
	Gestational age at birth for the current pregnancy	Interval data: Number and percentage
Clinical features	Urine analysis at registration: Sugar Ketone Albumin	Category data: Number and percentage
	Blood glucose tests: Oral Glucose Tolerance Test (OGTT): Fasting blood sugar (FBS) Post prandial Oral Glucose Challenging Test (OGCT) at 22-24 weeks of gestation	Category data: Number and percentage

Appendix H : Consent form

Respondent Code:

Title of the study: Expanding the midwife’s role in screening for gestational diabetes in primary health care in Oman.

Name of the researcher: Aisha Salim Al-Mamari

Please read each section carefully before you initial each box.

I confirm that I have read and understand the participant information sheet for the above study. I have had the opportunity to consider the information and ask questions, and those questions have been answered satisfactorily.	<input type="checkbox"/>
I understand that my participation is voluntary and that I am free to stop the recording at any time during the interview and am free to withdraw at any time without providing a reason.	<input type="checkbox"/>
I agree to be interviewed by the researcher and to the use of audio recording. I understand that verbatim responses from my interview may be used anonymously in the report produced from this study, in papers produced for publication, and for conference presentations. However, I can withdraw any part of the material I have provided at any time prior to the publishing of the report.	<input type="checkbox"/>
I understand that if, during the interview, information is disclosed that may put me or others at risk, the appropriate health care team will be informed.	<input type="checkbox"/>
I understand that the research governance staff working at Cardiff University may review the data collected during the study for the purpose of monitoring and auditing the conduct of the research. I give my permission for this to occur.	<input type="checkbox"/>
I understand that data collected will not be transferred to any other organisation.	<input type="checkbox"/>
I agree to take part in the above study.	<input type="checkbox"/>

Declaration by participant:

I hereby consent to take part in this study:

Name of Participant: ----- **Date:** ----- **Signature:** -----

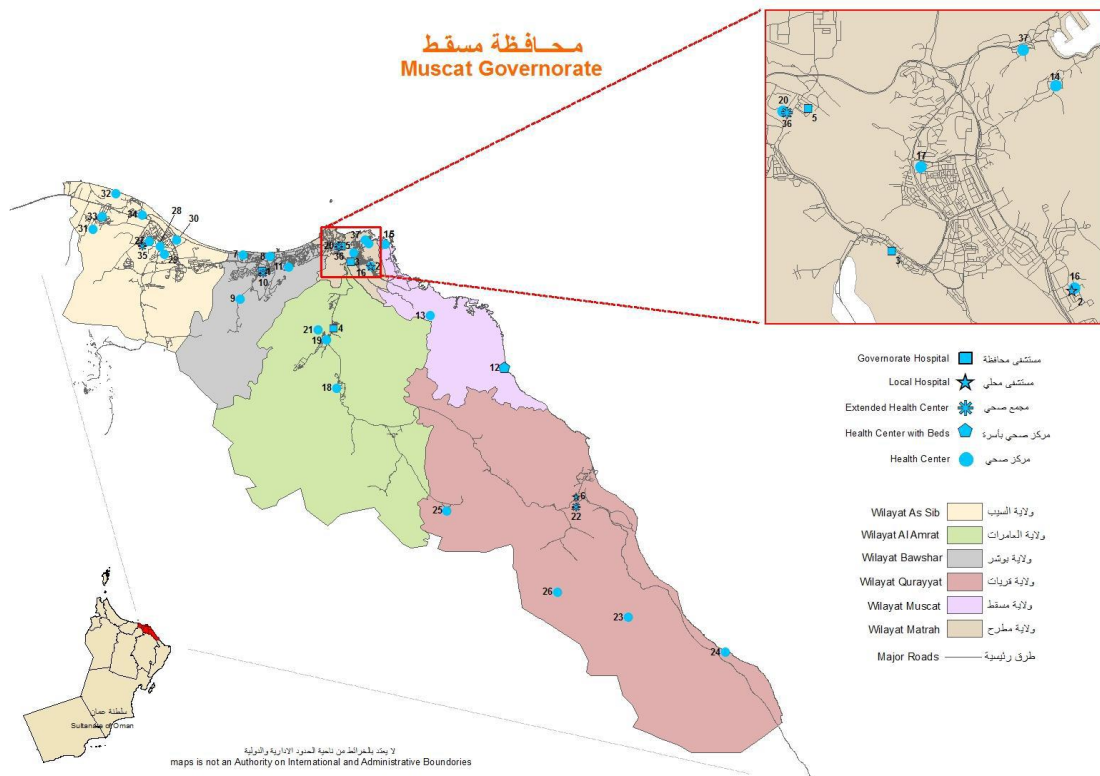
Declaration from the researcher:

I have given a verbal explanation of the research project to the participant and have answered the participant’s questions about the research project. I believe that the participant understands the study and has given informed consent to participate.

Name of Researcher: ----- **Date:** ----- **Signature:** -----

When completed, place one copy in the site file and give one copy to the participant.

Appendix I: A map of Muscat



Appendix J: Research flyer



Expanding the midwife's role in screening for GESTATIONAL DIABETIS in primary health care in Oman

Researcher: Aisha Salim Al-Mamari, PhD student, Cardiff University

Aims:
determine the current implementation of the GDM guidelines in PHC institutions (health centres)
develop a midwifery service model for the screening and diagnosis of pregnant women with GDM in Oman

Study Outcomes and Impact

The study provides an understanding of the processes that nurses, midwives, and medical practitioners are using in their current implementation of the guidelines. It will support the midwife services in the ANC by developing a midwifery service model that includes an educational package to contribute to the reduction of GDM cases in Oman.

Why are you invited?

You have been invited to take part in this study because we believed that your experiences as a nurse, midwife, medical practitioner and administrator can contribute to understanding of how GDM is diagnosed in women.

What is your role as a participant?

after signing the consent form, you will be interviewed. during interview, you will be asked to share your experiences in caring for women with GDM. what extent you have practice implementing the current GDM guidelines in your clinic. the interview will take place in August 2016 and will last from 30 to 60 minutes and be audio recorded for the purpose of data analysis. if you are willing to take part in this study please contact me on e mail [redacted] or mobile [redacted]

What are the possible benefits of taking part in the study?
there is a general benefits associated with increased knowledge and your participation will contribute to improving the quality of screening for gestational diabetes in the clinic.

Will my taking part in this study be kept confidential?
Yes, I will follow the ethical and legal practice guidance of Cardiff University and all the information about you will be handled in confidence. Your identity and the identity of your organisation will be anonymised in my thesis as well as in any presentations or publications. As a health professional, all the information about you and the audio recording will be handled in confidence.



Appendix K: Participant Information Sheet

Research Title: Expanding the midwife's role in screening for gestational diabetes in primary health care in Oman.

Introduction:

The purpose of this study is to describe the current implementation of the gestational diabetes mellitus (GDM) guidelines in primary health care institutions and to develop a midwifery service model for the screening and diagnosis of pregnant women with GDM in Oman. The research objectives include the following:

- to state the epidemiology of obesity and GDM, both globally and in Oman
- to explore the current practice in the screening and diagnosis of pregnant women for GDM
- to compare current practice in Oman with the evidenced based best practices
- to explore the implementation challenges of the current GDM guidelines in Oman
- to develop new service models that enable nurses/ midwives to screen for GDM and that assist with the early diagnosis of pregnant women with GDM.

Dear Sir or Madam,

I am Aisha Salim Al-Mamari, and I work in the Ministry of Health as the head of the midwifery programme at the Oman Specialized Nursing Institute (OSNI). I am currently pursuing a doctorate in nursing philosophy (PhD) at Cardiff University in Wales, the United Kingdom. I am in my second year and in the process of writing my thesis. I would like to give you information about my research and invite you to take part in a study designed to explore your experiences and understanding in screening pregnant women for gestational diabetes mellitus (GDM) in antenatal clinics. At this time, you do not need to decide whether you will participate in the study, but you are invited to read the information below, which should take less than five minutes. It is very important that you understand why the research is being conducted, and what your involvement would be, before you decide about your participation. Please do not hesitate to contact me by e-mail ([REDACTED]) or by telephone (mobile number [REDACTED]) if anything is not clear or if you have further questions.

Thank you for reading this.

1. What is the purpose of the interview?

The prevalence of gestational diabetes in Oman has increased from 5.7% in 2013 to 7.2% in 2014. There is a clear need to ensure early diagnosis and appropriate management of care for these women to avoid adverse pregnancy outcomes. The purpose of the interview is to explore with staff current practices, perceived facilitators, and barriers in screening for GDM in primary health care institutions in Muscat governorate.

2. Why have I been invited?

You have been invited to take part in this study because I believe that your experiences as a nurse, midwife, or medical practitioner can contribute to an understanding of how GDM is diagnosed in women. If you are a nurse-in-charge or medical officer-in-charge, your experience, knowledge, and understanding of health practice decision making are very important to my research.

3. Do I have to take part?

No, it is entirely up to you if you want to be interviewed and audio recorded. Even if you agree initially, but feel uncomfortable about continuing during the interview, you can ask me to stop recording and I will delete the conversation. You are free to withdraw at any time during the study without proving a reason. Furthermore, if you decide after the interview that you no longer want to participate, you can contact me, and I will delete the interview recording.

4. What will I do as a study participant?

If you agree to be involved in this study, please fill in the consent form and sign it. During the interview, you will talk about your experiences caring for women with GDM and to what extent you have practiced implementing the current GDM guidelines in your clinic. The interview, which will take place in either July or August of 2016, will last from 30 to 60 minutes and be audio recorded for the purpose of data analysis. If you are willing to take part in this study, please contact me to arrange an interview location that is convenient for you.

5. What will happen to the recording?

I will listen to the recordings and write down exactly what was said word for word. No names will be written down and all the information will be kept confidential. This information will be stored securely in a computer and protected by a password. All printed papers print will be kept in a locked file cabinet at Cardiff University.

6. Are there any possible disadvantages or risks associated with taking part in the study?

There are no disadvantages or risks associated with the research. If you feel uncomfortable during the interview with a particular question and do not wish to answer, I will move on to the next question. If you do not want to answer any more questions, you can ask me to stop the interview and, if you wish, delete the recording.

7. What are the possible benefits of taking part in the study?

While there are no personal benefits, there is a general benefit associated with increased knowledge and your participation may contribute to improving the quality of screening for gestational diabetes mellitus in your clinic.

8. What if I have concerns about the study?

If you are concerned about any aspect of this study, you should call the chairperson of the ethics committee in Oman at [Tel. Number to be confirmed].

9. Will my taking part in this study be kept confidential?

Yes, I will follow the ethical and legal practice guidance of Cardiff University and all the information about you will be handled in confidence. Your identity and the identity of your organisation will be anonymised in my thesis as well as in any presentations or publications. However, if unsafe practices occur during the interview, as a health care professional, I must adhere to the Omani nursing code of conduct rules and regulations as well as the unit policies regarding different types of unsafe practice. I will also be adhering to the UK nursing and midwifery council code of conduct. As a health professional, all the information about you and the audio recording will be handled in confidence. Audio files will be retained on an external drive kept in a locked cupboard in a locked room for fifteen years. Cardiff University will archive the files for fifteen years and then destroy them. If you wish to have a copy of the transcription, please let me know.

10. What will happen to the results of the research study?

The findings will be available for future studies related GDM screening and diagnosis and will be published in professional journals and magazines over the next few years. If you wish to have a copy of the results, one can be sent to you when they are available.

11. Who is organising and funding the research?

This study is funded by Ministry of Health in Oman.

12. Who has reviewed the study?

The School of Health Sciences Research Screening and Ethical Review Committee in Cardiff, Wales, and the Ministry of Health Research Ethical Committee in Oman have reviewed the study to protect your safety, rights, wellbeing, and dignity.

Thank you for reading this information sheet. Please keep it, and if you have questions about the study, feel free to contact me for further information.

My contact details:

Aisha Salim Rashid Al-Mamari

PhD Student Cardiff University

Cardiff/ Eastgate House Campus

35-43 Newport Road

CF24 0AB, Cardiff, United Kingdom

UK Mobile Number [REDACTED]

Omani Mobile Number: [REDACTED]

E-mail address: [REDACTED]

Or

My supervisors' contact details:

Dr. Julia Sanders

Reader & Consultant Midwife

School of Healthcare Sciences

[REDACTED]

[REDACTED]

[REDACTED]

Tel: [REDACTED]

E-mail address: [REDACTED]

Thank you.

Appendix L: Semi-Structured Interview Guide

Title of the study: Expanding the midwife's role in screening for gestational diabetes in primary health care in Oman.

Semi-Structured Interview Guide for Healthcare Professionals:

1. Self-introductory questions:

- What are your qualifications?
- How long have you had your qualifications?
- How long have you worked in an ANC?

2. Questions about knowledge of GDM guidelines:

- Did you read the recent GDM guidelines?

If yes, what did you understand from it?

If no,

- Did you liaise with any health care providers to answer your queries?

If yes,

- Who did you ask? (THE PERSON'S NAME IS NOT NEEDED)

Please state the department or a job title of the person.

- What were the information you received from her/him?

3. Questions about experience with the new GDM guidelines:

- What is the type of women who screened for GDM?
- At what stage of pregnancy do you screen for GDM?
- What method do you used for screening?
 - Is it clinical, laboratory, or both?
 - If laboratory screening, which test do you use to screen for GDM?
 - Who is performing the test?
 - What diagnostic method do you use?
 - Is it a 75 gram or 100 gram glucose tolerance test?
 - Is there anything you would have liked included in the guidelines for early diagnosis of GDM?

Each interview is anticipated to take between 30 minutes and one hour.

Appendix M: A scanned shot initial coding for interview in PHC2.

Participant: the role of antenatal clinic she is welcoming women first time and (aaaaa)
(silence)

Me: she is in the separate room or...

Participant: yes. there is in a separate room for antenatal ... doctor she is sitting with the staff ... everything for the antenatal... they are doing in that room only.... Yah . nobody is entering here and there ... like privacy... ok. and when the woman come ... she is opening her a card for a first time giving the ANC number doing the registration. Taking history if there is any (yani) if she is primi or multi and she is fill that card... part of the card. The data of the patient until that (yani) after that she will give to the doctor then she will enter the computer later. the vital signs of the lady...

Me: right. ok in terms of the women who are at risk specially with diabetes is there a special procedure you are doing or what exactly you are doing for such women who are at risk for diabetes...

Participant: the woman who is at risk they are doing special investigations for her like random blood sugar. will see if it is (yani) from... will do first fasting blood sugar if it is high they will give appointment for GTT and after that if it is high will refer to the specialist clinic |

AA Aisha Al-Mamari
Doctor and the staff nurse are sitting in one room called antenatal clinic

AA Aisha Al-Mamari
In this room will be history taking. and register the woman in antenatal register and refer to the doctor for computer entry and examination.

AA Aisha Al-Mamari
Any woman who is suspected to get diabetes in pregnancy will do fasting blood sugar (FBS) and if it is high will be given appointment for GTT then if it is still high will be referred to Wattaya polyclinic.

<p>3. Can you please describe the ANC and what is the role of the nurse in the antenatal clinic?</p>	<p>the role of antenatal clinic she is welcoming women first time and there is in a separate room for antenatal ... doctor she is sitting with the staff ... everything for the antenatal ... they are doing in that room only.... Yah... nobody is entering here and there ... like privacy... ok... and when the woman come ... she is opening her a card for a first time giving the ANC number doing the registration. Taking history if there is any (yani) if she is primi or multi and she is fill that card ... part of the card. The data of the patient until that (yani) after that she will give to the doctor then she will enter the computer later... the vital signs of the lady...</p>	<p>Doctor and the staff nurse are sitting in one room called antenatal clinic (Team work)</p> <p>In this room will be history taking, and register the woman in antenatal register and refer to the doctor for computer entry and examination (Privacy, confidentiality, maintain records)</p>
<p>4. A. in terms of the women who are at risk specially with diabetes is there a special procedure you are doing or what exactly you are doing for such women who are at risk for diabetes...</p>	<p>the woman who is at risk they are doing special investigations for her like random blood sugar... will see if it is (yani) from... will do first fasting blood sugar if it is high they will give appointment for GTT and after that if it is high will refer to the tertiary health institution</p>	<p>Any woman who is suspected to get diabetes in pregnancy will do FBS (practicing 2015 GDM screening guidelines) and if FBS result was high will be given appointment for GTT (this is line to the 2015 GDM guidelines) then if it is still high will be referred to tertiary health institution (continuation of care by specialist)</p>

Appendix N: Concept map of the face-to-face interview themes

Interview one mind map:



Appendix (N): Critique of a Randomised control trial

Risk of bias for Crowther et al. (2005): effects of treatment of gestational diabetes mellitus on pregnancy outcomes.

Bias	Author's judgment	Support for judgment
Random sequence generation (selection bias)	Low risk	Computer-generated randomisation list, block size 6,8, and 10
Allocation concealment (selection bias)	Low risk	Adequate allocation concealment
Blinding (performance bias and detection bias) All outcomes	High risk	The study maintained blinding Women (routine group) as well as healthcare professionals were not aware about the GDM diagnosis, so no treatment provided
Incomplete outcome data (Attrition bias) All outcomes	Low risk	No loss to follow up
Selective reporting (reporting bias)	Low risk	Enrolment and outcomes charts were included
Other bias	Low risk	No indication from other bias

Appendix (O): Critique of a Randomised control trial

Risk of bias for Landon et al. (2009): A multicentre, randomised control trial of treatment of gestational diabetes mellitus outcomes.

Bias	Author's judgment	Support for judgment
Random sequence generation (selection bias)	Low risk	Women who met the criteria were randomly assigned using the urn method
Allocation concealment (selection bias)	Low risk	Adequate allocation concealment
Blinding (performance bias and detection bias) All outcomes	Low risk	The study maintained blinding
Incomplete outcome data (Attrition bias) All outcomes	Low risk	No loss to follow up
Selective reporting (reporting bias)	Low risk	Screening, Enrolment, Random Assignment, and follow up of the study participants chart provided.
Other bias	Low risk	No indication from other bias