A study on Type 2 Diabetes Mellitus in Abu Dhabi, UAE: prevalence, risk factors & quality of management

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Abstract

Background

The prevalence of diabetes, chiefly type 2 (T2DM), is particularly high in the United Arab Emirates (UAE). Effective management of the disorder and its co-morbidities is needed; however quality of T2DM care is variable and suboptimal worldwide. In the UAE, few studies have been undertaken to systematically review the prevalence of T2DM and its risk factors and any changes in these trends overtime. Also, studies on the quality of T2DM care and factors influencing it are lacking.

Aim

To examine the quality of care provided to people with T2DM in Abu Dhabi, particularly Al-Ain, and identify factors influencing it.

Methods

This was a multi-method study involving systematic reviews, and quantitative and qualitative approaches. Quantitative data were collected from a random sample of medical records of people with T2DM to assess the quality of T2DM care and improvement overtime and investigate any differences in the care provided to different age groups and genders. The qualitative method includes semi-structured interviews with healthcare professionals to investigate factors affecting the quality of T2DM care.

Results

Findings from the quantitative study demonstrated that the care provided to people with T2DM is sub-optimal for glycaemic and blood pressure control. Better glycaemic control was more common among people aged 40 and above. However, encouraging progress with regard to intermediate outcomes of diabetes control including glycaemic and lipid between 2008 and 2010 was found among both genders. Four main themes emerged from the thematic analysis including motivation of healthcare professionals, training of healthcare professionals, team work and Emirate cultural impact on diabetes care.

Conclusion

This study has provided a picture of T2DM prevalence and risk factors for its adverse outcomes in the UAE. Findings from this study can help policy makers, managers and healthcare professionals to plan and execute better quality culturally-appropriate interventions to improve diabetes care, and reduce its burden. Strengthening the collaboration and joint planning between different health authorities in the UAE through the development of a national planning framework is highly recommended to reduce the burden of T2DM epidemic and improve the quality of its care. Also, reinforcing the role of the primary care in providing T2DM care, and strengthening the collaboration and co-ordination between the primary and secondary care settings in the UAE is required to optimize the care provided to people with T2DM.

Table of contents

List of Tables

List of Figures

Abbreviations

(ADA)	American Diabetes Association
(AHRQ)	US Agency for Healthcare Research and Quality
(BMI)	Body Mass Index
(CARDS)	Collaborate Atorvastatin Diabetes Study
(CDC)	The Centre of Disease Control and Prevention
(CI)	Confidence Intervals
(CRD)	The Centre for Reviews and Dissemination
(DBP)	Diastolic blood pressure
(DCCT)	Diabetes Control and Complications Trial
(DHA)	The Dubai Health Authority
(DM)	Diabetes mellitus
(DQIP)	The Diabetes Quality Improvement Project
(EBM)	Evidence-based medicine
(GAHS)	The General Authority of Health Services
(GCC)	Co-operation Council for the Arab States of the Gulf
(HAAD)	The Health Authority Abu Dhabi
(HbA1c)	Glycated haemoglobin
(HDL)	High density lipoprotein
(HRQOL)	Health-Related Quality of Life
(ICDC)	The Imperial College Diabetes Centre
(IDF)	International Diabetes Federation
(IFG)	Impaired fasting glucose
(IGT)	Impaired glucose tolerance
(KSA)	Kingdom of Saudi Arabia
(LDL)	Low density lipoprotein
(MODY)	Maturity onset diabetes of the young
(MOH)	The Ministry of Health
(NCD)	Non-communicable diseases
(NHS)	National Health Services
(NICE)	National Institute of Clinical Excellence
(NWPOC)	Non-weighted process of care score
(OCED)	Organization for Economic Co-operation and Development
(PDM)	Physician Decision Making
(QOF)	Quality and Outcomes Framework
(RCT)	Randomised Controlled Trials
(SBP)	Systolic blood pressure
(SD)	Standard Deviation
(SEHA)	Abu Dhabi Health Services Company
(SIGN)	Scottish Intercollegiate Guidelines Network
(TC)	Total cholesterol
(TG)	Triglycerides
(T2DM)	type 2 diabetes mellitus
(UAE)	United Arab Emirates
(UKPDS)	The UK Prospective Diabetes Study

(WHO)	World health Organization
(4vOOC)	Four-variable outcome of care score

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Statement of Contribution

The work presented in this thesis is my own but I received direction from my supervisor Professor Azeem Majeed.

Chapter 1 : Introduction

This chapter addresses the following topics: an overview of diabetes mellitus (DM); specifically type 2 diabetes mellitus (T2DM), the worldwide prevalence of T2DM, the health and economic impact of T2DM, diabetes care, the quality of T2DM care, and interventions to improve it. This overview is essential to present a solid platform in which to start the study.

1.1 DM

DM is a chronic metabolic disorder caused by defects in insulin secretion, insulin action, or both (1). This disorder is defined by the International Diabetes Federation (IDF), and the global advocate of diabetes care, as a state of raised blood glucose level (hyperglycaemia) associated with premature mortality (2-3). Similarly, DM was defined as " a clinical syndrome characterized by hyperglycaemia in the fasting state due to absolute or relative deficiency of insulin or defect in its receptors or other abnormalities" (3-5).

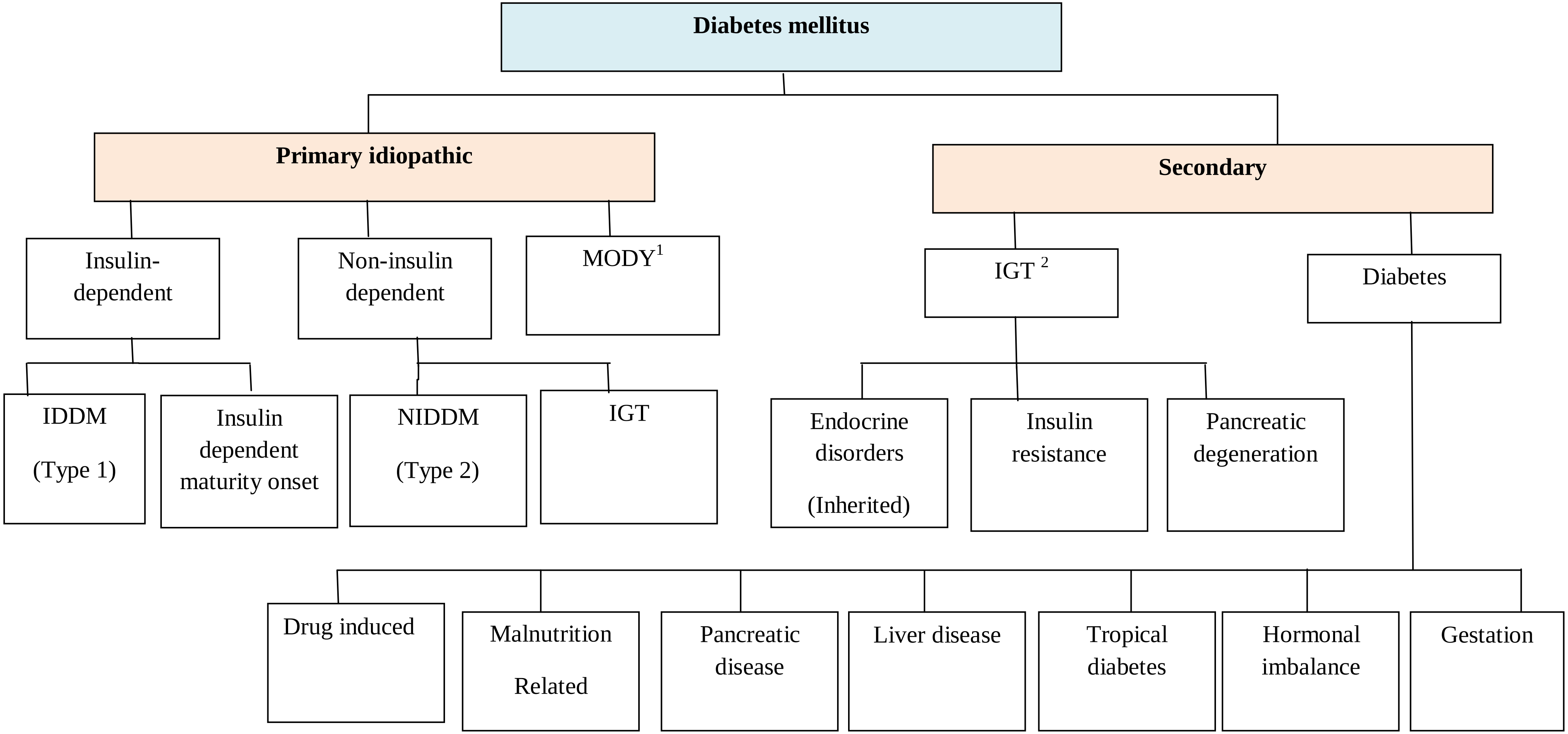
The deficiency in insulin or inefficiency of its action influence greatly almost all metabolic pathways including carbohydrate, protein, lipids, minerals and water metabolism. As a result, metabolic instabilities appear, and long-standing derangements result in structural and functional changes in the cells of the body and often cause permanent or irreversible damage (3-5). This leads to the development of various complications related to diabetes including biochemical, functional, symptomatic and morphological alterations (3, 6-9).

1.1.1 Classifications of DM

Many attempts have been made to classify diabetes; however the World health Organization (WHO) established the most accepted classification worldwide and it was originally proposed by Irvine (4). Other classifications for instance, by the National Diabetes Data group have been used (5).

DM is classified mainly as either primary idiopathic or secondary to other pathology as seen in figure one. There are four known subtypes of DM (10). The first subtype is called type 1 diabetes, which is caused by a failure of pancreatic beta cells to produce insulin, and it accounts for 5-10% of all diagnosed cases of DM (10). Secondly, T2DM which accounts for roughly 90% of diagnosed cases of diabetes, and is associated with insulin resistance and other environmental factors such as obesity/overweight and physical inactivity (10-11). Gestational diabetes is the third form of diabetes, and it develops in approximately 2-5% of all pregnancies, but in most cases resolves post-partum (10-11). There are other specific types of diabetes that result from various causes such as genetic syndromes and malnutrition, but these account only for 1-2% of all diagnosed cases (10-11).

Figure 1: Classification of DM



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(1) MODY: Maturity onset diabetes of the young (2) IGT: Impaired glucose tolerance

1.1.2 Aetiology of DM

In both major types of DM type 1 and 2, the precise aetiology is not yet certain; however it has been widely accepted that this disorder is associated with many factors including genetic and environmental factors (12). In T2DM, there is a strong association between the disorder and both genetic and environmental factors such as nutrition, obesity and physical activity (12). Potential factors associated with increased risk of T2DM including ethnicity and geographical differences, gender difference, nutritional factors, severe and prolonged stress, thrifty genotype hypothesis, drugs, physical inactivity, genetic factor, and other factors including age and parity are discussed below.

1.1.2.1 Ethnicity and geographical differences (urban vs. rural)

There is a large body of evidence linking ethnicity to an increased risk of diabetes. For instance, higher prevalence rates of T2DM were reported in South African Indians compared to South African blacks (8.9% vs. 4.2%; respectively) (13). Another example is the difference in the prevalence of T2DM among Aborigines and Malays living in the same community (4.4% vs. 11.3%; respectively) (13).

Previous research supports the role of geographical differences in increasing the risk of developing T2DM. For instance, Japanese people living in Brazil had higher prevalence rates of T2DM compared to those living in Japan (14). Equally, Japanese American living in Hawaii and Los-Angeles had higher prevalence rates of T2DM compared to native Japanese (14). Since Japanese Americans are genetically indistinguishable from native Japanese, geographical differences were associated with developing T2DM (14).

In the Middle East, Elmugamer et al found higher prevalence of diabetes in urban areas compared to rural areas in the UAE (p=0.000) (15). Similarly, Al-Nuaim found that Saudis living in urban areas had higher rates of diabetes compared to those living in rural areas (age adjusted prevalence: males 12%, females 14% vs. males 7%, females 7.7%; respectively) (16). In contrast, Elbagir et al did not find any association between geographical location and development of T2DM in Sudan (17). This finding might be due to the fact that urban areas in Sudan do not differ dramatically from rural areas.

The differences in the prevalence of T2DM between urban and rural areas can be a consequence of the following: (1) people living in urban areas might be more affluent and prone to unhealthy diets compared to those living in rural areas; and (2) people living in rural areas might be more involved in physical activities due to the nature of their lives which reduces the risk of developing T2DM and other associated risk factors such as overweight and obesity (12).

1.1.2.2 Gender difference

Some prior have investigated the relation between gender and prevalence of T2DM, but this association is still not certain. Previous research showed that T2DM is more common among women (18); however Lerman et al documented that T2DM is more prevalent among males than females in Mexican population of all age groups (16.7% vs. 9.5%; respectively) (19).

1.1.2.3 Nutritional factors, body weight and fat distribution

Several studies have shown that high Body Mass Index (BMI), is directly associated with a higher risk of T2DM in many ethnic groups (20). Similarly, many studies (e.g., 21-23) indicated that obesity is a risk factor for T2DM. The use of energy rich food, rich in saturated fats, refined sugars and deficient in complex carbohydrates (fibres) may contribute to the development of obesity and T2DM (20). Studies (e.g., 24) found a strong positive correlation between the development of T2DM and excessive intake of processed carbohydrate particularly sucrose. Similarly, Hinsworth found that low carbohydrate and high fat diet increase the risk of developing T2DM (25, 26). In contrast, no association was determined in a study carried out elsewhere (27).

1.1.2.4 Severe and prolonged stress

Some studies (e.g., 28) have reported that due to the activation of hormones caused by severe and prolonged stress, notably the glucocorticoids, which causes glucose intolerance; the risk of developing T2DM might increase with stress (28).

1.1.2.5 “Thrifty” genotype hypothesis

In 1962, Neel proposed that a protective effect is caused by the deposition of fat during a feasting period and used up during a famine (29). More clearly, in the days when human population was subjected to uncertain food supply and famine through factors such as drought and hurricanes, followed by overproduction as a result of improved environmental factors resulting in a state of “feast”, there was definite compensations in people, as seen in figure two (29).

This proposal suggests that the high energy diets readily available along with a sedentary life style may lead to both hyperinsulinaemia and insulin resistance; therefore beta cell destruction may occur and subsequently T2DM (29).

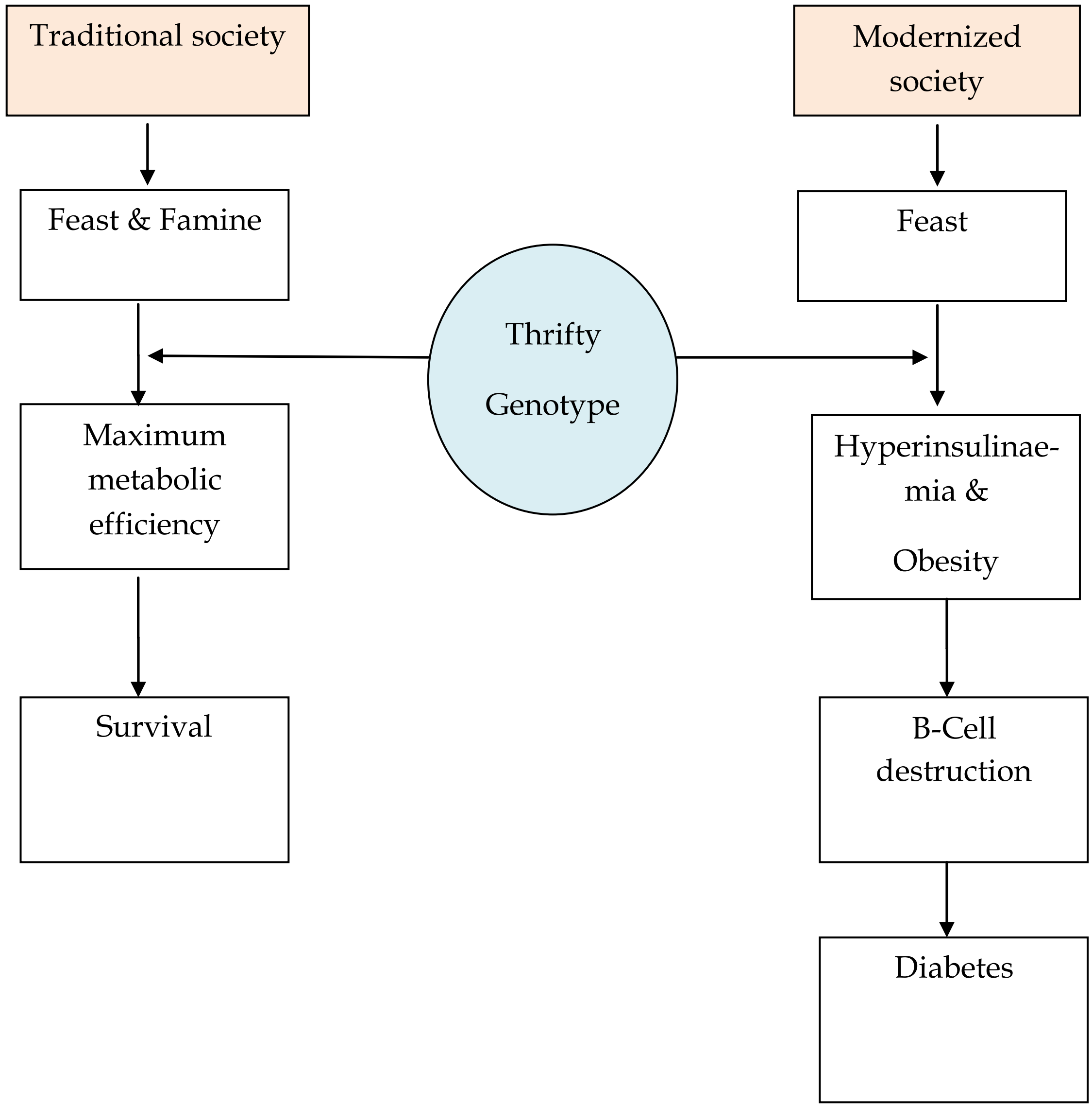
1.1.2.6 Drugs

There are some studies indicating the role of some pharmacological medicines in developing T2DM. For instance, some studies demonstrated that corticosteroids and oral contraceptive steroids may contribute in causing glucose intolerance and T2DM in susceptible individuals (30). However, the role of other drugs such as B-adreno-receptor blocking agents is not yet well-defined (30).

1.1.2.7 Physical inactivity

The role of physical activity in reducing the risk of developing T2DM has been commonly reported in previous research (31-33). For instance, a study carried out on an African America population in the US, indicated that the degree of inactivity and obesity increase the risk of developing diabetes (33).

Figure 2: The "Thrifty" genotype hypothesis



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1.1.2.8 Genetic factors

The exact mode of inheritance of T2DM is still not well defined despite the large number of studies focusing on this area. However, the association between T2DM with genetic factors is well documented; many studies have (e.g., 34-36) demonstrated statically significant results supporting the familial aggregation in T2DM.

1.1.2.9 Other factors

Other factors mentioned in the literature that are associated with increasing the risk of developing T2DM include age (e.g., 37, 38), and high parity (e.g., 39).

1.1.3 Prevalence of DM worldwide

Globally, the number of people with diabetes is increasing at an alarming rate, and diabetes is considered as a key threat to human health, and the epidemic of the 21st century. Approximately, 200 million people live with diabetes, and a dramatic increase in this number is expected by 2030 as highlighted in table one (40). Further, the IDF estimates 380 million people with diabetes by 2025 (1-2).

Developing countries face major epidemics of diabetes particularly type 2 mainly among adult population over the age of 25. The dramatic rise is in countries with relatively young populations, and still developing economic infrastructure, as they undergo the predicted increases in prevalence of diabetes associated with changes in lifestyle and economic development, and population growth, leads to risks not only for individuals, but for health systems, social systems, and state economies (40). Even when based on changes in population size and demography alone (40), the highest predicted future increases listed by the IDF are expected in the 'African region' (estimated: 98.1 % increase 2010 – 2030), followed by the 'Middle East-North Africa' region (estimated: 93.9 % increase 2010 – 2030) as shown in table one (1). The Middle East-North Africa region already has some of the highest rates of diabetes in the world.

As shown in table two, five of the six countries of the Co-operation Council for the Arab States of the Gulf (GCC) are included in those currently ranked "top 10" for diabetes prevalence among the 216 countries for which data are available (1). These GCC countries based on the highest prevalence of diabetes are United Arab Emirates (UAE), Saudi Arabia, Bahrain, Kuwait and Oman (1).

In the UAE for instance, the prevalence rate of diabetes, chiefly T2DM is worrisome (1, 41, 42). As seen in table two a gradual increase is expected between 2010 and 2030 in the prevalence of diabetes in this country (18.7% vs. 21.4%, respectively) (1).

However, there is a variation between rural-urban settings, age group and different nationalities living in the UAE (41).

Table 1: IDF regional estimates for diabetes (20-79 years): 2010 - 2030

	2010			**2030**			**2010/ 2030**
	Population (20-79 years)	**No. of people with diabetes**	**Comparative diabetes prevalence**	**Population (20-79 years)**	**No. of people with diabetes**	**Comparative diabetes prevalence**	**Increase in the No. of people with diabetes**
Region	Millions	Millions	%	Millions	Millions	%	%
NAC	320	37.4	10.2	390	53.2	12.1	42.4
MENA	344	26.6	9.3	533	51.7	10.8	93.9
SEA	838	58.7	7.6	1,200	101.0	9.1	72.1
EUR	646	55.2	6.9	659	66.2	8.1	20.0
SACA	287	18.0	6.6	382	29.6	7.8	65.1
WP	1,531	76.7	4.7	1,772	112.8	5.7	47.0
AFR	379	12.1	3.8	653	23.9	4.7	98.1
Total	4,345	284.6	6.4	5,589	438.4	7.7	54.0

(Modified from reference No. 1)

Table 2: Top ten prevalence of diabetes (20-79 years): 2010 - 2030

2010		2030	
Country	**Prevalence (%)**	**Country**	**Prevalence (%)**
Nauru	30.9	Nauru	33.4
United Arab Emirates	18.7	United Arab Emirates	21.4
Saudi Arabia	16.8	Mauritius	19.8
Mauritius	16.2	Saudi Arabia	18.9
Bahrain	15.4	Reunion	18.1
Reunion	15.3	Bahrain	17.3
Kuwait	14.6	Kuwait	16.9
Oman	13.4	Tonga	15.7
Tonga	13.4	Oman	14.9
Malaysia	11.6	Malaysia	13.8

(Modified from reference No. 1)

1.1.4 Health and economic impact of DM

Through its various complications and a widespread high prevalence (42), DM is a major contributor to morbidity and mortality worldwide. T2DM is not only associated with an increase in overall age-adjusted mortality of twice as that of non-diabetics, but it is also associated with roughly 5-10 years reduction in life expectancy of middle aged people with diabetes (43). There are many complications associated with diabetes such as dyslipidaemia, hypertension, blindness and non-traumatic amputation.

Dyslipidaemia is a significant risk factor for developing macrovascular complications in diabetic patients. The Centre of Disease Control and Prevention (CDC) recently reported that 70-97% of individuals with diabetes suffer from dyslipidaemia (43, 44). This contributes to an excess, risk of coronary heart disease, which is two to four times higher in people with diabetes compared with non-diabetic population (45).

High blood pressure is another of the co-morbidities of diabetes. It has been documented that the prevalence of hypertension in the diabetic population is 1.5 to 3 times greater that of non-diabetics (43). Hypertension can increase the risk for renal insufficiency, diabetic retinopathy and possibly neuropathy in diabetic individuals (43). Hence, diabetes is the most common reason for renal replacement (45).

Furthermore, diabetes is the leading cause of new cases of blindness among adults aged 20-74 years (43). In the US, diabetic retinopathy causes 12,000 to 24,000 new cases of blindness yearly (43). It is the most common reason for blindness in the under 65 (45).

Diabetes is the most common cause of non-traumatic amputation worldwide (45). It has been estimated that more than 60% of non-traumatic lower limb amputations occur due to diabetic foot ulcers in the US (43).

Coma and death could be consequences of sudden development of short-term life threatening complications of diabetes if not treated promptly, such as ketoacidosis and severe hypoglycaemia (45).

Besides that, the project increase in the number of people with diabetes will cause a major burden for health systems (12). In China for instance, the WHO predicts a total of US$ 557.7 billion net loss in national income as a consequence of diabetes, stroke and cardiovascular diseases in the 10-year period from 2005 to 2015 (46). It is a major public health issue, carrying huge societal and economic, as well as personal, cost and risk (46). This risk has been acknowledged by the United Nations through Resolution 61/225, which issued a call for Member States to implement strategies to address the diabetes problem (46).

1.1.5 DM care

The main goals of managing people with diabetes are screening for complications and achieving tight glycaemic control along with the management of other co-morbidities such as hypertension and hypercholesterolaemia to prevent or delay diabetes related complications which are addressed in section 1.1.4. Studies such as the Diabetes Control and Complications Trial (DCCT) and The UK Prospective Diabetes Study (UKPDS) underlined the importance of active medical intervention or management in reducing diabetes related complications (47). Evidence has confirmed the association between strict glucose and blood pressure control and reduction in microvascular complications (48-56). For people with T2DM who are at high risk of cardiovascular diseases, careful management of risk factors including smoking, hyperlipidaemia, and hypertension is important (48-56).

1.1.5.1 Prospects for health improvements in DM

As addressed in sections 1.1.4 and 1.1.5, controlling or normalizing blood glucose and screening for or controlling the related co-morbidities such as hyperlipidaemia and hypertension are essential for people with diabetes. Evidence indicates the need of both primary and secondary prevention programmes to improve health outcomes in diabetes, and prevent or delay diabetes related complications (52-60).

Previous research shows (e.g., 53) that secondary prevention measures including the control of blood glucose, blood pressure and lipids reduce diabetes related complications. Also, encouraging people with diabetes to discontinue smoking is important, and can help in achieving the desired treatment outcomes (54).

Regular screening for retinopathy, nephropathy, peripheral neuropathy and peripheral arterial disease is essential as it can help in detecting or managing these conditions (52).

Based on the scope of this thesis and the aim of the cohort study addressed in chapter five, the following section will focus on secondary prevention in diabetes including blood glucose, lipids and blood pressure control.

Blood glucose control

Results from the UKPDS showed that the reduction in the mean Glycated haemoglobin (HbA1c) (7.0% v 7.9%) (optimal range ≤ 6.5) by 11% among people with diabetes who were treated intensively, lead to a significant reduction by 25% (95% Confidence Intervals (CI) 7% to 40%) in microvascular endpoint (58). Additionally, UKPDS demonstrated a reduction in the risk for myocardial infarction associated with the reduction in the mean HbA1c; however this reduction in the myocardial infarction risk was not statistically significant [AOR 0.84 95% CI 0.71-1.00] (58).

Blood pressure control

In terms of blood pressure, results from the UKPDS showed significant improvement in the control of blood pressure for those patient who received intensive treatment control (mean BP 144/82 mm Hg compared with 154/87 mm Hg) (47, 49). Added to the improvement in blood pressure, people with diabetes who received intensive blood pressure control had a significant reduction in the followings: diabetes related endpoints 24% (95% CI 8% to 38%), deaths related to diabetes 32% (95% CI 6% to 51%), strokes 44% (95% CI 11% to 65%), reduction in all microvascular endpoints 37% (95% CI 11% to 56%) (47, 49). Moreover, in the same trial people with diabetes allocated to the intensive blood pressure group were significantly less likely to develop retinopathy than those were treated normally (47, 49, 57, 58).

Lipid control

Many studies indicated the importance of blood lipids control and the use of drugs such as statins to regulate blood lipids as a secondary prevention measure in diabetes. For instance, the use of drugs to control blood lipids was found to be beneficial for all subjects with diabetes, even for those who did not have existing coronary artery disease as indicated by MRC/BHF Heart Protection Study (59).

The Collaborate Atorvastatin Diabetes Study (CARDS) found that the use of Atorvastatin in people with diabetes reduces the risk of acute coronary heart disease events by 36%, coronary revascularisations by 31%, stroke by 48% and mortality by 27% (59).

1.1.5.2 Interventions to improve DM care

Improving the quality of diabetes care remains important worldwide (60, 61). There is increasing evidence that diabetes care is suboptimal on the international level in terms of standards attained, degrees of variability and levels of accountability of health professionals (62, 63).

The most recent report of the US Agency for Healthcare Research and Quality (AHRQ) of the strategies used for improving the quality of care provided to people with T2DM such as audit and feedback, case management, team changes, electronic patient registry, clinician education, and clinician reminders demonstrated that most strategies lead to a small to moderate improvement in glycaemic control (51). The report emphasised the use of two or more of the listed strategies to improve diabetic care as this was successful than employing a single intervention (51).

Most of the intervention studies were published in western countries (e.g., 53-55); however, little work has established from other countries, particularly those located in the Middle East.

1.1.6 Quality of DM care

Defining quality of care

Due to the growing demand for health care, rising costs, constrained resources and variation of clinical practice; improving and measuring quality of health care are becoming important issues. These are now in national agendas of health systems in many countries, including the USA and UK (62, 63).

Formulating a concise and meaningful definition for quality of care was a challenge for experts for decades. A frequently quoted global definition of quality in health is that used by the Institute of Medicine; which is "the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge" (64). Furthermore, Maxwell and Donabedian have developed the most recognised disaggregated definitions of quality (64-66). Maxwell defined quality in health care based on mainly six dimensions including: accessibility, effectiveness, equity, efficiency, acceptability, and relevance (64-66). Donabedian's definition; however covers many of the same dimensions including effectiveness, efficiency, efficacy, acceptability, equity and legitimacy as highlighted in table three (66).

Table 3: Quality dimensions

Quality dimension	Donabedian 1998	Maxwell 1992
Effectiveness	×	×
Efficiency	×	×
Access	×	×
Safety	×	
Equity	×	×
Appropriateness	×	×
Timeliness		
Acceptability		×
Responsiveness		Respect
		Choice
		Information
Satisfaction		
Health improvement	×	
Continuity		

(Modified from References No. 64-66)

Measuring quality of care

Experts worked for more than 25 years to create measures that are both reliable and valid so that they can be used to assess the quality of health care. Quality measures include process of care and outcomes (67). Outcome measures have been included to not only measure the rate of morbidity and mortality, but to assess various kinds of functional status as well (68-70). Assessing health care system performance by using quality measures is becoming an essential tool internationally and a legal requirement in many countries (71-73).

In the UK due to the movement from assessing both cost and activity to assessing the quality of health care services; performance measurement and quality improvement are emphasized for the National Health Services (NHS). Also, as a result of the need to assess quality, a national performance frame work has been developed (74).

Several factors other than health care have been shown to have substantial effects on health as measured by mortality rates such as, lifestyle, environment, poverty and social structure of society. For instance, 31% of the decline in coronary heart disease in women in the US between 1988 and 1992 was a result of changes in lifestyle (diet and smoking) (72).

Quality indicators are divided based on the three main components of health care including structure, process and outcome (70). Outcome measures examine the mortality, morbidity, quality of life and patient perception including measures of patient satisfaction (70). Variations in outcome between health care providers might be due to difference in type of patients, measurements, chance and difference in quality of care. Regarding type of patients, factors including age, gender, severity of the disease and related co-morbidities are the patient characteristics that create differences in type of patients. For example, a 40% reduction in the mortality rate of stroke patients in Edinburgh, Scotland disappeared when results were adjusted for case mix (74, 75). Despite all the limitations in the use of outcomes, they remain the ultimate validators of the effectiveness and quality of medical care. Examining the process of care itself is another method to assess the quality of care, in addition to assessing outcomes (71, 76).

Process measures have four main fundamental advantages over outcomes which include reduction of case mix bias, lack of stigma, prompt wider action and they are useful for delayed events (69-70). However, process measures used in performance management should be valid; therefore they should be either self-evident measures of quality or be evidence based.

Quality standards and indicators

The science of quality measurement is still developing in many developing countries, while these measurements are used more widely in developed countries. However, there are some attempts to standardize international quality measures, e.g. by the Organization for Economic Co-operation and Development (OCED) (68-70). Quality indicator sets have been developed by national bodies, for instance National Performance Assessment Framework in the UK, National Committee for Quality Assurance in the USA and several international bodies such as the OECD (68-70).

Quality standards differ from quality indicators and it is essential to distinguish between them. Quality indicators have been defined as “measurable elements of practice performance for which there is evidence or consensus that they can be used to assess the quality of care provided" (71). On the other hand, quality standards stand for "the level of compliance with a criterion or indicator" (71-73). Basically, indicators are related to the care provided to the patients, while outcomes of care for these indicators are referred to the standards. For instance, it is a standard from the National Service Framework for Coronary Heart Disease in England that all patients with diagnosed coronary heart disease receive low dose (75mg) aspirin where clinically appropriate (48). Yet, in general meeting such absolute standard is a challenge.

Use of quality of care indicators in diabetes care

Despite the large number of indicators used to assess the care provided to people with diabetes, international agreement on the indicators to assess diabetes care is not specified. The Diabetes Quality Improvement Project (DQIP) was used in the US in the late 1990s for evaluation and improving the quality of diabetes care (72). Later, the comprehensive set of national measures provided by DQIP was updated as the National Diabetes Quality Improvement Alliance (73). The measures are based from data extracted either from hand-written medical records or electronic records to assess: (1) recording of care (HbA1c, eye examination, lipid profile, assessment of diabetic nephropathy, blood pressure and foot examination); and (2) the percentage of targets achievement of HbA1c, lipid and blood pressure. Added to these assessments, a patient survey measuring smoking cessation counselling, nutritional education, satisfaction, self-management, and interpersonal skills of the health care team was used (73).

In the UK, the assessment of diabetes care used indicators taken directly from the general medical services contract for UK general practitioners (74).The assessment includes recording of several indicators of care such as BMI, smoking habit, HbA1c, cholesterol, blood pressure and retinal screening. Also, it includes achievement of HbA1c, lipid and blood pressure targets, and prescribed treatment such as therapeutic intervention for poor glycaemic and blood pressure control. Besides, since the introduction of the Quality and Outcomes Framework (QOF) in 2004 in the UK, the quality of care indicators have been used chiefly in UK primary care settings (74).

Others (e.g., 70, 71) have also assessed the quality of diabetes care using a combination of process, intermediate outcomes of care, and clinical interventions such as the use of appropriate pharmacological treatment to control blood glucose or blood pressure level.

Chapter 2 : UAE

This chapter is classified into three main parts. The first part provides an overview of the UAE's location, government and people; and its, economic and social development. Also a general overview on health profile in the country is highlighted. Providing this information is needed for the reader to have a good understanding about the UAE and its health, which is the country of focus in this thesis.

Secondly, due to the differences in the bodies regulating the health services in the UAE, an overview about Abu Dhabi the capital of the UAE is provided along with a brief description on the health profile. Providing this information is important as both the quantitative and qualitative components of this thesis as addressed in chapters five and six respectively took place in Tawam hospital that is located in the capital Abu Dhabi. Understanding the health system followed, and reviewing the diabetes profile in Abu Dhabi city can help drawing the picture about the burden of diabetes epidemic in the capital.

The final section focuses on reviewing the interventions initiated in the UAE to tackle diabetes and improve its care. Reviewing these interventions is useful as it can help in providing some recommendations both in the hospital and policy levels. Also, being aware of the interventions initiated to improve the quality of diabetes care would be productive for the systematic review carried on the quality of diabetes care in the GCC as addressed in chapter four, section three.

Section one

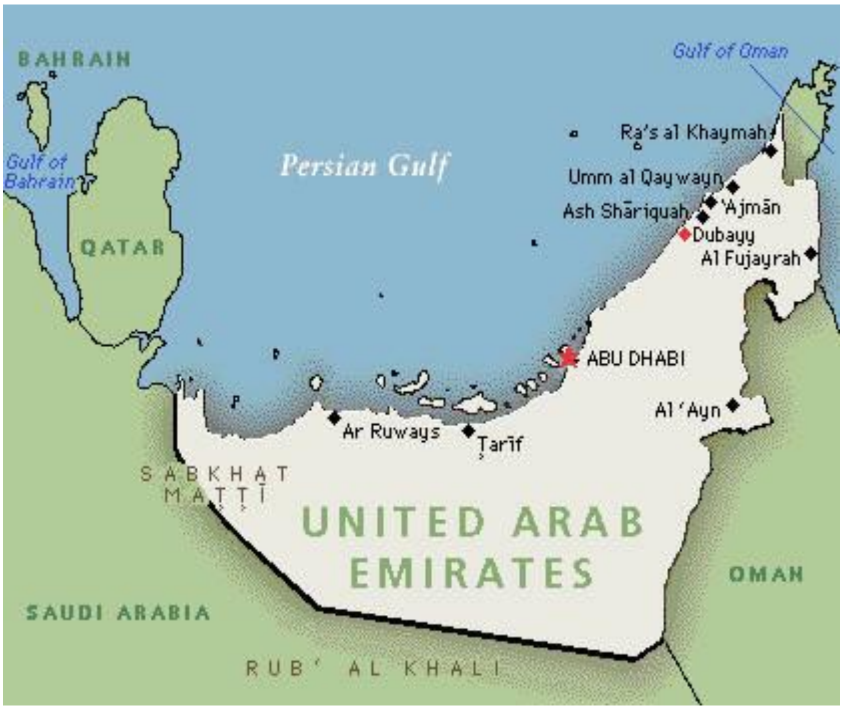
This first section of chapter two presents an overview of the UAE. A brief description of the health system, health and diabetes profiles is provided. Reasons for providing this information are listed in the opening of chapter two.

2.1 Background

2.1.1 Location and geography

The UAE is located in the southeast of the Arabian Peninsula in southwest Asia on the Persian Gulf. It's bounded by two countries from the west, Qatar and Kingdom of Saudi Arabia, Sultanate of Oman from the south, and the Gulf of Oman from the east as shown in figure four. The Arabian Gulf encircled the UAE from the north and North West as seen in figure three. The total area of the country is 83, 600 square kilometres (77, 78).

Figure 3: Geographical location of the UAE



Source: http://wwp.greenwichmeantime.com/ map-United-Arab-Emirates/index.htm

2.1.2 Government and people

UAE was established in December 1971. It's a Middle Eastern federation of seven countries named emirates including: Abu Dhabi (the capital), Ajman, Dubai, Fujairah, Ras al-Khaimah, Sharjah, and Umm al-Quwain (77, 78).

In 2010 according to the estimates from the national bureau of statistics, the total population of UAE was 8, 264, 070 of which 6, 161, 820 were males, and 2, 102, 250 were females (78). Only 947, 997 (11.5%) of the population were UAE nationals (78). Total life expectancy at birth for all people residing in UAE including both nationals and non-nationals was estimated in 2008 as 77.4, females had higher life expectancy at birth compared to males(80.2 vs. 63.5; respectively) as highlighted in table four (77, 78).

Table 4: UAE's profile 2008 (Demographic, socioeconomic and health indicators)

Demographic indicators	Value	Health expenditure indicators	Value
Area in square kilometres	83,600	GDP/ capita US $ exchange rate	64,009
Total population in thousands	8,073,626	Total expenditure on health (per capita) (average US$ exchange rate)	1,551
% of urban population out of total population	81	Government expenditure on health (per capita) (average US$ exchange rate)	1,044
% population growth rate	6.1	Total expenditure on health % GDP	2.4
		Public % of total health expenditure	74.4
Health status indicators	**Value**	**Coverage with primary care services indicators Value (1-year old immunized)**	
Total life expectancy at birth (years)	77.4	BCG	98%
• Male	63.5	DPT3	92%
• Female	80.2	Measles vaccine	92%
Prenatal mortality rate/ 1000 total births	10.4	HBV3	92%
Neonatal mortality rate	4.9		
Infant mortality rate/ 1000 live births	7.6		
< 5 mortality rate/ 1000 live births	9.8		
Maternal mortality ration / 1000 live births	1.5		

(Modified from references No. 77, 78)

2.1.3 Economic and social development

Before the discovery of oil, UAE was considered as one of the poorest countries in the region. People living in the UAE relied on its few natural resources such as fishing and revenues from pearl business (79). However, after the oil discovery, it became the main revenue and nourished the UAE's economy (79). In Abu Dhabi, oil was discovered in 1958 and it started exporting in 1962. In recent years, the country has developed rapidly and vastly in many areas such as industry, economy and tourism. Hence, the gross national income increased between 1972 and 2002 dramatically (4.7 billion AED vs. 229 billion AED; respectively) (79). Also, gross domestic product increased from 6.5 billion AED in 1972 to reach 260 billion AED in 2002, with an annual growth rate of 13% (79).

The UAE gives high importance to education, and the government allocates all required funds to ensure high quality of education to all UAE citizens (78). As highlighted in table four, the rate of literacy among both genders male and female aged 15 years and over is high (92% vs. 93%; respectively) (79).

Added to education, the UAE gives great importance to environmental protection, and many initiatives have been established such as MASDAR city in Abu Dhabi as which aspires to be one of the most sustainable cities in the world (80).

The Ministry of Health (MOH) in the UAE has developed remarkably in the field of information technology and e-government. The country has occupied grade level one among the Arab countries for its distinguished programme of the e-government, and globally it occupied grade level 21 (79).

2.1.4 Health profile

2.1.4.1 Overview

Six different authorities provide health services in the UAE, five of them are governmental and the last one is the private sector. Each authority has its own staff and system (77, 79). The public healthcare services are administered by three main authorities in the UAE including MOH, the Health Authority Abu Dhabi (HAAD), and the Dubai Health Authority (DHA) (79). The MOH managed the Northern Emirates healthcare system including Ras Al Khaimah, Ajman, Umm al Quwain, Sharjah and Fujairah; however in 2009 the Emirates Health Authority that has similar regularity function and initiatives as HAAD and DHA has been established pursuant to Federal Law No. 13 of 2009 (81).

2.1.4.2 Health policies and strategies

The biggest change in the UAE's policy is the withdrawal of the MOH from the direct health care delivery (77, 79). Similarly to Dubai which has its own government health system that has existed for more than 30 years, Abu Dhabi recently has established its own health authority. Reforming the relation between those different health care providers and the MOH in the UAE is required as this relationship is ambiguous (77, 79).

2.1.4.3 Brief history of the health care delivery system

Before the discovery of oil in the UAE, the health situation was considered to be poor (79). Rich people used to get treatment abroad, while those who were not able to afford the expense of travelling abroad used traditional remedies instead.

In 1938, a medical officer was appointed by Britain for the Trucial Coast, and an Indian physician was sent to Dubai in 1940 to serve in a dispensary (79). After that, in 1949, Al Maktum Hospital was built in Dubai by the British government, and British physician from the Indian Medical Service was appointed in the hospital to establish a modern medical service (79). In the 1950s and 1960s, American Mission hospitals were commenced in three cities including Sharjah, Al Ain and Ras Al Khimah (79).

Furthermore, Abu Dhabi received technical and material assistance from Egypt in 1960s; however in 1965 one physician was employed by the Abu Dhabi government and three others started practicing in the private sector (79).

In 1971, after the union of the seven Emirates, a rapid growth in the health system occurred, though lack of coordination between these Emirates appeared (79).

Until 2001, free healthcare services were provided to all people residing in the UAE either national or expatriates. However, due to several factors such as the significant rise in the healthcare cost, the government considered the cost sharing in the form of user charge for the expatriate who constitutes over 70% of the population as well as considering a new compulsory health insurance schemes to encourage investment in the private healthcare sector (79).

Furthermore, based on the regional health systems observatory report the health care system in the UAE is improving. “In the early 1990s, the UAE had a modern health care system with facilities and professionals capable of providing excellent care, and performing advance procedures such as organ transplants and complex heart surgery. Although, the facilities are concentrated in the cities of Abu Dhabi and Dubai, people living in other Emirates have access to at least basic facilities” (79, 81).

As shown in table five, the health care infrastructure in the UAE has progressed in line with other health care developments, for example in 1971 there were only seven hospitals in the UAE with 700 beds; however in 2000 this number increased to 51 hospitals (78, 79,81).

According to the annual statistical report in 2002, there were total of 26 hospitals all over the UAE [15 (57.7%) hospitals in urban vs. 11 (42.3%) hospitals in rural areas] (79). Added to these hospitals, 106 healthcare centres are distributed between urban and rural areas of the country (35% vs. 67%; respectively). Almost all levels of health services are decentralized in the UAE (77, 79).

Table 5: Healthcare infrastructure in UAE: 1970 to 2000

Years	1970	1980	1990	2000
Population	580,000	1,040,000	1,844,000	3,108,000
Hospitals	7	20	29	30
Total number of beds	700	3000	4300	4473
(Pop./ bed)	1/1500	1/3500	1/4200	1/6900
Healthcare centres	21	65	90	115
Total number of physicians	200	1000	1500	2350
Pop./ physician	1/2900	1/932	1/1230	1/353
Total number of nurses	1000	3300	4600	6300
Pop./ nurse	1/580	1/315	1/400	1/490

(Modified from reference No. 81)

2.1.4.4 Health information system

The health information system in the UAE is developing. "Building and maintenance of the national health information system is a strategic objective to support and enhance the country cooperation strategy and all its strategic elements, including disease surveillance, trend analysis and burden of disease studies , health systems development, health and biomedical research, decentralization, privatization and public-private partnership, and health promotion and healthy lifestyles" (77, 79).

2.1.4.5 Human resources

In 2002, the total number of medical physicians was 2304, nursing staff 5779 and technicians 12,100 (84). There is a significant increase in the number of healthcare professionals in the MOH; though a shortage in availability of trained Emirate physicians and nurses exist in the country (77, 79).

2.1.4.6 Morbidity and mortality trends

Maternal and child health

As highlighted in table four, a number of key indicators such as infant mortality rate (7.6) and neonatal mortality rate (4.9) reflect the remarkable changes in the provision and impact of health services (78, 79).

Due to the sustaining maximum immunization coverage as addressed in table four, the incidence of immunizable childhood diseases have been declined dramatically (78, 79).

HIV/ and other sexually transmitted diseases

The WHO reported that UAE and other neighbouring countries have among the lowest number of HIV/AIDS cases globally. Besides, in 2003, 560 cases of syphilis were reported, 117 cases of gonorrhoea and 43 cases of other sexually transmitted diseases (78, 79).

Communicable diseases

The rate of many communicable diseases have been declined remarkably in the recent period; still controlling some communicable diseases such as tuberculosis and viral hepatitis pose a problem in the UAE (78, 79).

Non-communicable diseases (NCDs)

Based in the WHO-report of the country cooperation strategy 2000, cardiovascular diseases (28.7%), cancers (8.6%) and diabetes (2-3%) had been the leading causes of mortality (77).

In 2008, total death from NCDs in males and females respectively were 3,200 vs. 1,400 as shown in table six (78, 79,). The highest death rate per 100,000 was attributed to cardiovascular diseases and diabetes in both genders, females and males respectively (203.9 vs. 308.9) (78, 79).

Table 6: Mortality from NCDs, 2008

	Males	**Females**
Total NCD death (000s)	3.2	1.4
NCD deaths < 60 (%)	59.7	47.1
Age standardized death rate/ 100,000		
All NCDs	448	340
Cancers	63.4	64.4
Chronic respiratory diseases	11.6	23.1
Cardiovascular diseases and diabetes	308.9	203.9

(Modified from reference No. 83)

2.1.4.7 Life style and environmental factors

Tobacco consumption poses a problem in the UAE. In 2006, the estimated tobacco smoking rates in adults aged 15 years and over among males and females respectively were 25% vs. 2.6% (81). However, the country has an anti-tobacco programme that has four main elements including legislation, smoking cessation units, a community- based component, and school-based components (81).

As a consequence of the life style in the UAE such as physical inactivity and high consumption of fat foods, the prevalence of obesity and overweight are alarming. For instance, based on the WHO data estimates on 2008, the prevalence of obesity among males and females respectively were 30.2% vs. 43% (79).

2.1.4.8 Health education

Health education is important for all people residing in the UAE; however public communication is difficult in the UAE due to the diversity of nationalities and languages. Notably, there is no reference centre for health education in the community (81). However, awareness programs are now delivered through special radio and television production units (81). The efforts to promote health education in the UAE are increasing, but sill more emphasise should be placed on important role of health education by the government of the UAE.

2.2 Key issues and main challenges

Based on the WHO report 2002, there are some critical challenges the MOH should build up to achieve the desirable goals of good health including: (1) strengthening the organization of health services; (2) health financing; (3) resources for health; and (4) health education (77, 81).

Section two

This second section of chapter two presents an overview of the capital of UAE, Abu-Dhabi. A brief description of the health profile is provided. Reasons for providing this information are listed in the opening of chapter two.

2.3 Abu Dhabi

2.3.1 Population

Abu Dhabi is the capital of UAE, and it has been growing rapidly in recent years. The population of Abu Dhabi is estimated to be 1.9 million, 21% of whom are nationals (78). In 2009, one in five residents are nationals of whom 2/3 are under 30 and half under 19 years old (78).

2.3.2 Health profile

2.3.2.1 Overview

In 2001, the General Authority of Health Services (GAHS) was established by the Abu Dhabi governments; however the GAHS was split into two chief organizations in 2007 namely: (1) HAAD; and (2) Abu Dhabi Health Services Company (SEHA) (82).

The HAAD is the governmental regulative body of the Healthcare Sector in Abu Dhabi. It monitors the health status of the population to ensure excellence in healthcare for people living in Abu-Dhabi. HAAD has several responsibilities including: (1) defining the strategy for the health system, monitoring and analysing the health status of the population and performance of the system; (2) shaping the regulatory framework for the health system; (3) inspecting against regulations; (4) enforcing standards; and (5) driving programs to increase awareness and adopting of healthy living standards among people living in UAE (82, 83).

However, SEHA is considered as the operator of public health assets in Abu Dhabi. Based on the Abu Dhabi Amiri Decree No. 10 0f 2007, SEHA's mandate is to own and manage either directly or indirectly, public health facilities. Also, SEHA is expected to implement the policies and projects approved by HAAD (82). Currently

SEHA is collaborating with a number of healthcare groups such as Johns Hopkins Hospital for the management and operations of Tawam Hospital in Al Ain (82).

In 2007, mandatory health insurance was introduced to all residents of Abu Dhabi including both nationals and expatiates (82, 83).

2.3.2.2 Morbidity and mortality trends

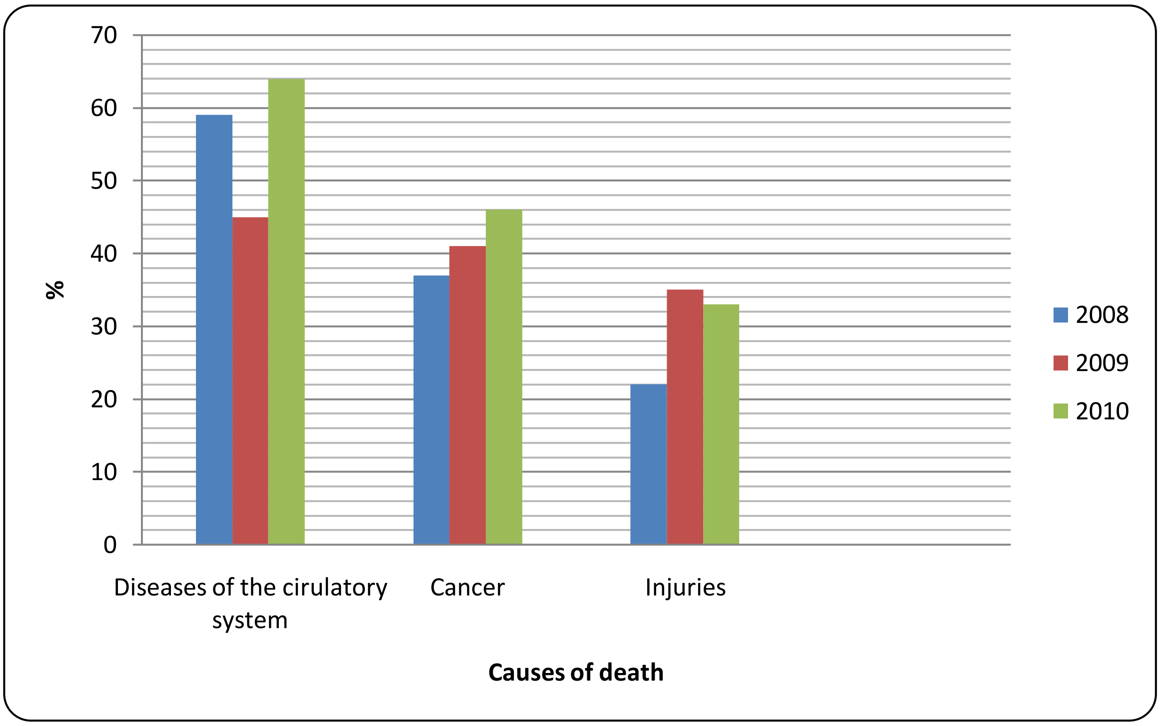
In 2009, HAAD statistics showed that the diseases of the circulatory system are number one cause of death in Abu Dhabi, accounting for 24% of all deaths (84, 85). While In 2010, as shown in table seven, the mortality rate in Abu Dhabi was 1.26 deaths per 1000 people in the population (84, 85). The top three leading causes of death in Abu Dhabi city in 2010 were namely: cardiovascular diseases, cancers, and preventable injuries such as those caused by road traffic accidents (84, 85). Among nationals, diseases of the circulatory system and cancer increased remarkably as seen in figure four from 2008 to 2010 (84, 85).

Table 7: Crude mortality rate in Abu Dhabi, 2010

	Death (%)	**Rate /1000 of population**
National population	967 (34)	2.66
Expatriate population	1888 (66)	0.98
Total population	2879 (100)	1.26

(Modified from reference No. 84)

Figure 4: Top three causes of death in Abu Dhabi: 2008 - 2010



(Modified from reference No. 85)

<u>NCDs</u>

The prevalence rate of DM among 76,070 adult residents in Abu Dhabi in 2005 was approximately 19%, hypertension 34%, hypercholesterolemia 18% and obesity 23% (86). Among emirate females and males, diabetes was more prevalent among age group 60-69 (59% vs. 56%, respectively) (85). Similarly to UAE nationals, the prevalence of diabetes was more common among the same age group of expatriates (female 61%, male 53%) (85).

Based on the WHO Statistical Information System and World Health Statistics 2007, DM was one of the five leading causes of death in Abu Dhabi (85). As shown in table eight and it amounted for 11.9% of the total deaths (85).

Table 8: The main leading causes of death in Abu Dhabi, 2007

Causes	(rate / 100,000 population)
Accidents and poisoning	37.5%
Cardiovascular diseases	29.8%
Cancer	21.7%
Congenital anomalies	10.7%
Diabetes mellitus	11.9%

(Modified from reference No. 85)

However, HAAD reported a 15% raise in the mortality rate caused by DM from 2004 and 2007 (85). 126 deaths were attributed to diabetes in 2004 and the number increased to reach 201 deaths in 2007 as highlighted in table nine (85).

Table 9: The rate of death in Abu-Dhabi: 2004-2007

Causes	2004	2005	2006	2007
Accidents and poisoning	563	565	503	633
Cardiovascular diseases	413	424	378	506
Cancer	298	294	315	370
Congenital anomalies	146	156	131	177
Diabetes mellitus	126	133	130	201
Other causes	443	874	993	867
Total	2489	2446	2450	2754

(Modified from reference No. 85)

Section three

This final section of chapter two presents an overview of the main interventions that have been initiated in the UAE to tackle diabetes and improve its care. Reasons for providing this information are listed in the opening of chapter two. This section starts with an overview of the UAE government's aims on health. Then it concentrates on the initiatives that have been undertaken by the MOH, HAAD and DHA respectively to tackle diabetes or improve its care.

2.4 interventions to tackle DM and improve its care

2.4.1 UAE's government

The UAE's government aims to ensure access to primary care for all people living in the UAE including both citizens and non-citizens, and to improve the quality of health services (78). Also, its long term target is to build a world-class health care system that ensures universal access to health care services, provide world-class health services, and reduce epidemic and health risks (78).

2.4.2 MOH

The MOH has implemented many initiatives to reduce the burden of diabetes in the UAE and improve its care for people who are living with diabetes. One of these initiatives is the establishment of the national strategy for diabetes control for 2009 to 2018. This program has several important objectives that aim to address the maxim of the MOH 'act on diabetes now' (86). These objectives include the following (86):

- Focusing on primary and secondary prevention of T2DM
- Improving the quality of care provided to people with diabetes at the three levels of health care
- Monitoring and evaluating diabetes care
- Promoting and encouraging research focusing on diabetes
- Strengthening the participation of the community in diabetes
- Empowering people with diabetes on the management of diabetes

Many steps have been undertaken by the MOH to support screening for diabetes and promote awareness on the disease, its risk factors and complications. Awareness campaigns for preventing and living with diabetes, for instance, have been held in Sharjah, with a focus on encouraging physical activity among people (87).

The world diabetes bus is another activity that began in 2010, and started from the capital Abu Dhabi moving to the other emirates (88). It aims to screen for diabetes and its risk factors such as overweight/ obesity, hyperlipidaemia and hypertension (88).

Additionally, the MOH has obtained international expert experience in diabetes by establishing the Rashid Centre for Diabetes Mellitus and Research in Ajman, which is the first centre of excellence with Swedish expertise for diabetes and obesity care in the region (89). This centre aims to provide a healthy and enjoyable life for people with diabetes living in the UAE (89).

2.4.3 HAAD

In 2006, the Abu Dhabi government aimed not only to improve access to health services, but also to improve the health outcomes for all people residing in Abu-Dhabi; therefore policy and system planners designed specific strategies to achieve the desired aims of the government (90).

Overall, there was lack in the skills needed for effective programs to tackle non-communicable disorders including diabetes in Abu Dhabi such as data collection, planning and monitoring; hence experts advice both at local and international levels was sought to establish evidence-based programs for screening for NCD's, particularly diabetes and cardiovascular diseases (90). A program called 'Weqaya' that means in Arabic prevention was initiated at Abu Dhabi (90). This program involves screening, planning and acting (90). As a consequence of the program, approximately 94% of Abu Dhabi citizens were screened for diabetes and cardiovascular disorders risk from 2008 to 2010 (90). Based on the results from the screening program, and acting process of Weqaya, health and non-health sectors and programme governance were involved to address the high prevalence of diabetes and its risk factors such as overweight/ obesity and physical inactivity (90).

Furthermore, specialized diabetes centres have been launched in Abu Dhabi such as the Imperial College Diabetes Centre (ICDC) which is considered as state of the art in diabetes treatment, research, training and public health (91).

2.4.4 DHA

Many initiatives have been carried out in DHA to either prevent diabetes or improve the quality of its care. In terms of improving the care provided to people with diabetes, a quality improvement program was adopted from the chronic disease management model in the primary care centres (92, 93). Improvement in the care was indicated by the metabolic measurements for diabetes such as glycaemic control (93).

The Harvard affiliated Joslin Diabetes Centre was launched in Dubai in 2009, aiming to provide treatment, prevention, education, lifestyle management, and podiatry services (94).

Chapter 3 : The thesis

3.1 Rationale for the thesis

Diabetes is a complex disorder that needs effective management strategies to achieve the desired therapeutic outcomes as addressed in chapter one. To summarize, the main goals of managing people with diabetes are screening for complications and achieving tight glycaemic control along with the management of other co-morbidities such as hypertension and hypercholesterolaemia to prevent/delay diabetes related complications. Effective management of diabetes can help in preventing both micro and macro-vascular complications (47). Studies such as the DCCT and the UKPDS underlined the importance of active medical intervention or management in reducing diabetes related complications (49, 50).

However, due to the increasing evidence that diabetes care is sub-optimal on international level in terms of the standards attained, the degree of variability and the level of accountability of health professionals; improving and measuring quality of health care are becoming important issues world-wide (60, 61). These are now in national agendas of health systems in several countries such as USA and UK (62, 63).

The UAE has the second highest prevalence rate of diabetes globally (20.1% among the adult population) based on the data from the IDF as addressed in chapter two; therefore this disorder represents a real challenge to the health planners, policy makers and health care system thinkers, and increases the economic cost to the society (1). The increased cost includes its effects on morbidity, employment, productivity, premature mortality and the increased use of health services. For this reasons, actions are needed to prevent a dramatic increase in the prevalence rate of diabetes in the UAE, and to improve the quality of diabetes care (1). Strategies and interventions should be initiated in the UAE targeting diabetes and its related risk factors. Also, effective management of diabetes is essential to alleviate the symptoms and minimize the risk of long, debilitating and expensive complications.

Efforts to reduce the burden of diabetes epidemic in the UAE, and improve the quality of its management should be informed and supported by evidence-based knowledge. Despite the alarming prevalence rate of diabetes in the UAE, there is a shortage in research studies focusing on the prevalence of diabetes and its risk factors in the country; however as reported in chapter two, the MOH and the HAAD established some evidence-based screening programs for diabetes and cardiovascular disorders recently, and the country is encouraging research studies on the field of diabetes.

Furthermore, many previous research studies were carried out to assess the quality of diabetes care and identify factors influencing it in Europe and America. Some of this research included systematic reviews and meta-analysis to examine the quality of care provided to people with diabetes and identify factors associated with it. Results from these studies demonstrated that the care provided to people with diabetes is sub-optimal, and diabetes care is influenced by many factors related to healthcare professionals, patients and the organization of services. However, few studies have been reported from the GCC in general and UAE in particular on the quality of diabetes care and factors affecting it, even though the prevalence of this disease is reaching an alarming rate in the region. Also, there was lack of studies in the systematic focusing on diabetes, its risk factors and management. Determining and examining the current standards of diabetes care, and investigating and understanding factors influencing it could potentially aid the implementation of appropriate quality improvement interventions in the UAE and other GCC states, and significantly improve diabetes care.

3.2 Research questions, aim and objectives

Research questions

1. What are the estimated prevalence rates of T2DM in the UAE from the available data, and what are the trends in prevalence across time?
2. What are the common reported risk factors for adverse outcomes in people with T2DM in the UAE from available data, and what are the trends in prevalence across time?
3. What is the quality of T2DM care in Abu Dhabi compared to international standards?

4. Is T2DM care in Abu Dhabi improving over time?
5. Do inequalities in T2DM care associated with age and gender exist in Abu Dhabi?
6. What are the factors both (facilitators and barriers) affecting T2DM care in Abu Dhabi from the perceptions and experience of healthcare professionals?

<u>Aim</u>

To examine the quality of care provided to people with T2DM in Abu Dhabi, particularly Al-Ain, and identify factors influencing it.

<u>Objectives</u>

The thesis was designed to fulfil the following major objectives:

1. To systematically review and demonstrate the followings:
    - prevalence of T2DM in the UAE, and trends in prevalence across time
    - risk factors for adverse outcomes in people with diabetes including overweight/obesity, hyperlipidaemia, 'pre-diabetic' hyperglycaemia, and hypertension and their prevalence rates in the UAE
    - quality of T2DM care in the UAE
2. To examine the quality of T2DM care using quality indicators, both process and intermediate outcomes of care, in accordance with the American Diabetes Association (ADA) targets 2012 in Abu Dhabi.
3. To identify any improvement in the quality indicators between 2008 and 2010 in Abu Dhabi.
4. To investigate the relationship between age or gender and the quality of T2DM care between 2008 and 2010 in Abu Dhabi.
5. To identify and provide further understanding on the factors affecting the quality of T2DM care from the perceptions, attitudes and experiences of healthcare professionals in Abu Dhabi.

3.3 Thesis outcomes

Several outcomes are expected from this thesis. Based on the first objective of this thesis listed in section 3.2, production of systematic reviews on: (1) the prevalence of

T2DM; (2) risk factors for adverse outcomes in people with diabetes including overweight/obesity, hyperlipidaemia, 'pre-diabetic' hyperglycaemia and hypertension; and (3) the quality of T2DM in the UAE are expected.

Data obtained from these systematic reviews can make the available evidence more accessible to healthcare professionals, researchers and decision and policy planners and makers in the UAE. They can obtain from the results of these systematic reviews an overview of the commonly reported risk factors of adverse outcomes of diabetes, and changes in the prevalence of T2DM and its adverse outcomes over time from all the available data in the UAE. Also, the systematic review on the quality of diabetes care in the UAE can provide a better understanding of the current quality of diabetes care, and identify any improvement in the care overtime. The accomplishment of these systematic reviews can help establishing appropriate preventive measures, improving the quality of diabetes care and planning and executing better quality interventions studies.

Production of useful baseline data on the quality of T2DM care in Al-Ain, and investigation of any improvement in this quality overtime are expected outcomes from the achievement of the second and third objectives of this thesis as outlined in section 3.2. Also, identifying differences in diabetes care provided to different age groups and genders in Al-Ain is a proposed outcome from the accomplishment of the fourth objective, which could assist healthcare professionals and policy planners and makers in addressing the problem and planning for quality improvement enterprises.

Factors influencing the care provided to people with T2DM in the UAE from the perceptions and attitudes of healthcare professionals have received little attention. Identifying factors affecting the quality of T2DM care in Al-Ain including both facilitators and barriers based on the perceptions, attitudes and experience of healthcare professionals are expected from the achievement of the final objective of this thesis. This can help optimizing diabetes care, also researchers can benefit from the data to investigate the factors affecting the quality of diabetes care in Al-Ain or UAE from the perceptions of patients.

Finally, one of the objectives of the UAE's MOH and HAAD is encouraging the research studies focusing on diabetes and its care; including understanding motivators and barriers to providing high quality of diabetes care. This study was undertaken within this objective, making the results immediately accessible and available to real-life practice (see chapter seven, section 7.3).

The corresponding methodologies used, and a reference to presentation of the results for each objective, are listed in table ten.

Table 10: Outline of the five main objectives and the methodologies used.

Objective	Methodology	Presentation of results
1	Systematic reviews	Chapter four
2, 3, 4	Quantitative: cohort study (descriptive & longitudinal analysis)	Chapter five
5	Qualitative: semi-structured interviews (thematic analysis)	Chapter six

3.4 Outline of the thesis

The introductory chapters, chapter one and two aim to respectively present the background of: (1) health and health systems in the UAE; and (2) diabetes care in UAE, particularly Abu Dhabi, along with key concepts such as quality of diabetes care. The objectives and rationale for the thesis have been presented in this chapter. Chapter four represents the systematic reviews carried out to fulfil the requirement of the first objective. Chapter five addresses the methodology, results, discussion and conclusion from the cohort study carried out to examine the quality of T2DM care in Al-Ain, which fulfils the requirements of objectives two, three and four as listed in section 3. 2. Methodology, findings, discussion and conclusion from the qualitative study that was carried out to accomplish the requirements of the final objective outlined in section 3.2 are addressed in chapter six. A summary of the key findings from chapters four, five and six, and a discussion of the contributions made, comparison with other work, strengths and limitations, implications for clinical practice and directions for further research are reported chapter seven.

Chapter 4 : Systematic reviews

To achieve the first objective of this thesis which is to systematically review and demonstrate in the UAE the following: (1) prevalence of T2DM; (2) risk factors for adverse outcomes in people with diabetes including 'pre-diabetic' hyperglycaemia, overweight/ obesity, hyperlipidaemia and hypertensions and their prevalence rates; and (3) quality of T2DM care; systematic reviews were carried out.

A review of all the studies carried out in the GCC on the prevalence, risk factors for adverse outcomes from diabetes, and quality of T2DM management was carried out for the states of the GCC instead of UAE alone. This was because: (1) shortage of studies on diabetes risk factors and management in UAE; (2) similarities in government, political environment, economy, health system, culture and lifestyle between the six Gulf states including Saudi Arabia, Kuwait, Oman, Qatar, Bahrain and UAE ; and (3) possibility of transferring successful diabetes management strategies (where available) that could represent good models for each other, even if thus far perhaps less rigorously validated than alternative international standards.

This chapter is classified into three main sections. The first section includes the systematic review carried out on the prevalence of T2DM in the GCC countries. Secondly, the systematic review on the risk factors for adverse outcomes particularly 'pre-diabetic' hyperglycaemia, overweight, obesity, hypertension and dyslipidaemia is presented. The final section in this chapter presents the systematic review on the quality of T2DM management in the GCC countries. Each section includes a comprehensive explanation of the followed methodology, results from the systematic review and discussion and conclusion.

Each systematic review was performed separately; therefore repetitions may occur in the introduction and discussion between the three systematic review sections.
Prior to presenting the systematic review sections, an overview on the systematic review, its importance in health and the followed frame work and methodological

steps for these systematic reviews performed in this study are addressed in the coming section.

4.1 Overview of systematic review

A systematic review is "a review of a clearly formulated question that uses systematic and explicit methods to identify, select and critically appraise relevant research, and to collect and analyze data from the studies that are included in the review" (95).

Systematic reviews aim to identify, evaluate and summarise the findings of all relevant individual studies, thereby making the available evidence more accessible to decision makers (95, 96). When appropriate, combining the results of several studies using "meta-analysis" gives a more reliable and precise estimate of an intervention's effectiveness than one study alone (98). Systematic reviews have increasingly become essential tools in healthcare; data from them can be a starting point for developing clinical practice guidelines for policy makers. Also, healthcare professionals can utilize from the systematic reviews to keep up to date within their field (96).

In brief as highlighted in figure five, the framework for the systematic reviews that I carried out included three stages: planning, conduction and finally reporting and dissemination of the review findings.

Figure 5: Frame work of the systematic reviews

Stage one: planning the review

- Identifying the need for a review
- Preparing the review proposal
- Developing a review protocol

↓

Stage two: conducting a review

- Selecting the studies
- Assessing the quality of the selected studies
- Extracting and monitoring data from studies
- Synthesising data extracted

↓

Stage three: reporting and dissemination

- Writing the report and recommendation
- Getting evidence into practice by publishing the systematic reviews

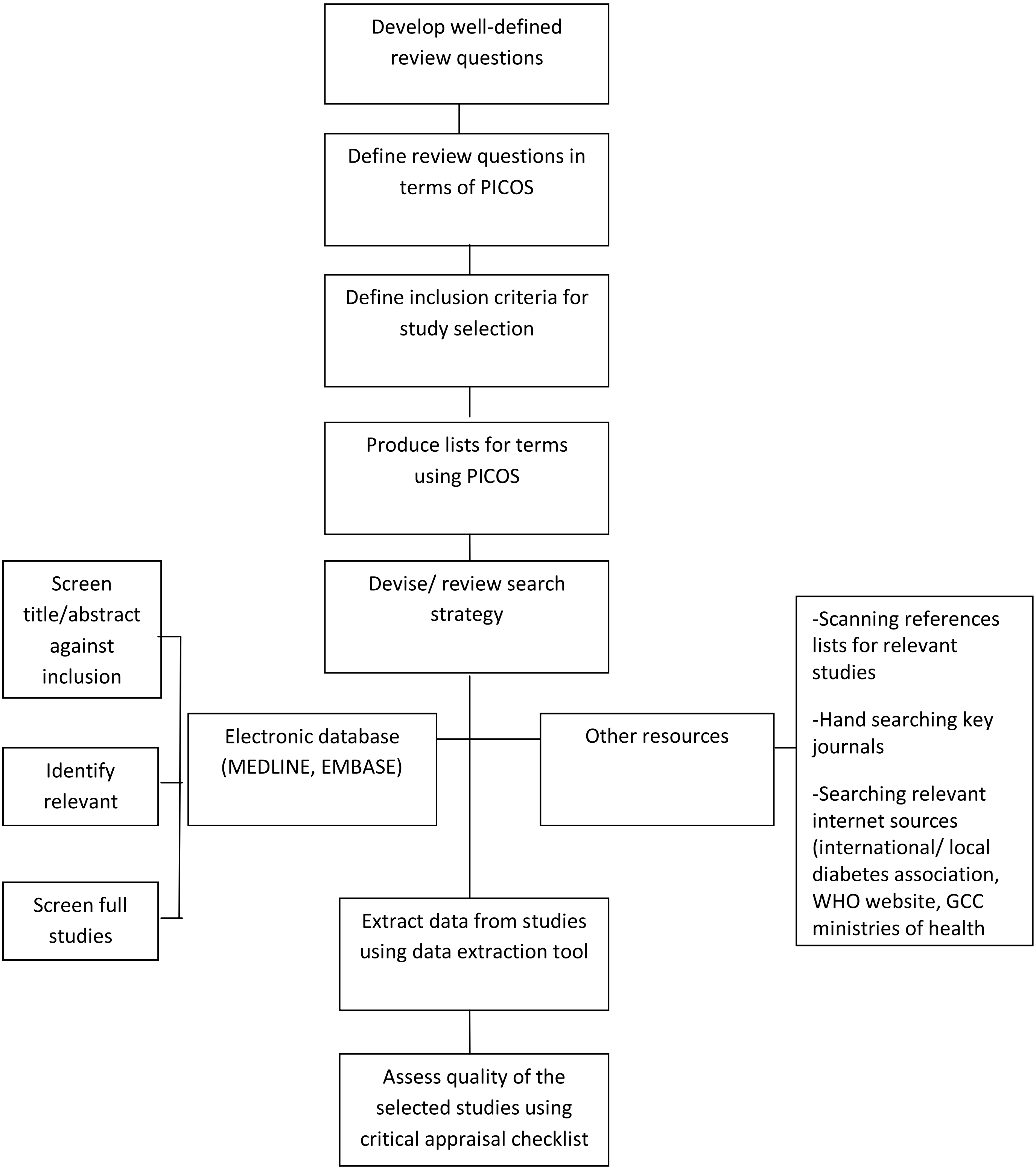
(Modified from reference No: 96)

Details of the process of the systematic reviews carried out for the three topics presented in this chapter including prevalence, risk factors for advocated outcomes and their prevalence rates and quality of T2DM management in the GCC are given in figure six. This include: (1) formatting well defined review questions to maintain the transparency for the review process (2) revising the review questions using

PICOS elements (Population, Intervention, Comparators, Outcomes, Study design); (3) defining the inclusion/exclusion criteria for the study; (4) formulating search terms; (5) devising a search strategy; (6) reviewing the search strategy; (7) appraising the retrieved studies critically; and finally (8) planning for dissemination (96).

To ensure transparent and complete reporting of the systematic reviews that, I used the PRISMA checklist for each review (See appendices 1, 2, 3).

Figure 6: Methodoloigcal steps in systematic review



(Modified from reference No: 95, 96)

Section one: Prevalence of T2DM in the states of the GCC

This section presents the systematic review carried out on the prevalence of T2DM in the GCC countries. It involves the following: introduction, methods (review questions, inclusion/ exclusion criteria, search, study selection process, data extraction, quality assessment, and data synthesis), results, discussion including limitations and implications of the review, and finally conclusion.

4.2 Introduction

The World Economic Forum describes chronic diseases as one of the 'top 6' Global Risks (1). They carry enormous levels of morbidity and have become major causes of mortality. DM is a chronic metabolic disorder caused by defects in insulin secretion, insulin action, or both. If ineffectively controlled, the resulting chronic hyperglycaemia is associated with numerous disabling complications (46).

4.2.1 The T2DM problem

DM is a chronic disease characterised by insufficient insulin production and/or insulin resistance (1). Through its various complications and a widespread high prevalence (1), DM is a major contributor to morbidity and mortality worldwide as outlined in chapter one. Insulin resistance with a relative or real insulin deficiency is the hallmark of T2DM. Over the last 3-4 decades, prevalence of T2DM has risen dramatically across the world (40). It currently accounts for over 90 % of all diabetes cases (46). Various factors including population growth, ageing, continued urbanisation and lifestyle modifications encouraging sedentary lifestyles and obesity, will lead to further increases in prevalence. Diabetes is a major public health issue, carrying huge societal and economic, as well as personal, costs and risks. This has been acknowledged by the United Nations through Resolution 61/225 (2006), which issued a call for Member States to implement strategies to address the burden of diabetes in their societies (43).

4.2.2 T2DM in the Gulf region

The GCC exhibit some of the highest rates of T2DM in the world. Five of the IDF's 'top 10' countries for diabetes prevalence in 2010 and in 2030 are projected to be in this region as addressed in chapter two (1). Rates in Qatar are also relatively high (15.4 % comparative prevalence) (1). The anticipated prevalence for diabetes 2010-2030 in the Gulf countries total population are: United Arab Emirates (UAE) 18.7-21.4%, Kingdom of Saudi Arabia (KSA) 16.8-18.9%, Bahrain 15.4-17.3%, Kuwait 14.6-16.9% and Oman 13.4-14.9% (1). The recent and rapid socio-economic development of the GCC countries has been associated with this rising prevalence. The IDF suggests that even in the absence of further economic development (that is, based on changes in population demography alone), the number of people with diabetes in its Middle East-North Africa region will increase 94% from 2010 to 2030. Only the Sub-Saharan African region is expected to see a greater increase in the number of cases of diabetes (98%) during this period (1, 97).

Management strategies for T2DM are anticipated to be more effective when built around particular population and country parameters. Strategies should aim to prevent the onset of T2DM in the UAE through population-based primary prevention initiatives, and lifestyle interventions for people at high risk of T2DM such as obesity and overweight. My aim here is to review the prevalence of T2DM in the GCC countries, to help establish that the problems in these states are broadly similar; and that their health systems are potentially suitable for implementation of similar management strategies. This is of particular current interest given the recent move within the GCC to co-ordinate control of diabetes care e.g. (43, 46).

In addition to reviewing the general T2DM burden in these countries, I aimed to review, where possible, rates by age, sex, residential environment (urban/rural) and ethnicity. These were all anticipated –based on previous studies and preliminary scoping searches - as putative covariates of prevalence, and thus areas wherein sub-populations may benefit from specifically targeted management strategies.

4.3 Methods

4.3.1 Ethics statement

Ethical approval was not needed as this study was a systematic review of the literature on the prevalence of T2DM in the GCC countries.

4.3.2 Review questions

A literature search was used to identify material relevant to the following review question:

- What is the prevalence of T2DM in the GCC countries?

4.3.3 Inclusion / exclusion criteria

Inclusion criteria

Types of studies

Studies that used designs from the used list of acceptable methods including: observational study (cross sectional, descriptive, ecological, cohort, case-control).

Types of participants

Subjects residing in the GCC countries at all ages, sexes and ethnicities were included, resident and expatriate populations, urban and rural, of all socioeconomic and educational backgrounds in the GCC. I didn't differentiate between studies that used all residents (nationals and non-nationals) and those restricted to nationals in this review.

Exclusion criteria

- Studies that used qualitative methods such as focus group and based on opinions
- Studies where population is mainly pregnant women with T2DM, or people with other types of diabetes such as type one.

4.3.4 Search

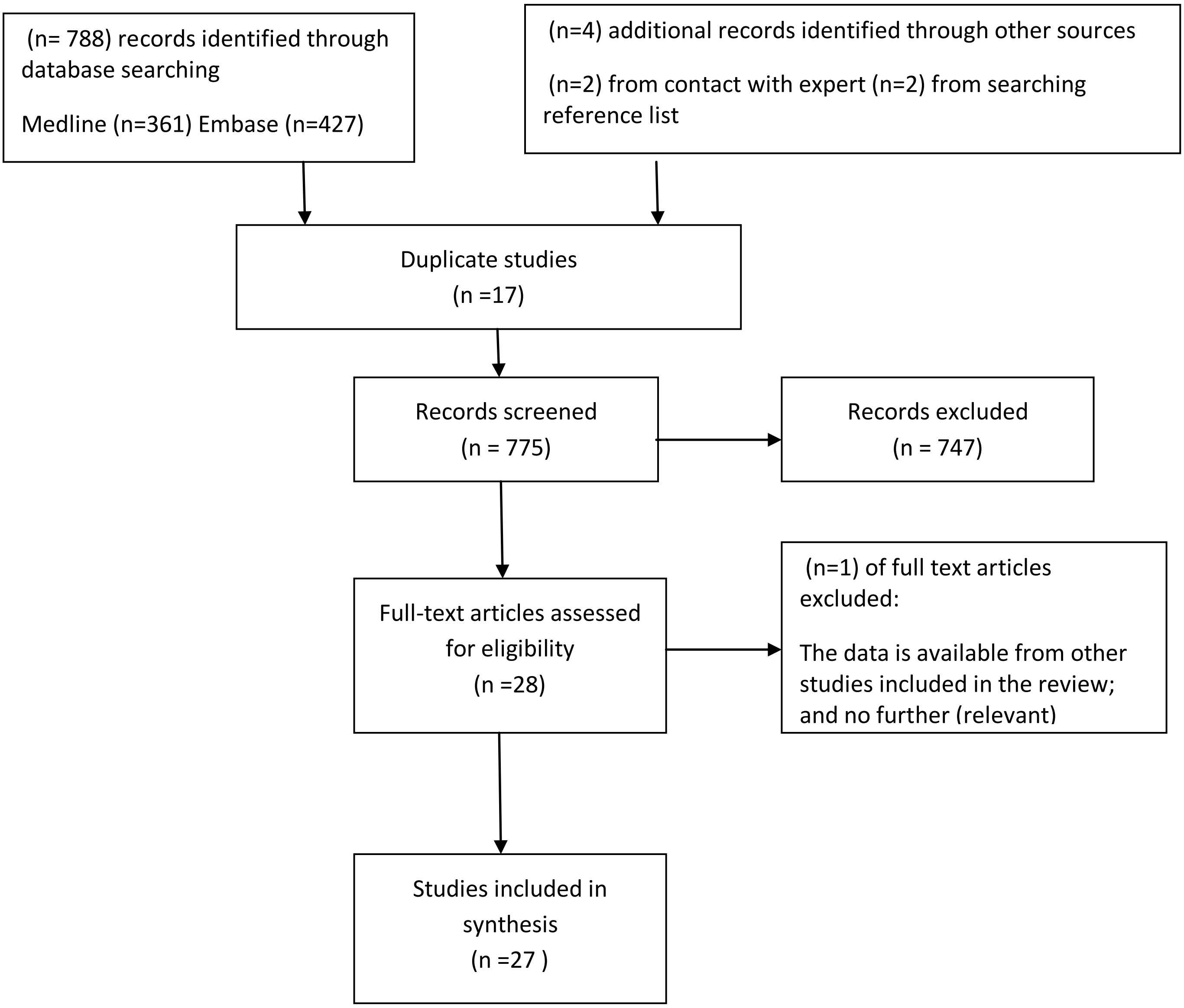
I developed a systematic review protocol (see appendix 4) using the Centre for Reviews and Dissemination (CRD) guidelines (96). Medline and Embase were searched separately on 15/07/2009 and the search was repeated on 03/07/2010 (via Dialog and Ovid, respectively; 1950 to July week 1 2010, and 1947 to July 2010) using terms identified from PICOS deconstruction of the above review questions such as diabetes mellitus, non-insulin-dependent, hyperglycaemia, prevalence, epidemiology and Gulf States, and database- and manually-derived alternatives (appendix 5). The search strategy (see appendix 6) was trialled, reviewed by independent professional colleagues (E.H., K.P.), and updated before use. Further relevant studies were identified by searching the reference lists of the database-derived papers, contacting expert investigators, screening conference proceedings, citation searching and hand searching the International Journal of Diabetes and Metabolism and the Saudi Medical Journal, for the periods 1993- 2009 and 2000-2010, respectively .

4.3.5 Selection

The initial search produced 792 studies. After excluding duplicated studies (17 studies), the titles and abstracts were evaluated by one reviewer (L.A) to determine eligibility for full text screening. No limitations on publication type, publication status, study design or language of publication were imposed. However, I did not include secondary reports of prevalence, such as review articles without novel data synthesis. The inclusion criteria required that the study population be of a GCC country, but otherwise all ages, sexes and ethnicities were included, resident and migrant populations, urban and rural, of all socioeconomic and educational backgrounds. Studies of general-, working-, university- and healthcare attending-populations were included. I did not specify diagnostic criteria, but required that they would detect at least predominantly type 2 (rather than other forms of) diabetes and they were incorporated into our data synthesis.

Twenty-eight studies were identified. The full texts of these studies were each examined by two reviewers (L.A and A.Mc). One study (98) was excluded as the data were already included in other studies (99, 100), and no further (relevant) synthesis had been performed. The full text of a further study (101) could not be accessed, thus the abstract alone was used for review. Additionally, I could not fully access the data published in three studies (102-105), and the extracted data were therefore similarly limited. The selection process is summarised in Figure seven.

Figure 7: Flow chart of study selection process



4.3.6 Data extraction/quality assessment

The data captured for each study included data relating to, (1) methods (study design, recruitment, measurement tools, and analysis), (2) participant characteristics, (3) setting, and (4) outcomes (those observed, their definitions, and results of analysis). Study quality was assessed using a checklist adapted from the CRD guidelines (9) (see appendix 7). Data extraction was performed, in duplication, by two reviewers (L.A and A.Mc).

4.3.7 Data synthesis

I was looking to estimate the prevalence of T2DM in the GCC countries between 1980 and 2009. To estimate the prevalence of T2DM, the related data was entered to STATA version 11 for statistical analysis. To assess the difference in prevalence of T2DM between different GCC countries and years, and to investigate the reasons for heterogeneity between the studies included in the review a subgroup analysis was carried out. Subgroup analysis was performed for each country separately, and for years, which were classified as: (1) 1980-1989; (2) 1990-1999; and (3) 2000-2009. Publication year was used instead of the definite start year, as the last was not indicated in many studies.

Further, the data synthesis was designed around several proposals produced, for the most part, *a priori*, but also included an appraisal of potential association between diabetes and urban/rural residency, after preliminary scoping searches demonstrated that data pertaining to this were commonly reported.

These proposals were therefore:

1. prevalence of T2DM is increasing
2. rates of T2DM in the GCC states are similar
3. prevalence increases with advancing age
4. there is a sex difference in prevalence
5. there are differences in prevalence between urban and rural populations
6. there are differences in prevalence between national and expatriate populations

In addition, prevalence in children was separately considered.

In consideration of the above proposals, synthesis included summarising the results of the data extraction process, considering the strength of evidence relating to each of the questions, and examination of results inconsistent with the formed suggestions.

4.4 Results

Twenty-seven journal-published studies were identified for inclusion. A summary is provided in table eleven, and further details are available in appendices eight and nine. The studies were carried out (where reported) and published between 1982 and 2009. Six studies were published and undertaken in the 1980s, thirteen in the 1990s, eight in the 2000s. Eleven studies were of Saudi populations, three Kuwaiti, two Bahraini, six Emirati, four Omani and one Qatari. Sample sizes ranged from 336 to 600132. All were cross-sectional studies. In 17 cases, the general population was the target population; in four cases, the sample was patients registered with primary health care centres. Three studies estimated prevalence in working populations with or without dependants, one in a university population, one a population of schoolchildren, and one a ‘clinic-attending population’ (clinic type unclear) . In one working population, and the university population, the sample was entirely male.

Table 11: Summary of included studies

Ref/dates of study*	Country	Sample size	Prevalence rate	Age & prevalence	Age & sex
Bacchus et al/ NR (1982)	KSA	1385	No diabetic cases in people <24 years 0.3%: age group 25-34 years 2.6%: age group 35-44 years 9.6%: age group 45-54 years 11%: age group 55-64		
Anokute et al/ 1985-1987	KSA	3158	Overall prevalence 'positive' FBG (unconfirmed DM): 6.0 %	The age specific prevalence increased with age to a maximum of 33.8% for the age group ≥ 50 years.	
Fatani et al/ NR (1987)	KSA	5222	overall prevalence DM 4.3%		prevalence DM lower in men (2.9 %) vs. women (5.9 %; p< 0.001)
Balasy & Radwan/ 1989[2]	UAE	1517	Age adjusted prevalence rate for DM: 5.69% Prevalence of DM among males vs. females: 1.81% vs. 2.58% respectively	The age specific prevalence of DM was steadily increasing until age 59 in both genders	Prevalence of DM among males vs. females: 1.81% vs. 2.58% respectively
Abu-Zeid and Al-Kassab/ 1989	KSA	1419	Overall prevalence DM 4.6%		Prevalence of DM in men (5.5 %) than women (3.6 %; p < 0.05); overall prevalence IGT: 3.7 %; higher in women (4.9 %) vs. men (2.5 %; p < 0.01)
Abdella et al/1989-1990	Kuwait	261387	Overall prevalence DM: 7.6 %	Prevalence generally increased with age in both sexes in both areas (rural and urban) (no test for significance)	Prevalence was generally greater in females (no test for significance)
El-Hazmi et al/	KSA	23493	The prevalence of T2DM: 4.9%	The prevalence of DM peaked in the	

1991			The prevalence of IGT: 0.7%	age group≥ 30 years (P<0.001)	
El-Hazmi et al/1991	KSA	2060	The overall prevalence of T2DM: 6.89%; IGT: 0.77%		
Al-Lawati & Mohammed / 1991	Oman	4682	Prevalence of DM: 10.5 % by WHO criteria, 8.2 % by ADA criteria Prevalence of IGT 10.5 % by WHO criteria, 5.7 % by ADA criteria		
Al-Nuaim/ 1991-1993	KSA	13177	Overall prevalence DM: 12 % in urban males, 7 % rural males, 14 % urban females, 8 % rural females Overall prevalence IGT: 10 % in urban males, 8 % in rural males, 11 % in urban females, 8 % in rural females		
Mahfouz et al/1993	KSA	600132	Prevalence DM 9.7 % in males, 9.8 % in females Prevalence IGT 8.1 % in males, 12.9 % in females		Prevalence DM 9.7 % in males, 9.8 % in females
Al-Shammari et al/ 1993-1994	KSA	2990	Overall prevalence DM 12.2 %		
Glasgow et al/ 1995	UAE	< 33 % of > 29809	The rate of DM from the two databases for UAE citizens >30 years: 5.7% and 11.2%	In one of the databases the rate of DM increased from 1.4% in the age group 30-34 years to between 8.9% and 11% in the age group > 40-44 years.	
Al-Mahroos & McKelcue/ 1995-1996	Bahrain	2002	Overall prevalence DM: 29.8 %		prevalence DM in males 40 - 49: 22.9 %; 50 - 59: 29.6 %; in females 50 - 59: 35.4 %; 60 - 69: 37.6 %

Townsend/ NR (1997)	UAE	336	Overall prevalence unclear 6.2% , > 30 years found to be diabetic 19% of subjects >20 years had IGT in previously undiagnosed: 4.8		
El-Hazmi et al/ NR (1998)	KSA	25337	The prevalence of T2DM and IGT: 5.63% and 0.5% respectively in males, in females: 4.53% and 0.72% respectively	The prevalence of T2DM was 0.12% and 0.79% in people< 14 and people aged 14-29 years respectively. In the age ≥ 60, the rate increased to 28.8% and 24.9% in males and females respectively.	Prevalence of T2DM in males vs. Females respectively: 5.63% vs. 4.53%
Al-Nozha et al/ 1995-2000	KSA	16197	Overall prevalence DM 23.7 %		prevalence higher in males: 26.2 % (95 % CI 25.2 - 27.2) vs. females 21.5 % (95 % CI 20.6 - 22.4; p < 0.0001) (significance unclear); overall prevalence IFG 14.1 % (no gender difference)
Malik et al/ 1999-2000	UAE	5844	overall prevalence DM: 21.4 % (95 % CI 20.4 - 22.4 %) Prevalence in UAE citizens 25 %, expats 13 - 19 %		prevalence in men 20.4 % (18.8 - 22.0 %); prevalence in women 22.3 % (20.9 - 23.7 %_
Asfour et al/ 2000	Oman	5096	Crude prevalence of DM: 10% in both gender.	In both gender, the prevalence of IGT increased with age, it peaked in the age group (60-69)	(11) Asfour et al/ 2000
Al-Asi/ 2000	Kuwait	3282	Overall prevalence of DM: 17%		

Al-Mahroos and Al-Roomi/ NR (2001)	Bahrain	2013	overall prevalence DM 30 %		
Moussa et al/ 2000-2002	Kuwait	128918	Overall prevalence DM: 34.9 per 100000 (95 % CI 24.7 - 45.1)	Significantly higher prevalence T2DM with advancing age ($p = 0.026$).	Prevalence of DM in males 47.3 per 100000 (CI 28.7-65.8); females 26.3 per 100000 (CI 14.8-37.8). significantly higher prevalence T2DM in males ($p = 0.05$)
Al-Lawati et al/ NR (2002)	Oman	5838	Prevalence of DM among male and female: 11.8% vs. 11.3% respectively ($P=0.275$)	Prevalence of DM rose with age and exceeded 20% in both genders at the age of 50 years	IGT was more prevalence among males than females 7.1% vs. 5.1% ($P<0.001$)
Baynouna et al/ 2004-2005	UAE	817	Overall prevalence DM 23.3%; prevalence by age and gender: males: 5.1 % 20 - 29 years, 11.1 % 30 - 39 years, 29.5 % 40 - 49 years, 35.5 % 50 - 59 years, 55.9 % > 60 years; females: 1.7 % 20 - 29 years, 5.3 % 30 - 39 years, 26.2 % 40 - 49 years, 27.1 % 50 - 59 years, 43.3 % > 60 years		
Saadi et al/ 2005-2006	UAE	2396	Overall prevalence DM: 10.2 % (9.4 % in males, 11.1 % in females); prevalence in 30 - 64 years population: 20.6 % (17.7 % in males, 22.1 % in women)		
Al-Moosa et al/ NR (2006)	Oman	5840	overall prevalence DM: 11.6 % (11.8 % in males, 11.3 % in females		
Bener et al/ 2009	Qatar	1117	Overall prevalence DM: 16.7 % (15.2 % males, 18.1 % females)	Age significantly associated with DM ($p = 0.0001$, multiple logistic regression analysis); peak age DM 40	

				- 49 years (58 %)	

NR: not reported

(*): the publication year was used instead when the study date was not reported

4.4.1 Prevalence of T2DM and association with time and countries

21 studies were included in the sub-analysis based on methodological consideration (99, 100, 104-123). The sub-analysis suggested that estimated prevalence had increased across the three time periods listed in the data analysis section respectively (3.58% [95% CIs, 1.94-5.23; 2 studies] 101, 102; vs. 4.01% [95% CIs, 3.58-4.43; 10 studies] 106-116; vs. 5.06% [95% CIs, 4.02-6.09%; 10 studies] 116-123, 104, 105). The differences in the estimated prevalence rate of T2DM in the GCC countries between the three periods was not statistically significant p=0.9.

Subgroup analysis by country indicated that the estimated prevalence rates of T2DM between GCC countries are comparable. The lowest estimated prevalence rate was found in KSA 4.01% [95% CIs, 3.60-4.43; 10 studies] 104-108, 110,111, 113, 114, and 116; followed by Oman 4.5% [95%CIs, 3.16-5.85; 4 studies] 103, 104, 116, and 126. Bahrain, in contrast, had the highest estimated prevalence rate of T2DM among GCC countries at 5.17% [95%CIs, 2.48-8.93; 2 studies] 115 and 117. However, the estimated prevalence rates between Qatar, UAE and Kuwait were close (5.12 [95% CIs, 0.39-9.85; 1 study] 125; vs. 5.10% [95% CIs, 2.90-7.30; 3 studies] 100, 120 and 121; vs. 5.14% [95% CIs, 1.45-8.82; 1 study] 109; respectively). Although as mentioned earlier based on the IDF data the prevalence of T2DM in the GCC is one of the highest in the world, different results found from this analysis. High prevalence rates of T2DM in the GCC was found, but not as described' the highest in the world'.

4.4.2 Prevalence of DM and age

Four studies (all studies in which testing was well described) demonstrated a significant association between advancing age and prevalence of diabetes (109, 120, 122, 123). There was otherwise, where reported, an apparently similar association of unclear significance, or in some cases, such an association until 40 - 49 (121), 59 (104) or 60 (115) years, after which point the prevalence appeared to decrease, or fluctuate. Fatani et al (107), report an association (multiple logistic regression analysis; $P<0.0001$) between age and blood glucose levels.

4.4.3 Prevalence of DM and sex

Significant sex differences were reported in six studies (including that of schoolchildren). All except one relatively old report (106) were in favour of a male predominance (107, 112, 113, 117, 121). In nine further studies, however, higher prevalence, of undetermined significance (or close to significance: (117)), was observed in females. This was the case for males in two studies. A further three studies showed no significant gender difference.

4.4.4 Prevalence of DM and residential environs

Urban versus rural prevalence was commented on in five studies (107, 108, 112, 117, 124). All except the oldest study (107) reported higher prevalence in urban areas.

4.4.5 Prevalence of DM in children

Prevalence in children was consistently reported to be low: 0.035% (121), 0.027 % (116), 0.033% and 0.099% (in urban and rural populations, respectively; (108)).

4.4.6 Prevalence of DM in national/expatriate populations

The prevalence of diabetes in UAE-resident expatriate populations, versus that in UAE citizens, was considered in only one study (123). The UAE citizens appeared to have relatively high rates of disease, although no statistical methods were employed to test this suggestion.

4.5 Discussion

I reviewed the prevalence of T2DM in the GCC region, and any differences by country, age, sex, urban-rural residence and ethnicity, but couldn't review the prevalence among nationals vs. non-nationals as this was limited only by one study. I identified 27 papers for review, and descriptive results from the review indicated that prevalence of T2DM in the GCC countries ranged between 4.3%-34.9% for studies published between 1980 and 2009. The estimated prevalence of T2DM in Qatar, UAE and Kuwait were close as the included studies were carried out in the same period between 2000 and 2008; however lower prevalence were observed in KSA and Oman as six of the studies included were carried out between 1990 and 1999, two studies in 1980s and two studies in 2000. The higher rates seen in Bahrain; however could be a result of the documented high prevalence rates in the two studies (115, 119) included in the sub-analysis by country (29.8% and 30%).

The observed high prevalence of diabetes in the GCC states is likely to be associated with the high prevalence of risk factors for T2DM in this region. The IDF suggests age, obesity, family history, physical inactivity, race and ethnicity, and gestational diabetes to be risk factors for T2DM (1, 124). I recently observed that overweight, obesity and hyperglycaemia are present at high levels in the GCC states (125). I also noted the aging of the GCC populations, which is a likely contributory factor to the increasing prevalence.

The study was also suggestive that prevalence increases with age (at least to 50-60 years), and that urban residence is associated with higher prevalence. The importance of age as a risk factor is consistent with previous data, from many contexts (124, 125). The prevalence of T2DM increases with age and among people living in urban areas.

4.5.1 Quality consideration

There were some inconsistencies in the tabulated results: both generally, and within the country of investigation. The studies of El-Hazmi et al (111) and Mahfouz et al (113) produced relatively low results, inconsistent with the general trend. The El-Hazmi et al sample is 39.1 % children < 14 years, which may account for the low rates (111). The authors report a 'significant' increase in prevalence with age, but we could not access the full data and the statistical methods used were not well-described. I have suggested a higher prevalence with advancing age of unclear significance, but with rates of 0.12 % and 0.79 % in those < 14 and 14 – 29 years, respectively, and rates of 28.82 % (males) and 24.92 % (females) in those > 60 years, this is potentially rather conservative. Indeed, the prevalences in these populations are much higher when children are removed from the calculation, although insufficiently to interrupt the general trends observed. This cannot however, explain the low rates reported by Mahfouz et al (113), and so I consider that these may be due to inclusion of only previously diagnosed people with diabetes (and omission of the often substantial 'undiagnosed' population), but
concede that the result could still be relatively low, and of importance given the sample size (113).

I cannot extend the observed association between T2DM and age to children. Low prevalences of T2DM in children have been reported since the late 1990s (date of first identified study). However, the data are few; insufficient to evaluate the possibility that prevalence in children is increasing, as has been observed in other countries (124, 125).

The relationship between T2DM and sex was unclear. I noted, where tested, predominance in males. Wild et al (40) have reported this to be the case ('globally') for individuals < 60 years. Even where these differences may exist, however, they generally appear to be slight. By contrast, I did observe higher prevalence associated with urban (cf. rural) residence, which again has been observed by others e.g. (130; 131).

Only a few of the included studies excluded patients with type 1 diabetes (including the study in schoolchildren) and/or pregnant women. It is therefore likely that in the majority of samples tested, the prevalence suggested includes small numbers of type 1, gestational, and potentially other forms of diabetes.

The majority of studies relied at least in part on the various WHO criteria for diagnosis. There is mild variation in definition by edition of WHO criteria, with discrepancies producing differences in estimations of the extent demonstrated by Al-Lawati and Mohammed (112), and only the later editions (1998 onwards) are consistent with those of the ADA. Some studies, however, used definitions of diabetes and methodological approaches that led to results relatively difficult to use comparatively. Some relied on previous records alone to make diagnoses (where the diagnostic criteria used were often unclear), and so potentially missed an 'undiagnosed' section of the diabetes population, which has been reported to be potentially substantial (104, 105, 122, 120). By contrast, relying purely on blood sampling to estimate of prevalence may have missed a significant number of cases of treated, well-controlled disease (109).There were also concerns that loss of difficult cases to secondary care (117), or identification only of cases sufficiently severe to merit secondary care (110), may have resulted in estimated prevalences providing relatively poor estimates for the general population.

4.5.2 Limitations of review

The heterogeneity of the reviewed studies, and variable availability of sub-group data, was a major limitation in our review process. All of the reviewed studies were published in English. Clarity of reporting was a relatively frequent quality issue, but I did not exclude any study on this basis. Indeed, with such paucity of data and inability to draw more than broad conclusions anyway, I included even studies without full data availability, and one where only the abstract could be accessed.

One of the main limitations is that sub-group analysis of the prevalence of T2DM based on the age groups was not possible to be carried out because of the different age bands used in the studies and the lack of patient-specific data.

Although four studies (112, 117, 121,122) had high rate of loss of follow-up (>20%), they were included in the review. In three of these studies (11, 117, 122), the target number of subjects that were supposed to take part in these studies was unreachable. For instance, in two studies (121,122) 382 and 861 subjects respectively were not resident at the address given. Other reasons for high loss to follow-up were participants' death, travelling abroad, refusal to participate in the studies, and exclusion based on health grounds. Bener et al. (123) was included although details on the high rate of loss of follow up was not mentioned because it is the single study carried out in Qatar, and excluding it from the review would not help us draw an estimated prevalence rate of T2DM in this country. All of these factors impact on the strength and confidence of the proposals.

4.5.3 Implications

The relatively high levels of T2DM in the GCC region, and increasing prevalence, suggest that novel, or more widespread, management strategies will be important to averting an increasingly unmanageable problem. This may be particularly so given the observed associations with urban residence and age, within a context of continued urbanisation and unfavourable trends in population demography. The nature of the problem is probably similar across the different GCC states (with the possible exception of Oman, for which data are limited). Potentially, then, cross-implementation of management strategies would provide relatively high levels of success, and a co-ordination of effort would likely be relatively cost-effective. Cost is particularly important given the size of the problem, the observed impact on the working population, and the nature of migrant populations within the GCC region.

The migrant populations contribute greatly to the currently high rates of population growth in these countries. General prevalence could thus be hugely influenced by differential disease rates between national and expatriate populations. This is particularly important to estimates of future rates of disease as these are usually based – at least in part – on predicted changes in population demographics. As the GCC countries have strict nationalisation policies, and the vast majority of expatriate workers are not national citizens, these countries are at relatively high risk of fluctuation in population size and structure, and predictions regarding demography are thus relatively difficult to make. Economic change could have a particularly strong impact on population structure, and building such possibilities into strategies for disease management, when this is itself of significant economic status, is important.

Given these issues, I find the observed infrequent consideration of ethnicity as a variable particularly striking, and anticipate that continued study of this issue would be useful. Study of physical inactivity – another risk factor for T2DM may also be useful. Finally, I expect that study of prevalence in children would be helpful, particularly given the recent rise in childhood prevalence reported elsewhere, as the available data are minimal. Longitudinal studies in both children and adults are desirable, as longitudinal data are lacking and such studies would be the optimal way to observe changes in prevalence with time.

4.6 Conclusions

This is the first systematic review has been undertaken in the countries of the GCC to estimate the prevalence rate of T2DM. There were several methodological challenges; in particular, the different populations studied and methods used to assess glycaemic status. This review presents the high prevalence of T2DM in the region and the increasing burden of this disorder over time in the GCC countries, which is in line with statistics from the IDF on the “top 10” countries for diabetes prevalence in 2010 and in 2030 . Primary prevention strategies may be useful in reducing its incidence in the GCC region. Finally, I recommend further epidemiological studies to estimate the prevalence of T2DM in the area and to observe any changes in prevalence rate over time, using longitudinal data collection in higher-quality studies that would give accurate statistics on diabetes prevalence, including prevalence in key population sub-groups.

Section two: Prevalences of overweight, obesity, hyperglycaemia, hypertension and dyslipidaemia in the GCC

This section presents the systematic review carried out on the prevalence of overweight, obesity, hyperglycaemia, hypertension and dyslipidaemia in the GCC countries. It involves the following: introduction, methods (review questions, inclusion/ exclusion criteria, search, study selection process, data extraction, quality assessment, and data synthesis), results, discussion including limitations and implications of the review, and finally conclusion.

4.7 Introduction

The increasing prevalence of DM, particularly T2DM, is well documented (1).T2DM is currently estimated to account for over 90 % of the global diabetes burden (40). Together with similar trends in other non-communicable diseases, it leads to risks not only for individuals, but for health systems, social systems, and state economies. This risk is in part to do with an anticipated relatively dramatic rise in countries with relatively young populations, and still developing economic infrastructure, as they undergo the predicted increases in prevalence of diabetes associated with changes in lifestyle and economic development, and population growth. Even when based on changes in population size and demography alone (40), the highest predicted future increases are expected in the IDF 'African' region (estimated: 98.1 % increase 2010 – 2030), followed by the 'Middle East-North Africa' region (estimated: 93.9 % increase 2010 – 2030; 1).The Middle East-North Africa region already has some of the highest rates of diabetes in the world. The GCC include those currently ranked 2, 3, 5, 7 and 8 for diabetes prevalence among the 216 countries for which data are available (40, 126).

This high prevalence in the GCC states is associated with higher prevalences of risk factors for T2DM. The IDF suggests the following as risk factors for T2DM: age, obesity, family history, physical inactivity, race and ethnicity, and gestational diabetes. Of the modifiable risk factors, physical inactivity appears to have been surprisingly little studied in this region, although it is likely to be correlated with overweight and obesity, which have been relatively well studied (126-128).

I aimed to review the prevalence of overweight and obesity in the GCC region. I also aimed to review the prevalence of potentially 'pre-diabetic' hyperglycaemia (measured either as impaired fasting glycaemia, impaired glucose tolerance or raised random glucose). Added to that, I examined hypertension and dyslipidaemia, which are risk factors for adverse outcomes in people with diabetes (129-132). Diabetes is complicated by various micro- and macro- vascular conditions and people with metabolic syndrome - a collective of obesity, insulin resistance, dyslipidaemia, hypertension and hyperglycaemia (133-135) - have a relatively higher prevalence of cardiovascular disease than those without (129). Due to the heterogeneity of studies identified on preliminary searching, there was no anticipated meta-analysis.

4.8 Methods

4.8.1 Ethics statement

Ethical approval was not needed as this study was a systematic review of the literature on the prevalence of overweight and obesity, hyperglycaemia, hypertension and dyslipidaemia in the GCC countries, with no primary data collection.

4.8.2 Review question

A literature search was used to identify material relevant to the following review question:

- What are the prevalences of overweight and obesity, hyperglycaemia, hypertension and dyslipidaemia in the GCC region?

4.8.3 Search strategy

I developed a systematic review protocol (Refer to appendix 10) using CRD guidelines (96). Medline and Embase were searched separately on 15/07/2009 and the search was repeated on 03/07/2010 (via Dialog and Ovid, respectively; 1950 to July week 1 2010, and 1947 to July 2010) using terms identified from PICOS deconstruction of the above review questions such as hyperglycaemia, high blood glucose, blood pressure, hypertension, hyperlipidaemia, cholesterol, overweight, obesity and GCC, and database- and manually- derived alternatives (appendix 11). The search strategy was trialled, reviewed by independent professional colleagues (W.I., K.P.) (Refer to appendix 12) and updated before use. Further relevant studies were identified by searching the reference lists of the database-derived papers, contacting expert investigators, screening conference proceedings, citation searching and hand searching the International Journal of Diabetes and Metabolism and the Saudi Medical Journal, for the periods 1993- 2009 and 2000- 2010, respectively .

4.8.4 Selection of studies

The search yielded 1331 studies. The titles and abstracts were evaluated by one reviewer to determine eligibility for full screening. All studies wherein overweight, obesity, BMI, hyperglycaemia, hypertension and dyslipidaemia were investigated were eligible for inclusion. No limitations on publication type, publication status, study design or language of publication were imposed. However, I did not include secondary reports such as review articles without novel data synthesis. The inclusion criteria required that the study population be of a GGC country, but otherwise all ages, sexes and ethnicities were included, resident and expatriate populations, urban and rural, of all socioeconomic and educational backgrounds. Studies of general-, working-, young-, student-, healthcare attending-, and other- populations were included. I did not specify diagnostic criteria for the studied conditions, but incorporated them into our data synthesis.

1331 studies were identified. The full texts of these studies were each considered by two reviewers (L.A. and A.M.). All studies of diabetic populations were excluded (136-138), and studies wherein people with diabetes had been excluded from the study population were excluded (139, 140). Further exclusions were made on the basis that the studies were:

- reviews without relevant novel synthesis (141, 142)

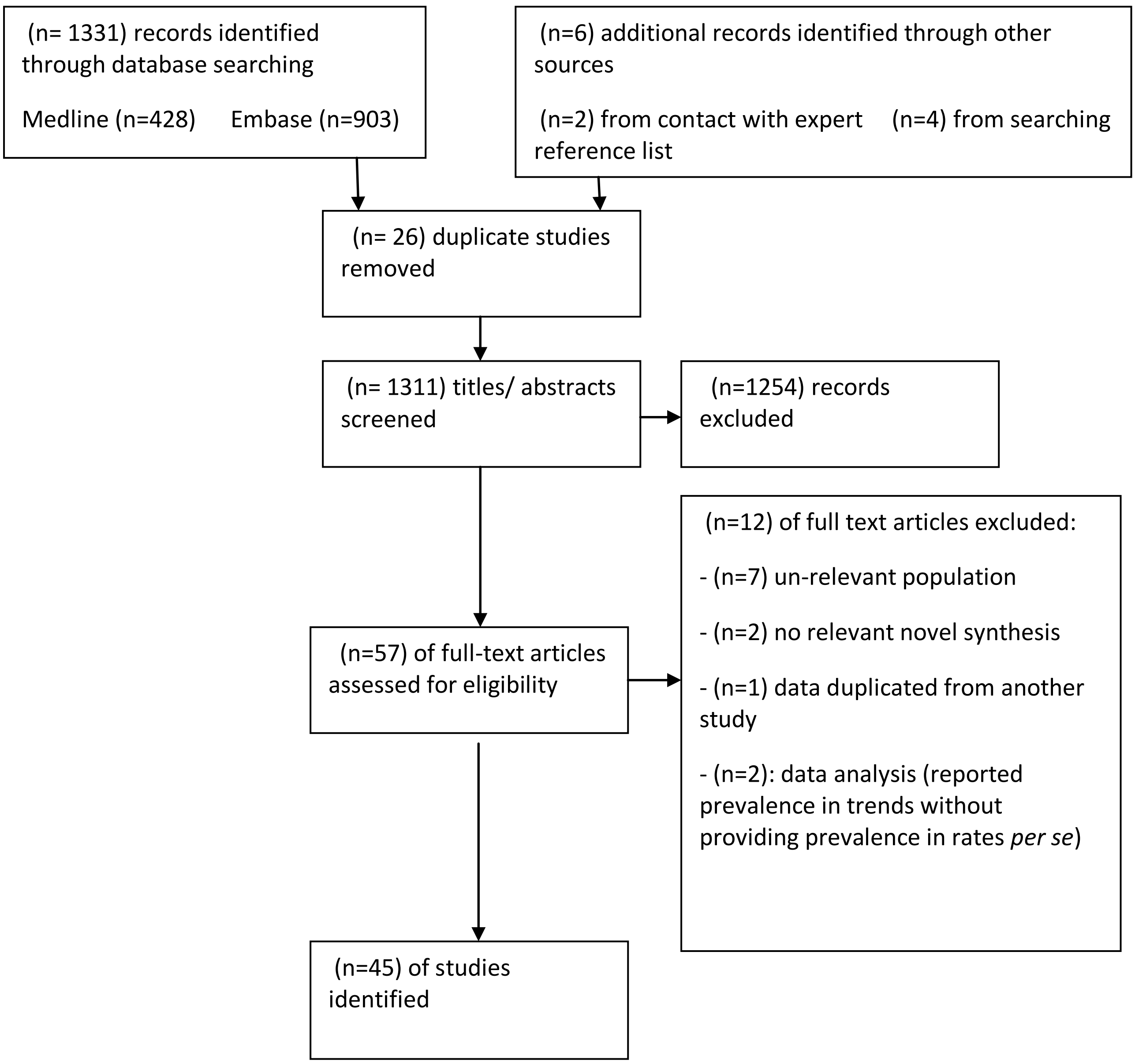
- of a population outside the GCC region (143)

- reported trends in prevalence, without providing prevalence rates *per se* (144, 145)

- duplications of data contained in other studies (146)

The selection process is summarised in Figure eight.

Figure 8: Flow chart of study selection process



4.8.5 Data extraction/quality assessment

The data extracted from each study included data relating to, (1) methods (study design, recruitment, measurement tools, analysis), (2) participant characteristics, (3) setting, and (4) outcomes (those observed, their definitions, results of analysis). Study quality was assessed using a checklist adapted from the CRD guidelines as outlined in appendices 13 and 14 (96). As the identified studies were relatively few and heterogeneous, no study was excluded on the basis of quality alone; rather the assessment was used to inform synthesis. Data extraction was performed, in duplication, by two reviewers (L.A. and A.Mc), and disagreement regarding any study eligibility was resolved through consensus and seeking the opinion of the third reviewer (A. Mc).

4.8.6 Data synthesis

Data synthesis included summarising the results of the data extraction process, considering the strength of evidence relating to various questions formulated *a priori* (see 'Results'), and examination of results inconsistent with our formed proposals. In the cases of hypertension and dyslipidaemia, synthesis was limited by the number of studies identified, and in these cases description and discussion suffices.

4.9 Results

45 studies (43 papers) 41, 99, 100, 102-123, 147-165 relating to risk factors and their prevalence were identified for review. All papers identified were journal articles published between 1987 and 2010. Five studies were carried out (where reported) and/or published in the late 1980s, 23 in the 1990s, and 15 in the last 10 years. Studies of various 20 Saudi, 7 Kuwaiti, 3 Bahraini , 8 Emirati , 4 Omani and 1 Qatari populations were included. All were cross-sectional studies; 23 of the general population, seven of primary care populations, four of school children, three of students, one of a young population, five of working populations. Females were exclusively studied in five cases, males in six. Sample size ranged from 215 to 25337.

In addition to examining the prevalence of the particular risk factors in the GCC states, I was interested in the following:

1. trends in prevalence across time

2. differences by country
3. trends in prevalence associated with age
4. sex differences
5. location (urban/rural) differences
6. prevalence in children

Only in the cases of overweight and obesity, and hyperglycaemia were study numbers sufficient that reasonable conjecture regarding subgroups could be made. They are considered separately, for each risk factor, below.

4.9.1 Obesity/overweight

33 studies addressed the prevalence of overweight/obesity (summarised in table twelve)

4.9.1.1 Overweight and effect of date and country

The reported prevalence rates of overweight (BMI 25 to < 30) in adults ranged from 26.3 % to 48 % in males, 25.2 % to 35 % in females. Although higher values are displayed in table 10 , they have been scaled down for/omitted from comparison as either the definition of overweight used included the typical definition of obesity, or the prevalence was given only by age group, allowing the possibility that similarly high figures were masked in the age non-specific data of other studies. A lower value has also been omitted where the study population was particularly young (156). Within these ranges, the data were fairly even distributed between the limits, and reported sex-non-specific prevalences were also consistent with these figures. The data showed no obvious trends or anomalies by date or country, although the data from Oman (two studies, reporting combined overweight/obesity rates) suggest prevalence there may be relatively low.

4.9.1.2 Obesity and effect of date and country

The reported general prevalence rates of obesity (defined as BMI $\geq$ 30) in adults ranged from 13.05 % to 37 % in males, 16 % to 49.15 % in females (again a lower value has been omitted where the study population was particularly young; 154). As for the overweight data, the reported sex-non-specific data are consistent with these figures, and potentially excepting the Omani data, show no obvious trends or anomalies by date or country.

4.9.1.3 Obesity and overweight and age

Age as a potential predictor of prevalence of overweight/obesity was considered in eight studies (of adult populations), and the results were tested for significance in two cases. These latter studies demonstrated correlation between overweight/obesity and age (112), and a significantly higher mean BMI in a 45 – 54 years age group versus a 55 – 64 years age group (19). Similarly, all remaining studies indicated that prevalence increased with age to a threshold level (variably between 30 – 40 and 50 – 60 years (potentially younger in females) after which it began to fall, or fluctuate (149, 150, 155).

4.9.1.4 Obesity and overweight and sex

Most studies reported prevalence rates by sex, but only four tested for differences. Of these four, in all cases but one, BMI/prevalence of obesity and overweight was higher in females (154,104, 118), and where overweight was higher in males (111), the combined prevalence of overweight/obesity remained higher in females. In the remaining studies, prevalence of obesity, and the combined prevalence of overweight/obesity was again always higher in females, although in some cases the 'difference' was slight.

4.9.1.5 Obesity and overweight and residential environs

Six studies considered prevalence in urban versus rural populations. In three, mean BMI was found to be significantly higher in rural populations (114; 154). In a further two studies, prevalence of both overweight and obesity were significantly lower in rural regions (152; 16). This trend (with one subgroup exception (female obesity) was also observed where significance of differences was unclear (152).

4.9.1.6 Obesity and overweight in national/expatriate populations

Only one study considered prevalences in national versus expatriate populations. This reported that the combined prevalence of obesity and overweight was higher in Kuwaitis versus non-Kuwaitis (158).

4.9.1.7 Obesity and overweight in children

In keeping with the association with age, prevalences in children/young people (< 20 years) are lower than those in adult populations. However, there is a greater indication that prevalences in the younger populations are increasing. Single figure prevalences were reported until around 2000, and have not been observed since. The most recent reports (suggesting prevalences of combined overweight and obesity > 30 %) provide rates comparable to those in adults. Although less considered, there is again evidence for higher prevalences with increasing age in these relatively young populations (162, 148, although see 158), in urban areas (41) and in females (165, although see 41).

Table 12: Summary of overweight/ obesity

Ref/dates of study	Population sampled	Country	Sample size	Population characteristics			Definitions		Results			
				% male	Age (years; range unless specified)	Residency status; area(s) of residence	Overweight (if not 25 to < 30)	Obesity (if not ≥ 30)	Prevalence overweight (%)		Prevalence obesity (%)	
									Males	Females	Males	Females
Al-Isa/ 1980 – 1981	PC	Kuwait	1171	0	18 to > 60	Kuwaiti nationals	> 25			59.2		32.2
Al-Isa / 1980 – 1981	PC	Kuwait	2067	43.3	18 to > 60	Kuwaiti nationals	> 25		21.7 to 69.4 (age-dependant)	as Al-Isa, 1997a (above)	8.5 to 24.1 (age-dependant)	as Al-Isa, 1997a (above)
Al-Othaimeen et al / 1985 – 1988	GP	KSA	17892	48.5	18 to < 61	Saudi nationals			30.7	28.4	14.2	23.6
Al-Mannai et al/ 1991 – 1992	GP	Bahrain	290	47.2	20 - 65	Urban/rural mix			26.3	29.4	16.0	31
Al-Nuaim et al/ 1990 – 1993	GP	KSA	13177	52	15 to > 60	Saudi nationals			33.1	29.4	17.8	26.6
Al-Saif et al/ 1990 – 1993	PC	KSA	3261	49.5	30 - 70	Saudi nationals; urban/rural mix			41.91	31.55	29.94	49.15
Al-Shammari	PC	KSA	1385	0	16 - 70	Urban/rural mix				26.8		47.0

et al / 1992												
Musaiger et al/ NR	SP	UAE	215	0	18 – 30	Emirati nationals				19		9.8
Al-Shammari et al/ 1994	PC	KSA	1580	100	> 16	Urban/rural mix			34.8		28.6	
El-Hazmi et al/ 1993-1994	Military hospital	KSA	1485	46.1	18 – 91	Saudi nationals			40.1	31.5	21	40.5
Al-Rukban et al/ 1993 -1994	WP*	KSA	2990	NR[oo]	< 25 to > 60	94.7 % Saudi nationals			30.3		24.5	
Jackson et al/1993 – 1994	PC[#]	Kuwait	1705	0	18 to > 60	Kuwaiti nationals	> 25			72.9		40.6
Jackson et al/ 1993 – 1994	PC[##]	Kuwait	3435	50.3	18 to > 60	Kuwaiti nationals	> 25		44.3 - 75.1 (age-dependant)	as Al-Isa, 1997a (above)	17.1- 35.6 (age-dependant)	as Al-Isa, 1997a (above)
Al-Haddad et al/ NR	SC	UAE	4075	43.9	6 – 17	UAE nationals	Overweight: 85th - 95th percentile Obesity: > 95th percentile or BMI > 30		8.5	9.3	7.9	7.9
Al-Turki / NR	GP	KSA	14660	42.0	14 – 70	Saudi nationals			27.23	25.20	13.05	20.26

Al-Hourani et al/ 1998 – 1999	SC	UAE	898	0	11 - 18		Overweight: 85^{th} – 95^{th} percentile Obesity: > 95^{th} percentile			14		9
Moussa et al / 1998 – 2000	WP[o]	Kuwait	9755	48.0	Mean age + SD: Females: 33.3 + 11.6; Males: 29.2 + 8.2	Kuwaiti nationals			38.3	32.8	27.5	29.9
Malik et al/ 1998 – 1999	SC	UAE	4381	49.6	5 – 17	48.0 % UAE citizens; 81.7 % urban	IOFT criteria		19.2	19.8	13.1	12.4
Al-Asi et al/ 1998 – 2000	WP[o]	Kuwait	740	100	45 – 80	Kuwaiti nationals					37	
Abdella et al/ 1999 – 2000	WP**	Kuwait	3282	85	54 % < 40	62 % Kuwaiti nationals			48		27	
Sheikh-Ismail et al/ 1999 - 2000	GP[##]	UAE	724	0	20 to > 60	UAE nationals		30 – 40		27		16
Al-Lawati et al/ 2000	GP	Oman	5838	49.8	20 to > 80	Omani nationals; urban/rural mix			28.9		18.5	
El-Hazmi / NR	GP	KSA	11208	41.3	20 – 70	Saudi nationals			32.82	29.09	15.21	23.97

Saadi et al/ 1999 – 2000	GP	UAE	5844	42.8	20 to > 65	UAE residents; '80 % urban'			48	35	24	40
Al-Lawati et al/ 2000	GP	Oman	5847	48.8	20 to > 60	900 urban; 4947 rural					19.1	
El-Mouzan et al /2001 - 2002	YP	KSA	894	100	12 – 20				13.8		20.5	
Baynouna et al/ 2004 - 2005	PC	UAE	817	49.3	20 to > 60	UAE nationals					28.3	46.5
Bener et al/ 2007 – 2008	GP	Qatar	1117	51.1	20 – 59	Urban/semi-urban			31.9		45.2	
El-Hazmi et al/2005	SC	KSA	19317	50.8	5 – 18	Saudi nationals	WHO 2007 criteria		24.8	28.4	10.1	8.4

Summary of cross-sectional studies investigating the prevalence of overweight/obesity in the GCC region

PC = primary health care-registered population; GP = general population; WP = working population; SC = schoolchildren; SP = student population; YP = young population

* employees of Saudi National Guard and dependents; [#]attendees at primary health care centres with minor complaints, plus accompanying persons; [o]adult attendees of the Kuwait Medical Council and Public Authority for Social Security (government employed/retired population); **employees of Kuwait Oil Company; [##]all subjects recruited via family member at UAE University; [oo] ‘mostly settled tribal men’; ***age-adjusted data

4.9.2 Hyperglycaemia

17 studies reported on the prevalence of hyperglycaemia, as impaired glucose tolerance (IGT; 12 studies) impaired fasting glucose (IFG; 3 studies 119, 41, 102) or a high random capillary glucose (> 10 mmol/L). Generally, IGT was defined as venous plasma glucose ≥ 7.8 and < 11.1 mmol/L 2h post glucose loading. Where the WHO 1980 criteria were used, however, the IGT would be defined as venous plasma glucose 8.0 and 11.0 mmol/L 2h post glucose loading, and the study of Al-Moosa et al (122) involved capillary whole blood rather than venous plasma samples (see table 13). Impaired fasting glucose (IFG) was consistently defined as a fasting venous plasma glucose ≥ 6.1 and < 7.0 mmol/L. The studies of random capillary blood glucose and IFG are so few that interpretation is difficult. Additionally, the random glucose measurement figures are likely to include instances of transient/'stress' hyperglycaemia. Nevertheless, both are potentially consistent with the IGT results.

4.9.2.1 Prevalence of IGT and age

Broadly speaking, the relatively comprehensive study of IGT is suggestive of a recent and on-going increase in prevalence, with the latest published figures suggesting rates of perhaps 10 – 20 % in the adult population. Although there are some inconsistent figures (see Table 13), I consider that these could be accounted for by a combination of changes in prevalence across time and the ages of the studied populations. The studies of El-Hazmi et al (111) in particular reports an inconsistently low figure, but their sample was 39.1 % children and the authors report a significantly higher prevalence with increasing age, although I could not access the full data and the statistics were not described. Similarly, the other relatively young populations are those wherein reported prevalences are relatively low. Furthermore, of all studies reviewed (including those of random blood glucose and IFG), five considered the effect of age on prevalence (148, 149, 109, 110, 103). All found the prevalence was higher with advancing age, and in all cases where tested (three cases), the relationship was found to be significant (148, 149, 109).

4.9.2.2 Prevalence of hyperglycaemia by country

There was no obvious discrepancy in prevalence by country, but the number of studies available prohibited a reasonable comparison.

4.9.2.3 Prevalence of hyperglycaemia by sex

Thirteen studies reported differential prevalence rates by sex, although not all considered the strength of sex differences. The majority of studies (ten) suggested a higher prevalence in females (107, 100, 109, 110, 114, 103, 41, 120, and 123). Two demonstrated a significantly higher prevalence (41, 107). Conversely, two studies (152, 106) showed a higher prevalence in males (one significantly so; 99), and one demonstrated no sex difference (115)

4.9.2.4 Urban/rural residence and prevalence of hyperglycaemia

Only one study reported prevalence according to urban versus rural residence (107). Prevalence was higher in urban areas.

4.9.2.5 Prevalence of hyperglycaemia by residential status

No studies reported on effects of ethnicity, or on the prevalence of hyperglycaemia in national versus expatriate populations.

4.9.2.6 Hypertension and dyslipidaemia

Only few of the identified studies investigated the prevalence of hypertension (124, 113, 41, 119, 121, 120) and dyslipidaemia (121, 117, 113, 149). Moreover, variable or ill-defined definitions of the diagnosis were used in each case.

4.9.3 Hypertension

I identified eight studies that included an assessment of hypertension (114, 153, 117, 41, 119, 121, 120, 123).The definitions of hypertension employed ranged from $\geq$ 140/$\geq$ 90 mmHg to >160/95 mmHg, and variably included those on antihypertensive medication. Additionally, one study (114) depended upon a previous (un-described) diagnosis. Reported rates of hypertension ranged from 6.6 to 33.6 %. Potentially prevalence has been increasing since 1993/1994 (when the first identified studies were undertaken).

4.9.4 Dyslipidaemia

Dyslipidaemia was considered in six studies (114, 148, 149, 117, 120, and 123). Dyslipidaemia was defined as: cholesterol $\geq$ 5.2 mmol/L, cholesterol > 5 mmol/L, high density lipoprotein (HDL) < 1.0 mmol/L, low density lipoprotein (LDL) > 4.1 mmol/L, triglycerides (TG) $\geq$ 2.3 mmol/L, or a previous (undescribed) diagnosis. Reported rates of dyslipidaemia ranged from 2.7 – 51.9 %. This relatively large range is potentially partially due to increasing rates across recent years, to consideration of different aspects of the lipid profile in different studies and to differing definitions of abnormality. Additionally, in the study reporting the very lowest prevalence (114)diagnosis was established by 'previous diagnosis' alone, and thus allowed no assessment of the extent of undiagnosed cases.

Table 13: Summary of hyperglycaemia prevalence data

Ref/dates of study	Country	Population sampled	Sample size	Participant characteristics			Diagnostic criteria			Results (prevalence; %)		
				% male	Age range (years)	Residency status; area(s) of residence	IGT	Hyper-glycaemia	IFG	IGT	Hyper-glycaemia	IFG
Abu-Zeid and Al-Kassab / 1989	KSA	GP	1419	49.4	10 to > 60	98 % Saudi nationals; 'semiurban-rural'	2-hour fasting post-meal CBG 7.8 - 11 mM			3.7		
El-Hazmi et al / 1991	KSA	GP	2060	48.5	14 to > 60	Saudi nationals	WHO 1980/ 1985			Males: 0.6 Females: 1.2		
El-Hazmi et al / 1991	KSA	GP	23493	46.1	2 - 70	Saudi nationals	WHO 1980/ 1985			Males: 0.49 Females: 0.9		
Al-Nuaim et al/ 1990 – 1993	KSA	GP	13177	52	15 to > 60	Saudi nationals	WHO 1985			Urban males: 10 Rural males: 8 Urban females: 11 Rural females: 8		
Asfour et al/ 1991	Oman	GP	5096	41.9	20 to > 80	Urban/ rural mix	WHO 1985			Males: 8.1 Females: 12.9		
Al-Mahroos et al/ 1995 – 1996	Bahrain	GP	2002	58.6	males 40 – 59 females: 50 – 69	Bahraini nationals	WHO 1985			17.9		

El-Hazmi et al/NR	KSA	GP	25337	46.2	< 14 to > 60	Saudi nationals	WHO 1980/ 1985			0.62		
Al-Nozha et al/ 1995-2000	KSA	GP	16197	47.6	30 – 70	Saudi nationals			ADA 1997			14.1
Moussa et al/ 1998 – 2000	Kuwait	WP[#]	9755	48	18 – 80	Kuwaiti nationals		random CBG > 10.0 mM			Males: 8.25 Females: 362	
Al-Asi et al/ 1998 - 2000	Kuwait	WP[#]	703	100	45 - 80	Kuwaiti nationals		random CBG > 10.0 mM			26	
Saadi et al/ 1999-2000	UAE	GP	5844	42.7	24 to > 65	UAE residents[o]; '80 % urban'	WHO 1999		WHO 1999			Males: 4.5 Females: 8.0
Al-Lawati / 2000	Oman	GP	5838	49.8	20 to > 80	Omani nationals; urban/ rural mix			FPG > 6.1 and < 7 mM			Males:7.1 Females: 5.1
Saadi et al/ 2005-2006	UAE	GP	2396	49.1	18 to > 70	UAE nationals; urban	WHO 1999			20.2		
Bener et al/ 2008 - 2009	Qatar	PC	1117	51.1	20 - 59	Urban/ ‘semi-urban’	WHO 2006			12.5		

Summary of cross-sectional studies investigating the prevalence of (non-diabetic) hyperglycaemia in the GCC region

WP = working population; GP = general population; PC = primary health care-registered population; NR = not reported; KSA = Kingdom of Saudi Arabia; UAE = Unites Arab Emirates; WHO = World Health Organisation; ADA = American Diabetes Association; CBG: capillary blood glucose; IFG = impaired fasting glucose; IGT = impaired glucose tolerance

* government/municipal salaried workers; # adult attendees of the Kuwait Medical Council and Public Authority for Social Security (government employed/retired population); ° selection of subjects intentionally biased towards UAE citizens .

4.10 Discussion

I found the prevalence of overweight to be 25 – 50 %, obesity 10 – 50 %, relatively high in females and higher with advancing age to threshold levels between 30 – 40 and 50 – 60 years. Prevalence was also found to be high in children, and appeared to be increasing in this group. I estimated, from relatively recent reports, the prevalence of hyperglycaemia in adults (using IGT as the outcome measure) to be approximately 10 – 20 %. Prevalence of hyperglycaemia appears to have been increasing across recent years, and higher prevalence again showed an association with advancing age and female sex. There has been relatively little research of the prevalences of hypertension and dyslipidaemia in the GCC region and a lack of consistency in definitions used for study. Accordingly, estimates of prevalence vary: between 6.6 and 33.6 % for hypertension, between 2.7 and 51.9 % for dyslipidaemia, and it is unclear what additional factors may have impacted on these ranges.

Potentially, the prevalences of hypertension and dyslipidaemia are increasing, which would be in keeping with a more widespread trend (e.g. 166-168). The increasing prevalence of hyperglycaemia is similarly in keeping with trends reported elsewhere. By contrast, we observed no obvious temporal trend in prevalence of overweight and obesity in adult populations, which is not in keeping with reports from elsewhere, and despite a relatively well established association with diabetes (both epidemiologically (1; 166-169) and pathophysiologically). Importantly, though, particular authors have noted a rising prevalence within the relatively well controlled environments of their own studies (170, 171), and several of the reviewed studies did demonstrate correlation between BMI, and overweight and obesity, and diabetes or blood glucose concentration (103; 105; 148). Moreover, the observed prevalence of overweight and obesity by age, increasing with advancing age until a plateau or decline in middle and older age, is suggestive that overweight and obesity may be an important risk factor for diabetes.

I noted differences in the patterns of spread of diabetes and obesity and overweight in the GCC region. For example, the observed bias of obesity and overweight to the female population is not obviously replicated in the population distribution of diabetes (unpublished data), demonstrating that additional aetiological factors may hold important roles in the current expansion of the diabetes problem.

4.10.1 Limitations of study

I reported above that individual studies included in our review demonstrated recent temporal trends in prevalence of overweight and obesity, even though this was not clear from our overview of studies. This is probably illustrative of the general heterogeneity of the reviewed studies. The studies reviewed were relatively few and distributed across many years. They were of varied population characteristics, in different regions of six countries, and the utilised definitions of particular risk factors were inconsistent. I was thus able to make only relatively crude observation, and could not provide measures of confidence in our outcomes. The quality of reporting of results in the examined studies was also variable. For example, many studies did not report confidence intervals or had missing data for key variables. This reinforces the need for authors of risk factors studies to use standard methods for reporting the results such as STROBE guidelines.

Although quality was variable, it was never alone a reason for exclusion. Quality was, rather, incorporated into building the estimations of ranges for normal versus abnormal among the results returned. This was difficult due to the wide variability in these results, and the potential for bias has implications for the strength of the proposals. In addition, I may have increased bias by duplication of included data., as it is anticipated that the female sample of one Al-Isa study (146) is that included in the mixed sample of another (147), and the male sample of Jackson et al, 2002 (148) that included in the sample of Jackson et al, 2001 (149). Finally, all of the reviewed studies were published in English, although I had no language restriction. Hence, I may have limited capture of publications in other languages due to the databases I searched.

4.10.2 Implications

I consider the need for further study to identify the major contributory factors to the current diabetes problem in the GCC region, and of factors such as hypertension and dyslipidaemia that compound the risks of diabetes, an important outcome of our review. The limited number and heterogeneity of existing studies pose difficulties for targeting, designing and developing potential management strategies. The relatively high levels of hyperglycaemia, and obesity and overweight (and potentially of hypertension and dyslipidaemia) observed – and their possible rising prevalence – are indicative that current management is insufficient. The reviewed data are suggestive that age and urban residence may be risk factors for, at least, overweight/obesity and hyperglycaemia. Enhanced management is thus crucial to prevent escalation of the problems as urbanisation and changing population demographics continue.

It would be useful to determine that the situation is similar across the various GCC states. This is likely but cannot be confirmed from the data reviewed here. If so, expansion of existing management strategies, and co-ordination of novel strategies, across the region, would probably be relatively successful and relatively cost-effective. The likely contribution made by overweight/obesity to the diabetes problem in the GCC region is suitable for management, at least in part, by primary preventative measures, which we anticipate would also be relatively cost effective.

4.11 Conclusions

Prevalence of overweight and obesity in the GCC region is high and the ages of those affected suggest it may be a relatively important factor in the growing diabetes burden in this region. Further the study aimed at elucidating its relative contribution to the diabetes problem is desirable, but regardless the reviewed data are suggestive that implementation and enhancement of primary preventative strategies in particular would be useful in the management of T2DM in the GCC region. The current prevalence of hypertension and dyslipidaemia are unclear, but potentially relatively high compared to many other parts of the world. More comprehensive study of their prevalence is desirable, and standardisation of definitions of these conditions will be important if further study is to be maximally useful. Primary preventative strategies may also be useful in managing these conditions.

Section three: Quality of T2DM management in the states of the GCC

This section presents the systematic review carried out on the quality of T2DM management in the GCC countries. It involves the following: introduction, methods (review questions, inclusion/ exclusion criteria, search, study selection process, data extraction, quality assessment, and data synthesis), results, discussion including limitations and implications of the review, and finally conclusion.

4.12 Introduction

DM is a chronic disease characterised by insufficient insulin production and/or insulin resistance. Through its various complications and a widespread high prevalence (1). Diabetes is a major public health issue, carrying huge societal and economic, as well as personal, costs and risks. This has been acknowledged by the United Nations through Resolution 61/225 (2006), which issued a call for Member States to implement strategies to address the burden of diabetes in their societies.

4.12.1 T2DM in the Gulf region

The states of the GCC exhibit some of the highest rates of T2DM in the world. Five of the IDF'S 'top 10' countries for diabetes prevalence in 2010 and in 2030 are projected to be in this region (1). The anticipated prevalences for diabetes 2010-2030 in the Gulf countries are: UAE 18.7-21.4%, Kingdom of Saudi Arabia (KSA) 16.8-18.9%, Bahrain 15.4-17.3%, Kuwait 14.6-16.9% and Oman 13.4-14.9% (1).

4.12.2 Responding to the T2DM problem

Many countries have responded to the concerns about T2DM by producing and implementing national diabetes programmes (at the suggestion of the World Health Assembly, aided and monitored by the IDF). The IDF suggests Oman, Kuwait and Bahrain have all implemented national diabetes programmes (with no data available for the UAE and KSA, and no national diabetes programme in Qatar) (1). The UAE, however, published national guidelines in 2009 (172). I have not been able to determine that the KSA has a national programme, but note that it produces by far the greatest research output on diabetes among the GCC countries. For all countries, the extent and timings of programme implementation are unclear, and in many cases the content of the programmes also. Although the IDF suggests various dimensions that a national diabetes programme would ideally include, there are no particular suggested standards in any of these themes (1). Although this reflects the need for locally tailored programmes, it perhaps also reflects that there are no standardised desired clinical outcomes, even in relatively well-studied populations. Both the extent and efficacy of current diabetes management in the GCC region is thus unknown.

4.12.3 Review aims

The aim of this review was to examine the current quality of management of T2DM in the member states of the GCC. Unchecked, the chronic hyperglycaemia of diabetes is associated with various adverse macro- and micro- vascular outcomes. Glycaemic-, blood pressure- and lipid- control were used as indicator outcomes as they are relatively well established correlates of adverse vascular sequelae; preliminary searches suggested these were relatively frequently considered outcomes; and they are widely incorporated into national guidelines e.g. (69, 70, 173, 174). I aimed to, wherever possible, specify results according to age and gender, as evidence indicates that age/gender specified sub-populations with specific disease prevalences and characteristics or severity may exist, and thus that these populations may benefit from differential management strategies. Due to the heterogeneity of studies identified on preliminary searching, there was no anticipated meta-analysis.

4.13 Methods

4.13.1 Ethics assessment

Ethical approval was not needed as this study was a systematic review, with no primary data collection.

4.13.2 Review questions

A systematic literature search was carried out to identify information relevant to the following review questions:

1. How good is current control of T2DM in the GCC region, based on glycaemic-, blood pressure- and lipid- control indicators?

2. Have implemented strategies (including public health/preventative strategies) improved management of T2DM in GCC countries?

4.13.3 Search

I developed a systematic review protocol (See appendix 15) using the CRD guidelines (96). The Medline and Embase databases (via Dialog and Ovid, respectively; 1950 to July 2010 (Medline), and 1947 to July 2010 (Embase) were searched separately on 15/07/2009 and the search was updated on 08/07/2010. The search was carried out using terms identified from PICOS deconstruction of the above review questions, and database- and manually- derived alternatives (see appendix 14). Keywords used in the search strategies reflected the quality of management of T2DM and blood pressure, lipids and glucose in the GCC such as DM, non-insulin-dependent, hyperglycaemia, hypertension, hyperlipidaemia and Gulf States. The search strategy (see appendix 15) was trialled, reviewed by independent professional colleagues (E.H, K.P), and updated (on 02/02/2010) before use. Further relevant studies were identified by searching the reference lists of the database-derived papers, contacting expert investigators, screening conference proceedings including those of The International Conference on Recent Advances in DM and Its Complications 2006 and Gulf Research Meeting 2010, citation searching and hand searching the available online contents of the International Journal of Diabetes and Metabolism and the Saudi Medical Journal, between the periods 1993-2009 and 2000- 2010, respectively.

4.13.4 Selection

The search yielded 788 studies. The titles and abstracts were evaluated by one reviewer to determine eligibility for full screening. Studies that utilised designs from a pre-determined list of acceptable methods - including randomized controlled trial and observational study (cross sectional, quasi-experimental and interventional) - were included. All studies wherein glycaemic-, blood pressure- and/or lipid-control were investigated (clinical and/or process outcomes) were eligible for inclusion. In addition, any study describing primary preventative measures was eligible. No limitations on publication type, publication status, study design or language of publication were imposed. However, I did not include secondary reports such as review articles without novel synthesis. The inclusion criteria demanded that the study population be people with diabetes (at least predominantly type 2; unless a study relating to primary prevention), and of a GCC country. All ages, sexes and ethnicities were included, resident and expatriate populations, urban and rural, of all socioeconomic and educational backgrounds. General population studies and studies at all healthcare levels were included. 33 studies were identified as suitable for full review, and were each considered by two reviewers. Six studies were excluded, by consensus, either because data were not (fully) available, or because the reporting left us unable to assess, sufficiently, study quality (see figure nine).

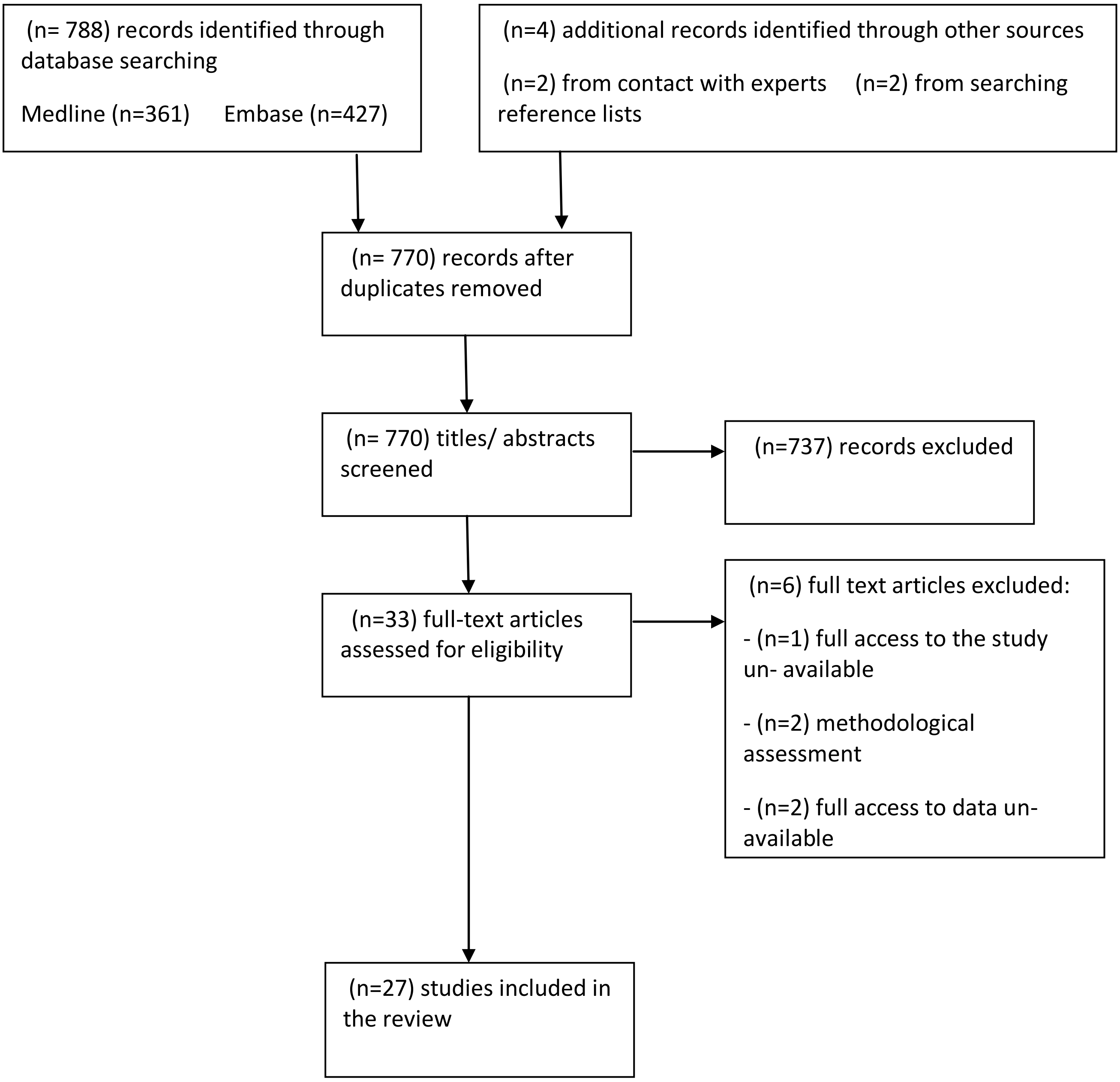
4.13.5 Data extraction/quality assessment

The data captured for each study included data relating to, (1) methods (study design, recruitment, measurement tools, and analysis), (2) participant characteristics, (3) setting, and (4) outcomes (those observed, their definitions, results of analysis, length of follow-up). Study quality was assessed using a checklist adapted from the CRD guidelines (see Appendix 16) (96). Data extraction was performed, in duplicate, by two reviewers. Any disagreements were resolved by discussion with a third reviewer.

4.13.6 Data synthesis

Data synthesis included summarising the results of the data extraction process, considering the strength of evidence relating to each of the questions, and examination of results inconsistent with our formed proposals. Synthesis was limited by the numbers of studies, particularly in consideration of the identified quasi-experimental studies (see 'Results'), and thus for this set of data, description and discussion suffices.

Figure 9: Flow chart of study selection process.



4.14 Results

I identified 27 journal-published studies for review: 21 cross-sectional (108, 116, 120, 121, 165, 175-191) and 6 quasi-experimental studies (192-197).

4.14.1 Cross-sectional studies

The cross-sectional studies included one undertaken in 1988/1989, 2 in the 1990s, the remainder from 2000 onwards. The studies were carried out in KSA (14), UAE (3), Bahrain (3) and Oman (1). In all but one study, wherein subjects with diabetes were identified through a general population screening (121), studies were carried out in primary care or hospital environments. All involved retrospective review of patient records, and a very small minority included a prospective component. Identification of individuals with diabetes was in all cases by previous diagnosis. In some cases, diagnosis of T2DM was specified; otherwise the populations were mixed diabetic populations of predominantly T2DM. Sample size ranged from 30 – 1236.

I identified fifteen studies of each of glycaemic- and blood pressure- control, and eleven of lipid control. In all cases, the lack of standardised targets for these outcome measures was reflected in a heterogeneous collection of definitions of control. Data that would allow comparison of subgroup outcomes were generally not available.

4.14.1.1 Glycaemic control

The identified studies of glycaemic control are summarised in tables 14, 15, 16 and 17. One study investigated process measures alone (although several additional studies included these). 12/15 studies that reported clinical outcomes considered HbA1c levels, 6/15 fasting blood glucose (one fasting blood glucose as a sole measure), and 3/15 'post-prandial' blood glucose levels (one post-prandial glucose and fasting blood glucose alone).

With regard to clinical outcomes, target levels of HbA1c were almost always < 7 %, whereas the definition of 'poor control' was more variable, but generally more than at least 8 %. 'Good control' by fasting blood glucose and post-prandial blood glucose were < 7 mmol/l and < 9 mmol/l, respectively. Fasting blood glucose > 8 mmol/L and post-prandial glucose > 10/11 mmol/L were considered 'poor control'. Process measures variably required documentation of fasting blood glucose/HbA1c testing within the study period, or within the previous 6 or 12 months.

The data of glycaemic control was summarized based on the source of care provided: primary, secondary, university and private hospitals.

Results from the primary care are summarized in table 14. The range of achieving HbA1c target < 7% was between 6.6% and 33.3% in the seven studies included ; however in one of these studies carried out by Al-Shammari et al 60.6% of the sample achieved the defined target of HbA1c <8% (155). Frequency of documentation of process of care ranged between 73% and 98% in the primary care settings.

Two studies assessed the care provided in secondary settings. HbA1c targets < 7% was achieved in 21.8% in one of these studies, and in the second study 77.2% of the sample had HbA1c >8.8% as summarised in table 15.

Five studies assessed the care provided in university hospitals as outlined in table 16. In three studies HbA1c was recorded (e.g. <7% was achieved by 45% of the sample of Afandi et al (180) and 6-8% was achieved by 34% of the sample of Qari (181)). However, in the third study carried out by Al-Ghamdi 77% of the participants had HbA1c >8%. Frequency of documentation of process of care ranged between 49% and 97% in the university hospitals (178).

One study assessed the care provided in private hospitals as outlined in table 17. HbA1c < 6 was achieved by 14 %, and HbA1c 6 – 8% was achieved by 40 % of the sample. The frequency of documentation of process of care was not reported.

Plotting the values across time, there was no obvious indication of recently improving/declining control. Process measures were less commonly investigated, and of variable outcome (0.4 – 98 % achieved).

Table 14: Summary of glycaemic control in primary care settings

Ref/dates of study	Setting	Country	Sample size	Population characteristics			Outcomes and results						Study limitation
				% male	Age		Glycaemic control indicators			Process outcomes (frequency of documentation)			
					Mean (SD)	Range	HbA1c levels (%)	FBG levels (mM)	Post-prandial glucose levels (mM)	HbA1c levels	FBG levels	Post-prandial glucose levels	
Al-Shammari et al / 1993 - 1994	PC	KSA	365	NR	'All ages'		< 8.1: 60.6 %; 8.1 – 11: 32.2 %; > 11: 7.1 %						-potential of selection of less severe cases - potential for non-standardised treatment -potential for non-standardised measurement of reported outcomes
Khorsheed et al / 1998 - 2000	PC	KSA	138	69.6	Mean: Males: 49.7 Females: 53.4					73 %	98 %		-very specific population (employees of National Guard) -selection bias (single visits/not seen after Jan 2008 excluded ;potentially individuals with less severe disease
Al-Turki / 2000 - 2001	PC	KSA	1236	57.4		< 15 to > 60		> 10: 49.2 %; 7 - 10 : 28.9 %; < 7: 14 %		0.4%	92.1 %		-potential for lack of standardised measurements -sampling methods for the health care centres and subjects not clear -study limitations not discussed
Al-Hussein / 2003-2004	PC	KSA	651	45.5	53.2 $\pm$ 11.7		Mean ± SD: 9.0 ± 2.0; < 7: 20.6 %	Mean ± SD: 9.9 ± 3.9	Mean ± SD: 15.0 $\pm$ 5.3	55.4 %	64 %	61 %	-potential for non-standardised treatment, measurement of reported outcomes - study limitations not discussed
Saadi et al/2005 - 2006	PC	UAE	245	44.9		18 to > 70	<7: 33.3 %			(within 1 year): 91 %			-data from subjects in Al-Ain might not be typical for all individuals in other Emirates -potential of under- or overestimation of the reported rate of DM diagnosis (10.2%) based on disease reporting rate -% of subjects out of those sampled households (2455) was underwent

													testing was small
Al-Kaabi et al / 2006	PC	UAE	409**	39	51.44 + 11.2		< 7: 31.1 %; 7 – 8: 19.6 %; 8 – 9: 16.7 %; > 9: 32.6 %						-limited details on sampling process
Al-Elq / 2006	PC	KSA	353	NR	51.6 + 10.8		Mean + SD: 8.2 + 1.89; < 7: 27 %			(within 6 months): 81 %			- characteristics of population not -non-standardised lab assays - lack of actual assessment of DM complications --lack of evaluation of barriers for not achieving glycaemic or cardiovascular risk factor targets - lack of calculation of direct and indirect economic burden of DM

PC = primary care; NR = not reported

Table 15: Summary of glycaemic control in the Secondary care settings

Ref/dates of study	Setting	Country	Sample size	Population characteristics			Outcomes and results						Study limitation
				% male	Age		Glycaemic control indicators			Process outcomes (frequency of documentation)			
					Mean (SD)	Range	HbA1c levels (%)	FBG levels (mM)	Post-prandial glucose levels (mM)	HbA1c levels	FBG levels	Post-prandial glucose levels	
Famuyiwa et al / 1988 - 1989	SC	KSA	1000	54.2		1 – 98	> 8.8: 77.2 %						-selection process and data collection not well described
Kharal et al / 2005-2006	SC	KSA	1188	38.5	All ≥ 30 years		Mean ± SD: 9 ± 2; < 7: 21.8 %	Mean: 10 ± 4.2; < 7: 25.0 %		81 %	95 %		-specific population (Saudi national guards and their dependents)

SC: secondary care

Table 16 : Summary of glycaemic control in university hospitals

Ref/dates of study	Setting	Country	Sample size	Population characteristics			Outcomes and results						Study limitation
				% male	Age		Glycaemic control indicators			Process outcomes (frequency of documentation)			
					Mean (SD)	Range	HbA1c levels (%)	FBG levels (mM)	Post-prandial glucose levels (mM)	HbA1c levels	FBG level s	Post-prandial glucose levels	
Akbar/ 1999 - 2001	UH	KSA	443	49	54.8 ± 16.2			Mean ± SD: 9.7 ± 3.2 (38 % < 7 : 11 % 7.1 – 8: 51 %; > 8: 51 %)	Mean ± SD: 13.75 ± 5.5 (22 % < 9: 7 % 9.1 – 10; 71 % > 10)				-sample selection method not clear -limitations of the study not discussed
Al-Ghamdi / 2002 - 2003	UH	KSA	130	41.6		15 - 80	> 8: 77 %	> 8 : 69 %	> 11: 69%	49 %			-data analysis not well reported -selection bias (some T1DM included) -sample inclusion criteria was not clear - study limitations not discussed
Qari / 2005	UH	KSA	200	:30	UH: 47 ± 14		mean ± SD: 7.8 ± 1.8; < 6: 24 %; 6 – 8: 34 %						-selection method of hospitals was not clear -study limitations not discussed
Al-Shaikh / Not reported	UH	KSA	392	6.5	46.3			mean: 9.89; < 7: 11.5 %	Mean: 10.5				-sample selection process not reported -extent of co-morbidities e.g. smoking status in different populations not noted -unclear statistical tests used
Afandi et al / 2005	UH	UAE	30	40	All > 18		< 7: 45 %			97 %			-small sample size (30) -sampling method not clear - potential for non-standardised measurement

UH: university hospital

Table 17: Summary of glycaemic control in a private hospital

Ref/dates of study	Setting	Country	Sample size	Population characteristics			Outcomes and results						Study limitation
				% male	Age		Glycaemic control indicators			Process outcomes (frequency of documentation)			
					Mean (SD)	Range	HbA1c levels (%)	FBG levels (mM)	Post-prandial glucose levels (mM)	HbA1c Levels	FBG levels	Post-prandial glucose levels	
Qari / 2005	PH	KSA	200	46	49.4 ± 13.7		mean ± SD: 7.8 ± 1.78; < 6: 14 %; 6 – 8: 40 %						-selection method of hospitals was not clear -study limitations not discussed

PH = private hospital

4.14.1.2 Blood pressure control

The identified studies of blood pressure control (176, 177, 179, 181-183, 123, 141, 185-190) are summarised in table 18. One study considered only process measures. Three studies provided only rates of hypertension (of variable definition) as an outcome. The remainder provide (at least) rates of 'well-controlled' blood pressure, of more consistent definition. Rates of poor blood pressure control were reported as either:

1. A basic record of 'current' rates of hypertension, or
2. Documentation of all (cumulative) rates of treated and untreated hypertension

There may therefore be discrepancies where hypertension assessment is not standardised and where cases of well-controlled hypertension exist. This hinders comparisons already complicated by differential lengths of diabetes diagnoses. It seems clear, however, that blood pressure targets, however described by the study authors, are far from met. The < 130/< 80 mmHg or < 130/< 85 mmHg targets were met in between 6.8 % and 32 % of patients with a history of hypertension, and between 14.2 and 42.1 % of the remaining samples, with one exception. Target blood pressure was met in 83 % of the sample of Afandi et al (180).

Rates of hypertension – of both cumulative and non-cumulative measures, and of various criteria were frequently between 30 – 60 %. Although only recorded in three studies, documentation of blood pressure checks suggested they were rigorously carried out, with almost 100 % documentation of blood pressure measurement achieved.

Table 18: Summary of BP control

Ref/dates of study	Setting	Country	Sample size	Population characteristics				BP control indicators results (units of all BP measurements = mmHg)			Process outcomes (Frequency of BP documentation)	Study limitations
				% male	Age		Additional information	BP<130/80	BP<130/85	BP>130/80		
					Mean (SD)	Range						
Famuyiwa et al / 1988 - 1989	TC	KSA	1000	54.2		1 - 98	77.7 % Saudi nationals					-sample selection method not clear -data analysis not well described (variable n-numbers for each outcome) - unconventional definition of overweight/obesity -limitations of the study not discussed
Khorsheed et al / 1998 - 2000	PC	KSA	138	69.6	Mean (males): 49.7 Mean (females): 53.4		Saudi nationals				100 %	- results may not be generalisable (population = employees of National Guard) -potential for selection bias (single visits/those not seen after Jan 2008 excluded) -potentially individuals with less severe disease selected -limitations of the study not discussed
Sequeira et al / 2001	PC	Bahrain	266	30.8	58.4 ± 10.8***		Hypertensive population		9.8 %;			- potential for selection of less severe cases -limited data on population characteristics (e.g. ethnicity and co-morbidities)

Al-Khaja et al/ 2001	PC	Bahrain	357	GP clinics: 27.2 Diabetic clinics: 34.5	GP clinics: 58.1 ± 10.5 Diabetic clinics: 54.8 ± 10.8		Hypertensive population		Diabetic clinic6.8 % GP Clinic: :10 %			-limited data on population characteristics (e.g. co-morbidities, ethnicity, BMI) -potential for selection bias (diabetic clinics for more severe cases; patients at GP clinics older) -study limitations not discussed
Al-Ghamdi / 2002 - 2003	UH	KSA	130	41.6		15 – 80	69% non-Saudi			BP > 140/90: 41.5 %		-data analysis not well reported -selection bias (some T1DM included)
Al-Khaja et al/ Not reported	PC	Bahrain	220	36.4	54.9 ± 10.7		Hypertensive population		7.5 %			- control of DM not included as hypertensive population only -study limitations not discussed
Al-Shehri/ 2003 – 2004	PC	KSA	403	55.8		29 - > 60	98.6 % Saudi; military personnel and dependants	14.2 %				- results may not be generalisable (population = attendees of King Fahd Military Hospital) -study limitations not discussed
Qari / 2005	UH	KSA	200*	UH: 30 PH: 46	UH: 47 ± 14 PH: 49.4 ± 13.7		UH: 51 % Saudi PH:62 % Saudi					-limited data re study population
Afandi et al/ 2005	TC	UAE	30	40	All > 18						at most recent appointment: 100 %	-small sample size -sampling process not clear
Kharal et al/ 2005-2006	TC	KSA	1188	38.5	All ≥ 30		Saudi National Guard employees and dependants	39.1 %			99 % documented BP result during period of interest	- results may not be generalisable (sample from King Fahd Military Hospital) -lack of data re retinopathy screening, foot examination

												and neuropathy
Saadi et al /2005 - 2006	GP	UAE	245	44.9		18 to > 70	UAE nationals, urban residents	42.1%				-sampling process not well described
Al-Kaabi et al/ 2006	PC	UAE	409**	39	51.44 ± 11.2		50.4 % illiterate			53.7 %		-sample selection method not clear -study limitations not discussed
Al-Elq / 2006	PC	KSA	353	NR	51.6 ± 10.8		84 % 'Arab/Oriental/ Persian'; 22 % literate; 63 % in full time employment	16 %				-non-standardised lab. assays - lack of assessment of DM complications -lack of evaluation of barriers preventing achievement of various targets - lack of calculation for suggested direct and indirect economic burdens of DM
Eledrisi et al / Not reported	'outpatient clinics'	KSA	1107	45.3	All > 18		48.5 % history of HTN	32%				- potential lack of standardised measurement/reporting -sample selection method unclear
El-shafie et al / 2006 - 2007	UH	Oman	210	28.6	53.7± 9.1		Hypertensive population	34.4/76.1%		41.6/7.7%		- sampling method not clear - results may not be generalisable (sample from Sultan Qaboos University Hospital) -limitations of the study not clear

Summary of cross-sectional studies investigating BP control in diabetic patients in the GCC region.

PC = primary care; SC = secondary care; TC = tertiary care; UH = university hospital; PH = private hospital; GP = diabetic patients identified in cross-sectional study of general population; NR = not reported

* n = 100 for each hospital; **204 SC patients; 205 PC patients; ***data for final sample not reported;

†HTN = previous diagnosis/treatment or BP > 160/95 if patient > 40 years/ > 140/90 if patient < 40 years; ††definition of HTN not reported; †††HTN = BP $\geq$ 140/90 mmHg or antihypertensive medication; ^{o} HTN = systolic BP > 140 mmHg and/or diastolic BP > 90 mmHg or antihypertensive medication; ^{oo} HTN = BP $\geq$ 140/90

4.14.1.3 Dyslipidaemia

The identified studies of lipid control are summarised in table 19. Again process outcomes were of varied definition and infrequently studied, but where investigated, documentation of measurement within the previous year was achieved in 97 % (178), 93 % (121), 87 % (180) and 14 % (182). The latter outlying result is from the most recent study, where large proportions of people with diabetes had not been screened for diabetes complications and/or cardiovascular risk factors in the previous twelve months. Unfortunately, the exact cause of the low documentation was not determined as the study did not test the compliance of people with T2DM to regular screening.

The definitions of dyslipidaemia used were variable and utilised various aspects of the lipid profile. LDL was the most commonly used clinical outcome, with a consistently applied target of < 2.6 mmol/L. This was met in approximately 30 - 50 % of patients, including in the cases of populations being entirely with or entirely without a history of dyslipidaemia (183). HDL, total cholesterol (TC) and TG levels were also used as measures of lipid control. Thresholds for dyslipidaemia were not consistent, yet where each indicator was used in isolation, rates of dyslipidaemia were: 27.9 % (173), 30 % (173), 72 % (175), 63 % (175), 44.6 % (176), 44.6 % (176).

Table 19: Summary of lipid control

Ref/dates of study	Setting	Country	Sample size	Population characteristics	Lipid control indicators (Levels of TC, LDL, HDL, TG measurement)				Process outcomes (Frequency of lipid measurement documentation)	Study limitations
					TC	LDL	HDL	TG		
Famuyiwa et al / 1988 - 1989	TC	KSA	1000	54.2 % male; age range: 1 - 98 years; 77.7 % Saudi	6.2 mM: 27.9 %			> 2.3 mM: 30.0 %		-selection process and data collection not well described -unconventional definition overweight/obesity -study limitations not discussed
Khorsheed et al / 1998 - 2000	PC	KSA	138	69.6 % male; mean age males: 49.7 years; mean age females: 53.4 years; Saudi nationals					69 %	- results may not be generalisable (sample = employees of National Guard) -selection bias (single visits/those not seen after Jan 2008 excluded) -potentially individuals with less severe disease selected
Akbar et al/ 2000 - 2001	UH	KSA	202	50 % male; mean age ± SD: 59.9 ± 12.9 years; dyslipidaemic population		< 2.6 mM: 31 %	> 1.1 mM: 28 %	< 1.7 mM: 37 %		-interview questions unclear, and results not discussed -study limitations not discussed
Al-Ghamdi et al / 2002 - 2003	UH	KSA	130	41.6 % male; ages: 15 - 80 years; 69% non-Saudi	> 5.2 mM : 55.4%			> 2.3 mM: 55.4 %		-data analysis not well reported -selection bias (some T1DM included)

Qari / 2005	UH/PH	KSA	200*	<u>UH</u>:30 % male; mean age ± SD: 47 ± 14 years; 51 % Saudi <u>PH</u>: 46 % male; mean age: 49.4 ± 13.7 years; 62 % Saudi						-limited data re. study population
Afandi et al / 2005	TC	UAE	30	40 % male; ages: > 18 years					97% (within 1 year)	-small sample size -sampling process not clear
Kharal et al / 2005-2006	TC	KSA	1188	38.5% male, age: ≥ 30 years; Saudi National Guard employees + dependants		< 2.6 mM: 55.5 %			Documented LDL measurement within period of interest: 87 %	-specific population (Saudi National Guard and dependents)
Saadi et al/2005 – 2006	GP	UAE	245	44.9 % male; ages: 18 to > 70 years; UAE nationals, urban residents		< 2.6 mM: 30.8%			Documented cholesterol measurement within year: 93 %	-sampling process not well described
Al-Kaabi et al / 2006	PC	UAE	409**	39 % male; mean age ± SD: 51.44 ± 11.2 years; 50.4 % illiterate		> 2.5 mM: 78.6 %	< 1mM: 76.4 %	> 1.7 mM: 59.9 %		-limited details re. sampling process
Al-Elq et al / 2006	PC	KSA	353	Sex ratio not reported; mean age ± SD: 51.6 ± 10.8 years; 84 % 'Arab, Oriental, or Persian'; 22 % literate; 63 % in full time employment		> 2.6 mM: 65 %			within year: 14 %	- characteristics of population not well described -non-standardised lab. assays - lack of assessment of DM complications - lack of evaluation of barriers preventing achievement of various targets - lack of calculation for suggested direct and indirect economic

										burdens of DM
Eledrisi/ Not reported	'outpatient clinics'	KSA	1107	45.3 % male; ages: > 18 years; Saudi nationals; 70 % history of (treated) dyslipidaemia		-< 2.6 mM: 50.5 % (patients with history of dyslipidaemia) -> 3.38 mM: 17.6 % (patients without history of dyslipidaemia)				- potential lack of standardised measurement/reporting -selection process unclear

Summary of cross-sectional studies investigating lipid control in diabetic patients in the GCC region.

PC = primary care; SC = secondary care; TC = tertiary care; UH = university hospital; PH = private hospital; GP = diabetic patients identified in cross-sectional study of general population

* n = 100 for each hospital; **204 SC patients; 205 PC patients

4.14.2 Quasi-experimental studies

The six quasi experimental studies identified (192-197) are summarised in table 20. The studies were carried out between 1998 and 2007. There were two Saudi studies, three from the UAE, one from Kuwait. The study interventions included implementation of newly-designed diabetes clinics/services, or use of a flow sheet to guide management. There was no public health or primary preventative aspect to any of the interventions.

All studies were based in primary care, and based on populations previously diagnosed with diabetes. The samples are likely to contain a predominance of T2DM patients, except that of Udezue et al (194), which is likely to include a large proportion of type 1 diabetes patients (based on age at diagnosis). Where reported, the mean durations of diabetes diagnoses were several years.

The outcomes monitored were generally concerned with adherence to implemented guidelines, but three studies also monitored some clinical outcomes, including glycaemic control, throughout their duration. Generally, interventions successfully increased compliance with clinical guidelines and improved clinical outcomes, where monitored, over the duration of the study. The studies were followed up for periods of 1 year (197), 18 months (192-196), 2 years (193), and 4 years (194-195) post-intervention. Unfortunately, there are major limitations with all these studies. Only one study (194) included a control population, and in this case the physicians involved in writing the guidelines for the developed intervention were largely from the intervention group.

Table 20: Summary of intervention studies

Ref/dates of study	Country	Sample size	Population characteristics	Intervention	Outcomes observed	Main outcomes	Study limitations
Reed et al 2001	UAE	219	Control group: 52.3 % male; mean age + SD: 53.6 + 10.9 years; 84.6 % UAE nationals; mean + SD years education: 3.09 + 4.49 years Intervention group: 64.5 % male; mean age + SD: 49.4 + 11.7 years; 83.0 % UAE nationals; mean + SD years education: 3.12 + 4.87 years	Guideline implementation, chronic care clinics established, patient and provider education, improved clinical recording	Adherence to guidelines Clinical outcomes: HbA1c, BP, lipid levels Patient knowledge re. DM and patient satisfaction	Some baseline differences in clinical outcomes between groups; adherence to guidelines improved with intervention; higher satisfaction levels in intervention group	-Potential for different clinics to attract different population types (e.g. in terms of socioeconomic status, ethnicity) -Potential for different definitions, instruments and processes between clinics
Andrews/ 1998 - 2000	UAE	721*	43.6 % of patients who attended > once male; mean + SD age of patients who attended > once: males 56.8 + 13.2 years, females 53.7 + 12.5 years	'Mini clinic' (provider education, computer-assisted record keeping, guideline implementation)	Adherence to guidelines; HbA1c levels	Significant ↓ in HbA1c over 12 – 18 months, same as entry at 2 years; ↑compliance with guidelines	-no controls -analysis not fully discussed
Udezue et al/ 1998-2002	KSA	105	48.6 % male; ages: 14 - 20 years; employees of Saudi Aramco Medical Services Organization and dependants	'Young diabetes clinic' (lifestyle, medication and other education)	Assessment of management via monitoring: Compliance with attendance, use of glucose meters; HbA1c levels; eye, vascular and neurological examination results	↑ appointment attendance and use of glucose meters; no significant improvement in HbA1c levels; no patients developed retinopathy or neuropathy	- no control group - analysis not well described; co-morbidities and types of DM not stated - specific population: young people

Al-Adsani et al/ 2001-2003	Kuwait	250	Demographics of sample not reported	Clinical guidelines developed; training courses; implementation of auditing	Adherence to guidelines	↑ use of appointment/filing systems; various clinical measures, examinations and smoking assessments achieved more frequently	-no controls - characteristics of population studied not clear - selection of records not clear
Khattab et al/ 2002 – 2005	UAE	2548**	51.8 % male; mean age $\pm$ SD: 55.3 $\pm$ 11.6 years; 66 % UAE nationals; 90 % T2DM diagnosis	Clinical guidelines and information systems developed, diabetes nurse practitioners introduced; DM 'teams' formed; implementation of auditing	Clinical outcomes: HbA1c, BP, lipid levels Documentation of BMI, smoking status, fundoscopy referral	Significant ↓ in HbA1c, systolic BP and LDL over study period; ↑ documentation of HbA1c, BP, LDL, BMI measurements, smoking status and fundoscopy referral between 1st and 2nd audits	
Moharram et al/ 2006-2007	KSA	371	46 % male; mean age $\pm$ SD: 55 $\pm$ 5.8 years; military personnel and dependants	Flow sheet to guide management	Adherence to guidelines	↑ documentation of various clinical measures and examinations; ↑ patient education and dietician referral	- no controls - very specific population (military personnel)

Summary of outcomes of trialled interventions aiming to improve control of DM in UAE, KSA and Kuwait. All studies were carried out in primary care settings.

* n fell over follow up period to n = 45 in males at 21 - 27 months; **n at study outset/for 1st audit; n for 2nd audit = 1234

4.15 Discussion

I found management of T2DM in the GCC region – based on glycaemic-, blood pressure- and lipid- control indicators – to be suboptimal. Almost universally, fewer than 50% of patients meet targets for these clinical outcomes. There were no clear differences between primary and secondary or tertiary care (although possibly blood pressure was better controlled in hospital settings). This might be attributed to poor performance in the primary care settings.

The reviewed intervention studies were largely uncontrolled, and thus difficult to interpret. All strategies reviewed here did appear to improve outcomes, but involved multiple interventions and are likely to have been carried out against a background of evolving healthcare. No intervention studied included a primary preventative dimension.

Although I rate the quality of T2DM management in the GCC region as 'poor', the outcomes are similar to those reported from elsewhere. Due to the disparity in genetic and environmental contexts, type of health system, differences in intervention methods and management guidelines and target thresholds, we do not intend to suggest that any particular intervention method is similarly efficacious across regions. Nevertheless, I noted that for both clinical- and process- outcomes, similar results are reported for other countries in the region such Lebanon (198) and Egypt (199-201). In comparison with a selection of reports from various levels of healthcare in the UK (175, 202, 203), USA (204, 205) and Australia (206), clinical outcomes in the GCC countries were generally lower, but this was not always so. Lipid control (175,) and blood pressure control (203, 204) were most frequently potentially comparable between these non-GCC countries and the studies reviewed here, but Grant et al (205) also report a 34 % attainment of HbA1c levels < 7 %, which would be consistent with a number of the results from the GCC region. Notably, of the non-GCC region studies mentioned, this study includes perhaps the highest proportions of patients under relatively high level care. Although it may therefore underestimate outcomes more generally achieved, it may in fact be a better comparator for the mixed populations included in our review. I note also that in many cases the outcomes of the reviewed studies would satisfy the upper thresholds of the UK Quality and Outcomes Framework targets (175).

With regard to process measures, these were generally well met in all settings, but probably more so in the non-GCC developed regions, particularly for glycaemic control. Finally, and importantly, I note that with regard to intermediate outcomes of diabetes control, there has been evident progress in at least the UK and USA (175, 203, 204), which I have not observed here to be the case in the GCC region.

4.15.1 Limitations of study

A major limitation on the strength of the conclusions lies in the heterogeneity of the reviewed studies. They were of varied populations, reported on variable outcome measures, were from various levels of healthcare provision and different countries (although were predominantly from some and notably did not include all GCC countries). The outcomes of review are therefore necessarily of only a broad nature, and as expected, they were not appropriate for use in synthesis of outcomes with estimates of confidence.

All of the reviewed studies were published in English. Overall, the clarity of reporting in the reviewed papers was considered relatively low; considered so as it often hampered assessment of study quality. In a few cases, we excluded studies due to an inability to sufficiently assess study quality (see Fig. 9). Otherwise, I did not exclude studies based on quality, but noted some major limitations, particularly in the intervention studies. With regard to the cross-sectional studies, the relatively low numbers of papers returned by each search led to difficultly identifying inconsistencies versus widening accepted value ranges and extent of possible effects, and in turn difficulty considering the strength of our final proposals. Nevertheless, I feel the data are sufficient that we might comment on their potential implications for T2DM care in the GCC region.

4.15.2 Implications

I believe – based on the mentioned studies from non-GCC countries and the intervention studies reviewed here – that the standards of diabetes care in the GCC region can be improved. Both of these sets of studies suggest that improved adherence to process measures would improve clinical outcomes. In defining these desired process outcomes, and the mechanisms to comply, it may be useful to consider some of the interventions implemented in the reviewed intervention studies. These could potentially be as effective as those implemented elsewhere, and there is a degree of overlap. For example, the use of patient education programmes, diabetes specialist nurses and self-glucose monitoring appear to be potentially useful and are relatively well developed components of systems elsewhere. Continued auditing of these and other interventions will be important. Standardising both the process and clinical measures for clinical use and for auditing would be useful to facilitate comparisons, although this has yet to be achieved elsewhere, and fixing standards may be difficult. A review of potentially useful and realistic standards for this region has not been achieved and would be helpful.

I also consider that there is a large role for primary prevention programmes in any new management strategy. It is unclear whether or not any such intervention has been trialled in this region, and a concerted/wide-reaching programme is probably essential for feasibility and success of diabetes management. Finally, I have not considered strategies likely to produce changes in diabetes management without being aimed specifically towards this (e.g. those implemented as part of the WHO 'Innovative Care for Chronic Conditions Framework' adaptations in health systems associated with the shift towards management of chronic rather than acute diseases (46)), but it is anticipated that such changes will also be an important part of managing the diabetes burden in the GCC region.

4.16 Conclusion

Up to my knowledge, this study is the first to systematically review the quality of diabetes care in the GCC region. I found management of T2DM, as indicated by three major intermediate outcome measures (glycaemic control, blood pressure and lipid profile), to be sub-optimal in the GCC countries. In addition, I found that in many of the reviewed studies, there were quality issues that impacted on their usefulness. I thus feel attention to the management of diabetes in this region needs to be improved, and that enhanced management must include better quality of research and production of valuable data.

With regard to specific management strategies, I have here reviewed several studies of interventions, which suggest a number of secondary prevention strategies that may help in raising the quality of management in this region. However, other forms of intervention – particularly primary prevention strategies, which have not been clearly implemented or audited – are also likely to be useful. I anticipate that co-ordinated implementation of locally-successful/targeted strategies may be particularly effective. Continued, high quality review of all forms of interventions in the GCC states would also be desirable.

Chapter 5 : Quantitative approach

This chapter presents the quantitative component of this thesis. It is classified into four main sections including: (1) literature review, (2) method, (3) results, and (4) discussion and conclusion. The first section of this chapter represents a background about disparities on diabetes care and the literature review undertaken to identify disparities in diabetes care and their association particularly with age and gender. Secondly, the methods I used to carry out the study in Al-Ain, UAE is addressed. Then, I reported the main findings from the study carried out in the third section. Finally, explanations for these findings and comparisons with results from other studies are outlined in section four.

5.1 Introduction

As addressed in chapter one, two and four, the UAE has the second highest prevalence rate of diabetes worldwide (90% of cases of diabetes are of type 2) (1), and it is one of the IDF's 'top 10' countries for diabetes prevalence in 2010 and in 2030: 18.7-21.4%, (1).

Many organizations such as ADA, Scottish Intercollegiate Guidelines Network (SIGN) and National Institute of Clinical Excellence (NICE) have developed evidence-based guidelines for the control of blood glucose, blood pressure and cholesterol levels in people with diabetes to reduce diabetes related vascular complications (2-4). The UAE has developed guidelines for the management of T2DM, and they are the bases for structured protocols in diabetes care settings.

Improving and measuring quality of health care are becoming important issues world-wide. However, there is a growing body of evidence indicating that diabetes care is sub-optimal on international level in terms of the standards attained, the degree of variability and the level of accountability of health professionals (208-210). Despite the large number of available guidelines, several studies in developed countries have reported unsatisfactory care provided to people with diabetes based on evidence-based quality of care standards such as in the UK (203), USA (204, 205) and Australia (206). Similar findings were found in developing countries such as Lebanon (198) and Egypt (199-201).

In the Gulf, as found in the systematic review presented in chapter four, section three on the quality of diabetes care in the GCC countries that the extent of T2DM control to be sub-optimal and relatively poor . Assessment of the efficacy of interventions was difficult due to lack of data, but suggestive that more widespread and controlled trial of secondary prevention strategies may have beneficial outcomes.

Furthermore, disparities in diabetes care and their association with age, gender, deprivation and ethnicity have been investigated by many studies (e.g., 207--211) in western countries. For instance, some studies have identified that older patients were less likely to receive effective treatment compared to younger age groups (e.g., 208-211). While, the elderly had better cholesterol and glycaemic profiles in another study compared to young patients (75, 211). Females were less likely to achieve the target goals for cholesterol and blood pressure and to have quality indicators recorded (208). Similarly, women were found to receive poorer quality of care, in a large, population-based study from Delhi, India, (208).

Many studies investigated the association between deprivation and DM care. For instance, one study reported that the people living in the deprived areas were less likely to achieve the required goals for glycaemic control, and less rate of recording for process of diabetes care were found among them compared to those living in affluent areas (210).

In the UAE, only few studies have assessed diabetes care (180, 41), and based on the literature review I carried out, no studies have investigated its association with the age or gender. Improvement in diabetes care relies to a large extent on examining and evaluating the quality of care provided to people with diabetes. Therefore, this study was carried out to examine the quality of T2DM care in a diabetes centre located in a tertiary hospital in Abu Dhabi, UAE in 2008, 2009 and 2010. The quality of T2DM care was examined by using quality indicators, both process and intermediate outcomes of care, in accordance with ADA targets 2012 . Specifically I aimed to: (1) assess process and intermediate outcomes of care with particular attention to glycaemic, lipid and blood pressure control, (2) identify any improvement in the quality indicators between 2008 and 2010, and (3) investigate the relationship between age or gender and the quality of T2DM care.

Section one: Literature review

Firstly, this section provides a background on disparities in diabetes care. Then the literature review performed on disparities in diabetes care along with the search method, main outcomes from the literature review and findings are outlined. Findings from the literature review are classified into: studies from the developed and Arab countries. Finally, a brief summary of the overall content of this section is provided.

5.2 Disparities in diabetes care

Disparities in health have been studied for decades as indicated by Black report 1980 (212), The Acheson Report 1998 (213) and recently the WHO commission on the social determinant of health 2008 (214).

The international focus on health inequality is shown by many organizations and countries such as the International Society for Equity in health in 2000 that aims to promote equity in health and health services (214), and the European Region of the WHO (214).

Many western countries are aiming to tackle disparities in healthcare. For instance, in Sweden 2001, a proposal was presented to the parliament for a new health policy that tackles social inequalities in health (215). In Finland, since 1986 a focus has been made on this issue. In the UK and US, there are many policies adopted to reduce disparities in health care among people (215).

Nevertheless, despite this international efforts and consideration of the problem, there is a growing body of evidence indicating that inequalities in health exist and are increasing (216). For instance, based on the third report of the health committee on health inequalities 2008-2009 in the UK, they found an increase in the health disparities between the social classes (4% amongst men, and 11% amongst women) as compared to the health of the poor, the health of the reach is improving in a faster rate (216).

5.2.1 What is an inequality in health?

Kunst and Mackenbach used the following working definition of health inequalities: "Differences in the prevalence or incidence of health problems between individual people of higher and lower socio-economic status" (217).

Health inequality can be defined as difference in health standing or in the delivery of health determinants between various population groups. Inequality in health has evolved around three main areas including: (1) difference or variation in health (or income) between different groups; (2) inequalities in health or outcome; and (3) inequalities or the un-fairness of difference (217).

"The quality of care should not differ because of such characteristics as gender, race, age, ethnicity, income, education, disability, sexual orientation or location of residence" (217). Health inequalities exist between different groups of the population from different gender, age, and different ethnicity (216). Also, disparities in care are found among people suffering from disabilities and intellectual problems (221). There are many causes of inequalities in health, however they are complex. Factors studied and found associated with inequalities in health include: poverty, housing, education, access to healthcare, lifestyle factors such as smoking and physical activity. 'Institutional ageism' was suggested to be one of the causes, but found to be less significant than other listed factors (216).

5.3 Aims of reviewing the literature

Prior to examining the quality of diabetes care in the diabetes healthcare centre in the UAE, a systematic review on the quality of T2DM care in the GCC countries involving the UAE was carried out and addressed in chapter four, section three. This systematic review enabled me to review the quality of the diabetes care in the UAE and other Gulf countries, and to identify the gap in the literature regarding the quality of diabetes care in the UAE, which is essential for achieving the overall aim of this study which is to examine the quality of T2DM care in the Al-Ain, UAE. Also, carrying out this systematic review enabled me to review and critically appraise the quality of studies obtained in the Gulf region. Being aware of the quality of those studies and their limitations helped me in designing this study and improving its quality.

The systematic review obtained on the quality of T2DM care in the GCC countries including the UAE, however, did not focus on the disparities in the diabetes care in the region. Therefore, in advance to investigating the association between age or gender with the quality of T2DM care in this study; reviewing the literature on disparities in diabetes care and their association particularly with age and gender was performed. The main aims of carrying the literature review are: (1) to comprehensively appreciate the evidence on the association between age and gender with diabetes care, and (2) to identify the gap in the literature regarding the disparities in T2DM care and their association with age or gender in the Gulf in general, and UAE specifically.

5.4 Search method

A review was carried out in Feb-2009/March-2010. Potential studies were identified by: (1) searching the electronic databases mainly EMBASE, MEDLINE, CINAHL and the Cochrane Library using various key words such as (quality of care, barriers to diabetes care, facilitators to diabetes care, healthcare professionals, diabetes mellitus, type 2 diabetes); (2) searching reference lists in the retrieved studies and other relevant articles; (3) contacting investigators and experts in the fields for information; and (4) hand searching the international journal of diabetes and metabolism, which is an Emirate journal to identify any related studies carried out in the UAE and Arabic region.

The search was not limited to any language to enable the capture of any study published in other language than English including the Arabic. All papers from developing countries have been referred to along with significant either positive or negative findings from other publications.

5.5 Outcomes of the literature review

Most studies investigating disparities in diabetes care focused mainly on studying the following main factors: gender, race, age, ethnicity, income, education, disability, sexual orientation and location of residence.

5.6 Findings from the literature review

5.6.1 Studies from developed countries

There are many studies carried out in the developed world on health inequalities. In this subdivision, a summary on the common disparities in diabetes care reported in the literature included ethnicity, deprivation, age and gender are addressed. However, based on the objective of this initial study to investigate difference in diabetes care between different age groups and gender; disparities in diabetes care associated with gender and age are emphasised.

Ethnicity

There is evidence showing that people with T2DM belonging to racial and ethnic minorities In the US (176, 204, 205) and UK (203, 204) are receiving poorer quality of diabetes care, based on different outcomes measure. For instance, differences in healthcare access and utilization, and health outcomes have been identified in subjects with T2DM in the national sample of the Caucasians, African-Americans, and Mexican –Americans that were studied in the third national health and nutrition examination survey (218). Similarly, racial disparities in process and intermediate outcome of diabetes care have been reported in another study (219). Results from a systematic review of studies conducted in the US and UK showed that in the US, black Hispanics have higher risk of retinopathy and worse intermediate outcome of care (220). While in the UK, Asian found to be at a greater risk of end stage renal disease (221, 222).

However, using data from the Insulin Resistance Atherosclerosis study (1993-1998), the rate of treatment for diabetes and associated co-morbidities are similar across African, American and Hispanics (223).

Deprivation

The association between deprivation and the quality of diabetes care has been demonstrated by many studies. Variation in the process, outcomes of diabetes care, and the existence of diabetes related complications such as retinopathy were more prevalent among more deprived people with diabetes as indicated by many studies (e.g., 224-226).

Furthermore, in the US un-insured patients tend to receive lower quality of diabetes care compared to those insured as indicated by many studies (e.g., 219).

Age

Many studies claimed that difference in diabetes care exist between young and old individuals. Younger age has been linked to poor glycaemic control (e.g., 76, 226, 227).

Gender

Many studies in the literature have indicated that differences in diabetes care exist between men and women. The association between gender of people with diabetes and the glycaemic control has been studied, but results are uncertain; however more evidence pointed out that females have poorer access to care than males (e.g., 76, 207). For example, in the UK, one of the studies demonstrated that patient's sex – females vs. males- affects significantly the value of random HbA1c (p=0.01) (207). Another study carried out among Pakistani with diabetes receiving their treatment from either primary or secondary care in Manchester, UK indicated that women had poorer glycaemic control compared to men (19% vs. 31%, p=0.05) (228).

5.6.2 Studies from Arab countries

Disparities in diabetes care are given little consideration in the Arab world. Few studies in the literature found addressing this issue.

In Oman, a study found that low perception towards a patient-centred approach to be more common among women (229). They attributed the low perception among this group to two key reasons: (1) the social disempowerment of women; and (2) the power imbalances in the healthcare professional-patients relationship (229).

Summary

The evidence on the existence of disparities in diabetes care in the developed world is associated with number of factors such as deprivation, ethnicity, age and gender is increasing. Many western countries, such as the UK, US, Finland and Switzerland are focusing on tackling disparities in health including diabetes care. Despite the high prevalence of chronic diseases including diabetes the Arab world, especially the Gulf, studies addressing this issue are lacking. Disparities could be attributed to: person driven, professional driven, system- driven and disease- driven. However, based on the objectives of this study, differences in T2DM care provided to different age groups and genders was the area of focus in this thesis.

Section two: Methodology

The general aim of the quantitative component of this thesis is to examine the quality of T2DM care in a diabetes centre located in a tertiary hospital in Abu Dhabi, UAE in 2008, 2009 and 2010. The quality of T2DM care was examined using quality indicators, both process and intermediate outcomes of care in accordance with ADA targets 2012 (1). Specifically I aimed to: (1) assess process and intermediate outcomes of care with particular attention to glycaemic, lipid and blood pressure control, (2) identify any improvement in the quality indicators including both process and outcomes of care between 2008 and 2010, and (3) investigate the relationship between age or gender and the quality of T2DM care using both process and outcome indicators. Therefore the study aimed to answer the following research questions:

1- What is the quality of T2DM care in the diabetes centre in terms of process and intermediate outcomes of care measures compared to the international level?
2- Is T2DM care in the diabetes centre improving overtime in terms of process and intermediate outcomes of care measures?
3- Do differences in T2DM care subsist in the diabetes centre between different age groups and genders?

Details of the population definitions, data selection, data collection and methods of analysis are discussed in the coming sections.

5.7 Materials and design

5.7.1 Access issues

Ethical approval

Ethical approval was granted for the study by Al-Ain medical district (refer to appendix 17)

5.7.2 Population and setting

Patients

The study is limited to people with T2DM who are being followed-up by the diabetes health centre at Tawam hospital, Al-Ain.

People with T2DM from Abu Dhabi whose diabetes are not controlled in the primary care settings are referred to this centre. Also, many people with T2DM from other emirates are referred and complete their treatment in the centre. Believing on the high quality of the diabetes care in the centre, some patients get appointments from the centre directly to see the physicians (230).

Setting

Al-Ain

Al Ain is the third largest city in the UAE; therefore a health centre located in Al-Ain was chosen to present the population of Abu Dhabi, also other reasons for selecting this centre are presented in the following subdivision named ' diabetes centre'. According to the most recent census, it has a population of about 400,000 (230). It is located in the Eastern Region of the emirate of Abu Dhabi, about 140 kilometres from Abu Dhabi and 120 from Dubai (230).

Tawam Hospital- Diabetes centre

Tawam hospital is located in Al-Ain. It is an educational hospital and training centre for faculty of medicine and health sciences of UAE University. This hospital provides care to the residents of Abu Dhabi city including Al-Ain and other Emirate cities as well (230). Tawam hospital mission is to provide a continuum of quality health care which meets the needs and expectations of the UAE population and the surrounding GCC countries (230).

The centre provides an all round service for people with diabetes focusing on educating patients and their families (230). The clinic provides different services such as insulin pump instruction education and podiatry services.

Tawam hospital was selected for this study for several reasons. One of the reasons is that before selecting the diabetes centre at Tawam hospital, a pilot study was carried out in several hospitals and centres belonging to the HAAD. In summary results from the pilot study showed that:

(1) The medical records were in-complete and lacked of many essential data needed for quality assessment.

(2) There were some medical records that are un-organized and not possible to locate.

(3) There was lack in the use of glycaemic measurement (HbA1c) in some hospitals, which is agreed to be used as in indicator of glycaemic control instead of other indicators such as fasting blood glucose in this study; therefore drawing an overall picture of the glycaemic control wouldn't be possible.

5.7.3 Pilot study

Before starting data collection at the diabetes centre at Tawam hospital, a pilot study of the medical record review was carried out to:

- test the viability of the medical records review phase of the project
- verify accessibility to the medial records and health care facilities at Tawam hospital
- design and modify a data collection tool
- approximate the time needed to collect data to assist in calculating a sensible sample size for the study

The pilot study revealed that:

- the medical record review was feasible
- the facilities and information were accessible
- a realistic sample size was agreed with a statistician as explained in subdivision 5.7.8

Summary

Choosing the diabetes centre at Tawam hospital has many advantages including:

(1) It is the first hospital in Al-Ain that started computerizing patients' medical records, and the records are available on an electronic database from 2008, making assessment of any improvement in diabetes care from 2008 on-wards feasible.
(2) It has a special centre for people with diabetes that provides the essential care, and it follows international guidelines for the management of diabetes adapted from (ADA guidelines).
(3) It provides tertiary care to the residents of Abu Dhabi city including Al-Ain and other Emirate cities as well.

5.7.4 Study design

A retrospective cohort study, longitudinal data was collected for the period: 2008-2009-2010. This design was selected to measure the changes in the quality of T2DM care including process and intermediate outcomes indicators overtime. Also, the longitudinal analysis allows accounting for confounders and bias.

5.7.5 Data collection

A data collection tool was designed in Microsoft Word (see appendix 18). The data collection tool aimed to collect data on both intermediate outcomes and process of diabetes care in the following years: 2008, 2009 and 2010. Medical records of people with T2DM were available electronically from 2008; therefore this year was chosen to be the baseline for this study. For each intermediate outcome indicators including HbA1c, systolic and diastolic blood pressure (S/DBP) and low density lipoprotein LDL, I designed the data collection tool to collect data on three measurements of the listed indicators annually for the consecutive years from 2008 to 2010.

The following data from patient's medical records were collected:

(1) Demographic details of patients including sex, age, and duration of diabetes. Data on life style including physical activity and smoking was collected also.

(2) Glycaemic control:

- HbA1c measurement
- frequency of annual HbA1c measurement
- the use of anti-diabetic drugs
- the use of insulin

(3) Blood pressure control:

- S/DBP measurement
- frequency of annual S/DBP measurement
- the use of BP control therapy

(4) Blood lipid control:

- blood lipids measurement including total LDL
- frequency of annual lipid profile measurements
- the use of lipid modifying therapy

(5) The use of anti-platelet therapy including Aspirin and/ or Clopidogrel.

(6) The presence of diabetes related complications including:

- coronary heart disease
- hypertension
- heart failure
- atrial fibrillation
- renal failure
- peripheral vascular disease

5.7.6 Patient selection

A list of patients with diabetes who visited the centre during the period from January 2008 to December 2008 was obtained. T2DM patients were identified from the list of patients attending the diabetes centre (T1DM, gestational DM and other metabolic disorders). From the list, T2DM medical records were abstracted, and the patients' medical records which were referred to podiatry, dietician and ophthalmology were scanned to ensure if they have T2DM. Once the total number of patients with T2DM was known, each record was nominated a digit from one upward and a computerised random number program was used to determine which records to select. If a selected record was not available in the computerized database it was noted, and a request for the paper-based medical record was submitted for review. If it remained unavailable, the next randomly selected medical record was reviewed. If more than one medical record was available for the same patient, both records were reviewed.

5.7.7 Inclusion/exclusion criteria

Table 21 below lists the inclusion and exclusion criteria for the subjects included in the study.

Table 21: Inclusion/exclusion criteria

Inclusion criteria	**Exclusion criteria**
People with Type 2 diabetes	People with type 1 diabetes
UAE nationals and expatriates	Pregnant women
Patients who have been diagnosed for more than one year	Newly diagnosed patients (< one year)
Age≥ 18 years	
Both genders: Males and females	
People with type 2 diabetes who have been followed up at the centre from 2008	

5.7.8 Sampling

<u>Sample size calculation</u>

The sample size was chosen based on estimating a proportion 'p' with specified precision. To calculate a 95% confidence interval for p that is expected to be about 50% (0.50) with a margin of error not > 0.05, the followed formula was used: n=(1.96)2 x pq/ d2, q=1-p

N=sample size, p=proportion, d= margin of error.

This method requires entering a value of p which I want to estimate assuming that p=0.50 to obtain a range that is big enough to ensure precision.

Based on the formula above the needed sample for the study is roughly 384 subjects

n=3.84 x (0.50) (1-0.50)/ 0.0025= 384.

5.7.9 Quality indicators

5.7.9.1 Study variables

The quality indicators used for this report were in accordance with the ADA guidelines for the management of T2DM that are followed by the centre.

Process of T2DM care indicators

For this study the main process indicators were the proportion of people with T2DM who had HbA1c, LDL, and SBP/DBP measured during 12-months follow-up in the diabetes centre for the consecutive years from 2008 to 2010. Also, frequency of performing these measurements within 1-year follow-up was assessed for the same period.

Non-weighted process of care score (NWPOC) was calculated following a model proposed and undertaken by Gulliford et al in Trinidad and Tobago (231). I used the four measurements listed above: HbA1c, LDL, SDP, DBP for each patient with each measurement documented given an equal weighting; hence a patient could have a potential maximum score of four. Then the diabetes centre was given an average score based on the number of patients selected from the centre.

Intermediate outcomes of T2DM care indicators

Outcomes of T2DM care were assessed using intermediate outcomes of care. The assessment was based on whether the desired target level for the following measurements were met in accordance with ADA guidelines (HbA1c <7%, LDL < 2.6mmol/L, SBP < 130 mmHg and DBP < 80 mmHg). Proportions of people with T2DM reaching the required targets for these measurements at each year for the consecutive years from 2008 and 2010 were calculated.

Also, following the same model proposed and undertaken by Gulliford *et al* in Trinidad and Tobago (231), four-variable outcome of care score (4vOOC) was calculated based on the number of targets that were achieved yearly by each patient for the four targets described above. A score was given for each patient from zero (no targets achieved) to four (all targets achieved), and the average score was calculated for the diabetes centre. To make it clear, the assessment was based on an average of all the results collected. The following outcome variables were used:

- average mean HbA1c
- average mean systolic blood pressure
- average mean diastolic blood pressure
- average mean LDL

5.8 Data analysis

The analysis of the data involves two phases: (1) descriptive analysis, and (2) longitudinal analysis. A description of the main characteristics of the study sample was presented in the first section of the analysis.

5.8.1 Descriptive analysis

To fulfil the requirements of the first objective: to assess process and intermediate outcomes of care with particular attention to glycaemic, lipid and blood pressure control; the descriptive analysis presents the results on the assessment of both process and intermediate outcomes of diabetes care in the following years: 2008, 2009 and 2010 in accordance with the ADA targets.

Process of care was assessed by quantifying the proportion of subjects those had each measurement including: HbA1c, SBP, DBP and LDL documented in each year from 2008 to 2010. Also, the frequency of these measurements was assessed and quantified annually for each subject.

In terms of intermediate outcome of diabetes care, the first section of the analysis presents descriptive statistics such as mean for each measurement listed above for the period from 2008 to 2010. Also, the proportions of people with T2DM achieving the standard targets for each measurement annually were calculated and listed for the same period.

Descriptive summary of patients characteristics in each sex at the baseline index visit were presented as mean and Standard Deviation (SD) for continuous and normally-distributed variables, and count and proportion for categorical variables. A T-test was conducted for comparison of means of continuous variables between sexes and chi-square tests were used for testing differences in proportions for categorical variables.

The means (SD) and 95% (CI) of intermediate outcomes of care (HbA1c, LDL, SBP, and DBP) for all patients were determined for each year from 2008 to 2010. Using the figure at year 2008 as an index, a paired T-test was conducted to compare means at 2009 and 2010 with means at 2008 separately with an aim to detect significant changes across years.

To benchmark the quality of T2DM care in this study with the ADA guidelines for T2DM management, patients were grouped by sex and three age groups, namely (1) 18-39, (2) 40-59 and (3) 60 and over. Proportions of those that reached the ADA target for each intermediate outcome in each year were calculated. Chi-square tests were then performed to compare whether these proportions were statistically different across years in each age group and each sex.

5.8.2 Longitudinal analysis

To achieve the second objective of the study which is to identify improvements in the quality of diabetes care using indicators including process and intermediate outcomes in the consecutive years from 2008 to 2010; a comparison of the available longitudinal data on the quality indicators was performed using data from 2008 as a baseline.

To assess the changes in the process of diabetes care, proportions of subjects having the measurements documented in 2008 was determined and compared with those documented in 2009 and 2010 respectively. Also, the same process was followed for the frequency of the process of diabetes care.

In terms of intermediate outcomes of care, differences in the mean of the following measurements: HbA1c, LDL, SBP and DBP were worked out between 2008 and 2009, and 2008 and 2010 to assess improvements in the diabetes care. An overall comparison of the number of people with T2DM achieved the desirable standards of care between 2008 and 2009, and 2008 and 2010 was carried out.

Moreover, to detect any differences in the diabetes care between different age groups and genders using process and intermediate outcomes of care indicators, a comparison between the subjects from different age groups and genders reaching the standard targets for the process and intermediate outcomes of diabetes care was carried out. By doing so, the requirements of the following objective: to investigate the relationship between age or gender and the quality indicators including process and intermediate outcomes of T2DM care were achieved.

Further, a multilevel linear regression model was run to detect any rate of change in the intermediate outcomes across years and the associations between each outcome and accountable covariates during this period.

Since in this study repeated intermediate outcomes measurements were performed for the same individual at every year during period 2008-2010, a multilevel linear regression model was built to detect any rate of change of intermediate outcomes across years and the associations between each outcome and accountable covariates during this period. Occasions (in this study is year) were set as level 1 while individuals were set as level 2 in this model. I used a random-coefficient model, which allows the effect of covariates to vary by intercept and the slope. A time variable was also included in the model. A set of covariates was included in each model and likelihood ratio tests were performed for comparisons of nested models while HbA1c estimates were used to compare non-nested models. Residuals of each model were examined by plotting a histogram to see whether the residuals were normally distributed. A few observations were detected as outliers in each model and hence were excluded from the ultimate analyses. STATA 11 (College Station, Texas, USA) was used for all the analysis.

In the model, I adjusted for the potential confounding variables such as age, gender, duration of diabetes, life-style behaviours including physical activity and smoking and the use of pharmacological medications.

For glycaemic control, I used HbA1c as independent variable and adjusted for the following potential confounders: duration of T2DM, age, sex, use of oral hypoglycaemic drugs alone and combined with insulin, physical activity, and the existence of co-morbidities including coronary heart disease, hypertension and hyperlipidaemia.

For lipid control, I used LDL as independent variable and adjusted for the following potential confounders: duration of T2DM, age, sex, use of anti-hyperlipidaemia drugs, physical activity, and the existence of co-morbidities including coronary heart disease, hypertension.

For blood pressure control, I used two independent variables including SBP and DBP and adjusted for the following potential confounders: duration of T2DM, age, sex, use of anti-hypertension drugs, physical activity, and the existence of co-morbidities including coronary heart disease and hyperlipidaemia.

Section 3: Results

This third section of chapter five presents the findings from the cohort study carried out at the diabetes centre in Al-Ain. The results fulfil the following objectives of the study:

(1) To assess process and intermediate outcomes of care with particular attention to glycaemic, lipid and blood pressure control.

(2) To identify any improvement in the quality indicators including process and intermediate outcomes in the consecutive years from 2008 to 2010.

(3) To investigate the relationship between age or gender and the quality indicators including process and intermediate outcomes of T2DM care.

The results are classified into two main subdivisions: (1) descriptive analysis; and (2) longitudinal analysis of data.

5.9 Descriptive analysis

The first division includes a description of the main characteristics of the study sample, and results on the assessment of both process and intermediate outcomes of diabetes care in the following years: 2008, 2009 and 2010, which fulfil the requirements of the first objective.

In summary to the explanation in section two, process of care was assessed by quantifying the proportion of subjects those had each measurement including: HbA1c, SBP, DBP and LDL documented for each year from 2008 to 2010. The frequency of these measurements was assessed annually as well.

In terms of intermediate outcome of diabetes care, the first phase of the analysis presents descriptive statistics such as mean for each measurements listed above for the period 2008 to 2010. Also, the proportions of people with T2DM achieving the standard targets for each measurement annually were listed for the same period.

5.9.1 General characteristic of the study sample

Data from 384 people with T2DM was extracted from medical records. Descriptive statistics are displayed in table 22.

Of these 382 patients, roughly 55% were female (n=209) and the average age was 51 years old. There was no significant difference of age between male and female.

5.9.1.1 Complication rates

As shown in table 22, hypertension was the most prevalent co-morbidity among the study subjects (66%). It was more prevalent among women than men respectively (70.3% vs. 60.7%, p=0.05). The second most prevalent co-morbidity was hyperlipidaemia (44.2%), although not statistically significant this disorder was more common among men than women (49.2% vs. 45.7%; p=.21). Coronary heart disease was less common in this group compared to other co-morbidities (11.3%), and hypertension was more prevalent among men than women (17.3% vs. 6.2%, p <0.01 respectively).

5.9.1.2 Medications prescribed

The medications been prescribed for diabetes, hypertension and hyperlipidaemia are shown in table 22. The majority of patients have been prescribed oral hypoglycaemic agents (96.3%), and (45.6%) have been prescribed combined treatment of oral hypoglycaemic agents and insulin. As highlighted by table 19, no significant differences were found between women and men.

More than half the number of subjects (81.7%) were prescribed medications for hypertension, and almost all (91.1%) were on anti- hyperlipidaemia. Similarly to anti-diabetic agents, no significant differences found between sexes.

Regarding the use of anti-thrombotic agents, aspirin was commonly used (84.6%). Less frequently, clopidogrel was used for some patients (13.4%) as seen in table 22.

5.9.1.3 Life-style factors

As shown in table 19, significant difference in smoking was found among women and men respectively in this sample (0.48% vs. 42.2%, p<0.01). However, no difference was detected among genders on physical activity (20.2% in men vs. 20.1% in women, $p=0.97$).

Table 22: Demographic characteristics of participants

	All patients (n=384)	Male (n=175)	Female (n=209)	P value
Age	51 (16.3)	50.8 (15.8)	51.1 (16.5)	0.8
Age Group				
18-29	48 (12.6%)	17 (9.8%)	31 (14.8%)	
30-39	49 (12.8%)	27 (15.6%)	22 (10.5%)	
40-49	85 (22.2%)	43 (24.9%)	42 (20.1%)	
50-59	90 (23.4%)	36 (20.5%)	54 (25.8%)	
60-69	49 (12.7%)	28 (16%)	21 (10.1%)	
70+	63 (16.5%)	24 (13.9%)	39 (18.7%)	0.08
Medications				
Oral anti-DM drugs	370(96.3%)	167 (95.4%)	203 (97.1.2%)	0.37
Oral anti-DM drugs + insulin	174 (45.6%)	80 (46.2%)	94 (45.0%)	0.81
Anti-lipid drug	350 (91.1%)	160 (91.4%)	190 (90.9%)	0.89
Anti-BP drug	313 (81.7%)	147 (84.4%)	166 (79.4%)	0.21
Aspirin	325 (84.8%)	148 (84.5%)	177 (84.7%)	0.94
Clopidogrel	51 (13.4%)	26 (15.0%)	25 (12.0%)	0.38
Lifestyle factors				
Smoking	74 (19.4%)	73 (42.2%)	1 (0.48%)	**<0.01**
Physical activity	78 (20.2%)	36 (20.2%)	42 (20.1%)	0.97
Complications				
Coronary heart disease	43 (11.3%)	30 (17.3%)	13 (6.2%)	**<0.01**
Hypertension	252 (66.0%)	105 (60.7%)	147 (70.3%)	**0.05**
Hyperlipidaemia	188 (49.2%)	79 (45.7%)	109 (52.2%)	0.21

5.10 Standards of care

5.10.1 Process of diabetes care measures

The proportion of people with T2DM who had each individual process of care measured including: HbA1c, BP and LDL within 1-year of follow-up for 2008, 2009 and 2010 and there frequency rates are listed in table 23.

Also, as seen in table 24 NWPOC score as explained in methodology was calculated, using the four process measurements including: HbA1c, LDL, SDP, and DBP.

Table 23: Process measures performed each year (%) in the study cohort: 2008-2010

Frequency of HbA1c Measurement	2008		2009		2010	
	Women (n=209)	Men (n=175)	Women (n=209)	Men (n=175)	Women (n=209)	Men (n=175)
0	-	1	-	2	-	2
<3	-	1	-	-	-	-
≥3	209	173	209	173	209	173
Frequency of lipid Measurement						
0	-	1	-	2	-	2
<3	-	-	-	-	-	-
≥3	209	174	209	173	209	173
Frequency of BP Measurement						
0	-	1	-	1	-	2
<3	-	-	-	1	-	-
≥3	209	174	209	173	209	173

Table 24: NWPOC score for 2008, 2009 and 2010

NWPOC	2008	2009	2010
Mean ± SD	3.95 ± .21	3.9 ± .24	3.9 ± .22

5.10.2 Intermediate outcome of diabetes care measures

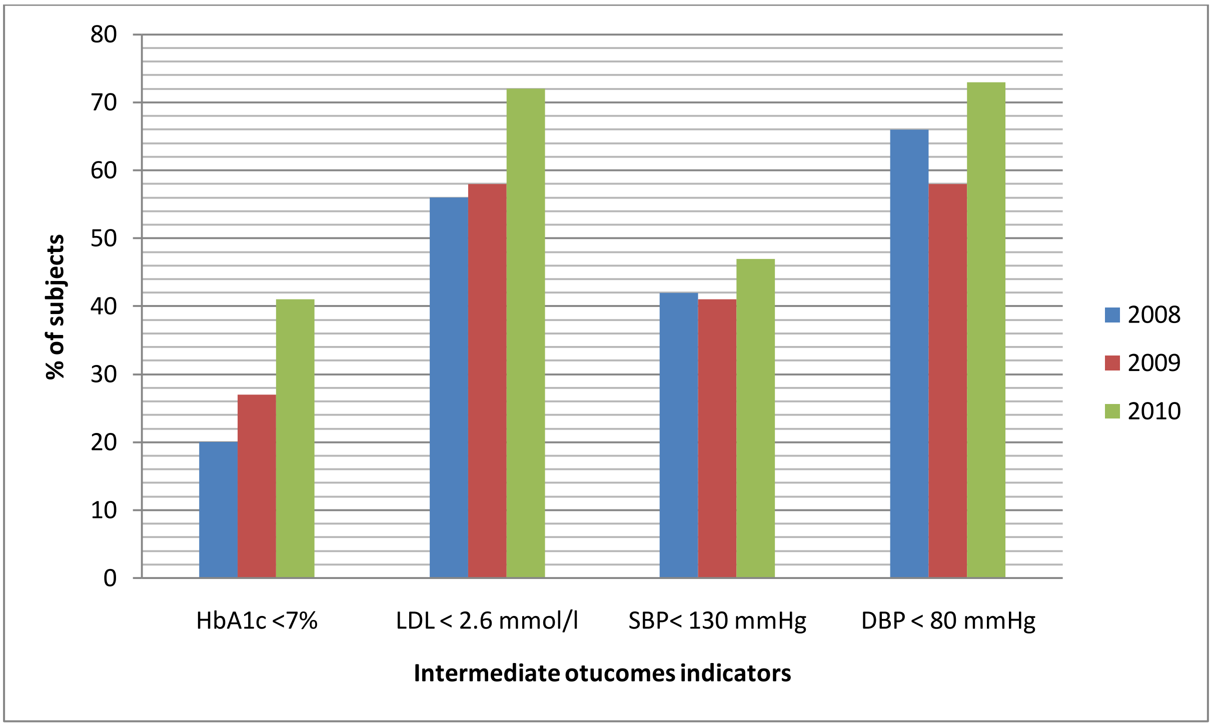
The mean results of HbA1c, SBP, DBP and LDL for the consecutive years from 2008 to 2010 are shown in table 25. Differences in results related to gender are demonstrated. However, no significant differences were detected among women and men, although a borderline significant was found in the DBP in 2009 between women and men. The mean of DBP found to be slightly higher among men compared to women respectively (78.1 mmHg vs. 77.3 mmHg, $p=0.057$).

Figure eleven shows the achieved standards of care based on the ADA targets as explained in the methodology. In 2008, 20% of the study subjects achieved the standards of glucose levels which increased to 27% then 41% in 2009 and 2010 respectively. As highlighted in table 25, the number of people achieving the SBP increased from 2008 to 2010 (162 vs. 172 respectively); however there was a drop in the number of people reaching this standard between 2008 and 2009 (162 vs. 175 respectively). Similarly to SBP, the number of people archiving the target of DBP increased between 2008 and 2010, but not 2009 (252 vs. 220 vs. 280, respectively). The achieved standard for LDL increased gradually from 2008 to 2010 as shown in table 25 (56% vs. 72%, respectively).

Table 25: Intermediate outcomes of care results: 2008-2010

	2008				2009				2010			
	Mean	Women (n=209)	Men (n=173)	P-value	Mean	Women (n=209)	Men (n=173)	P-value	Mean	Women (n=209)	Men (n=173)	P-value
HbA1c	8.50	8.51	8.50	0.98	8.16	8.1	8.19	0.71	7.50	7.50	7.50	0.9760
LDL	2.60	2.63	2.57	0.54	2.48	2.5	2.48	0.90	2.27	2.28	2.26	0.8226
SBP	133.1	132.2	134.1	0.16	133.9	132.9	135.1	0.09	133.01	130.34	131.8	0.1142
DBP	77.3	77.4	77.	0.62	77.9	77.3	78.71	0.057	76.6	76.19	77.	0.1025

Figure 10: Proportions of subjects reaching the intermediate outcomes: 2008-2010



5. 11 longitudinal analysis

The second phase however, includes longitudinal analysis for the available data for the consecutive years from 2008 to 2010. To accomplish the second objective listed above, a comparison of the data on the quality of diabetes care including both process and intermediate outcomes indicators was carried out using data from 2008 as a baseline. Additionally, quality of diabetes care scores for both process and intermediate outcome were determined for the consecutive years from 2008 to 2010 to identify any improvement in the quality of diabetes care in this period. To bear out the final objective listed earlier, each indicator including glycaemic, blood pressure and lipid were analysed separately and reported under subdivision 5.11.2 Proportions of women and men from different age groups reaching the standard targets for each indicator was quantified, and differences between different genders and age groups was assessed. Finally, to assess the influence of potential factors "confounders" on the main indicators including HbA1c, SBP, DBP and LDL, a multilevel model was performed adjusting for this potential factors, and results are discussed for each indicator separately under subdivision 5.11.2.

5.11.2 Intermediate outcome of diabetes care measures

4vOOc score was calculated for the diabetes centre as seen in table 26. The mean of the score increased gradually from 2008 to 2010 respectively [2.27 (95% CI: 2.18-2.37) vs. 2.62 (95% CI: 2.52-2.71)].

Table 26: Quality of care score: 2008 -2010

Quality of care score	2008			2009			2010		
4vOOC (n=382)	2.27	0.96	2.18-2.37	2.26	0.97	2.16-2.35	2.62	0.91	2.52-2.71

Using data from 2008 as a baseline, table 27 displays an overall comparison of diabetes outcomes of care between 2008 to 2009 and 2008 to 2010. Paired comparisons of diabetes outcomes of care are demonstrated in tables 24 and 25, using the subject's data for the following years (2008 vs. 2009 in table 28 and 2008 vs. 2010 in table 29).

On average, there was a significant improvement in the glycaemic control in the following years 2008, 2009 and 2010 based on the mean average of HbA1c as outlined in table 27. Comparing the reduction in the HbA1c level with the baseline data from 2008 with 2010 respectively, a substantial improvement was found: 8.5% (95% CI 8.33-8.67) vs. 7.5% (95% CI 7.36-7.63); P <0.001.

In terms of blood pressure, using figures at 2008 as a baseline, there were no significant differences for the mean DBP level during the three years as outlined in table 27. However, a range of 95% CI for mean DBP level at year 2009 and 2010 was not overlapped, hence it can be concluded that a significant reduction was found for these two years. For SBP, although a significant reduction was seen from 2008 to 2010, it was minor.

The mean of LDL improved significantly as seen in table 23 between 2008, 2009 and 2010. The average level of LDL was 2.60 mmol/L (95% CI: 2.51-2.70) at 2008, which was then increased by 0.17 mmol/L to 2.27 mmol/L (95% CI: 2.21-2.33) at 2010.

Table 27: Mean values of clinical indicators: 2008-2010

Clinical indicator	2008 Mean (SD)	95% CI	2009 Mean (SD)	95% CI	2010 Mean (SD)	95% CI	P value (09 vs. 08)	P value (10 vs. 08)
Hba1c (%)	8.50 (1.70)	(8.33-8.67)	8.16 (1.52)	(8.0 -8.3)	7.50(1.34)	(7.36-7.63)	<0.001	<0.001
LDL(mmol/l)	2.60 (0.91)	(2.51-2.70)	2.48 (0.58)	(2.4-2.5)	2.27 (0.62)	(2.21-2.33)	<0.0001	<0.001
SBP (mmHg)	133.1 (13.0)	(131.7-134.4)	133.9 (12.7)	(132.6-135.2)	131.01 (9.1)	(130.1-131.9)	0.13	<0.001
DBP (mmHg)	77.3 (7.84)	(76.4-78.0)	77.9 (7.00)	(77.3-78.7)	76.61(5.6)	(76.0-77.2)	0.07	0.11

Table 28: Paired comparison of outcomes in the study cohort: 2008-2009

	2008 Mean	(95% Confidence intervals)	2009 Mean	(95% Confidence intervals)	Mean difference (95% Confidence intervals)	p-value 1
HbA1c (%)	8.50	(8.33-8.67)	8.16	(8.0 -8.3)	.34 (.26-.42)	<0.001
SBP (mmHg)	133.1	(131.7-134.4)	133.9	(132.6-135.2)	-0.83 (-1.9-0.23)	0.13
DBP (mmHg)	77.3	(76.4-78.0)	77.9	(77.3-78.7)	-0.71 (-1.5-.06)	0.07
LDL (mmol/l)	2.60	(2.51-2.70)	2.48	(2.4-2.5)	.12 (2.4-2.5)	<0.001

1 Paired t-test for variables with normal distributions.

HbA1c: Glycated haemoglobin, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, LDL: low density lipoprotein.

Table 29: Paired comparison of outcomes in the study cohort: 2008 -2010

	2008 Mean	(95% Confidence intervals)	2010 Mean	(95% Confidence intervals)	Mean difference (95% Confidence intervals)	p-value 1
HbA1c (%)	8.50	(8.33-8.67)	7.50	(7.36-7.63)	1 (.92-1.1)	<0.001
SBP (mmHg)	133.1	(131.7-134.4)	131.1	(130.1-131.9)	2.04 (1.1-3)	<0.001
DBP (mmHg)	77.3	(76.4-78.0)	76.61	(76.0-77.2)	0.63 (-0.13-1.4)	.11
LDL (mmol/l)	2.60	(2.51-2.70)	2.27	(2.21-2.33)	0.33 (0.25-0.42)	<0.001

1 Paired t-test for variables with normal distributions.

HbA1c: Glycated haemoglobin, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, LDL: low density lipoprotein.

Glycaemic control

Based on the number of subjects archiving the ADA standards of diabetes outcomes of care, the proportions of patients who reached the HbA1c target were not significantly different between women and men respectively at each year (22% vs. 18%, p=0.3 at 2008, 28% vs. 25%, p= 0.5 at 2009, and 41% vs. 42%, p= 0.9 at 2010) as seen in table 30. However, both genders had significant improvement of reaching the target across the years as outlined in table 26 and appendix 19.

Equally, proportions of people with T2DM who reached the target increased across years at each age group for both genders as highlighted in table 27. However, significant differences of these proportions across the three years were only found at older age group (> 40 years old) for both sexes. At younger age, among men and women there were no significant differences of these proportions, although borderline significance (p=0.059) was found among males aged 18-39 years. Notably, in 2010 the lowest proportion of participants 26% (increased from 11% at 2008) achieving the HbA1c target was among females aged 18-39 years.

Table 30: Proportions of men and women achieving the standard blood glucose targets: 2008-2010

Intermediate outcomes	2008				2009				2010			
Targets for HbA1c achieved:	**Women N (%)**	**Men N (%)**	**Total N (%)**	**P-value**	**Women N (%)**	**Men N (%)**	**Total N (%)**	**P-value**	**Women N (%)**	**Men N (%)**	**Total N (%)**	**P-value**
Yes	46 (22%)	31 (18%)	77 (20%)	P=0.3	59 (28%)	44 (25%)	103 (27%)	P=.5	86 (41%)	72 (42%)	158 (41%)	P=.9
No	163 (78%)	142 (82%)	305 (79%)		150 (72%)	129 (75%)	279 73%)		123 (59%)	101 (58%)	224 (59%)	

Table 31: Proportion of subjects archiving standard targets for blood glucose by age groups and sex: 2008-2010.

Clinical indicator (ADA target)		**Male (n=173)**			**Female (n=209)**			
	18-39 (n=44)	40-59 (n=78)	60+ (n=51)	Total	18-39 (n=53)	40-59 (n=96)	60+ (n=60)	Total
Hba1c (<7%)								
2008	25%	12%	22%	18%	11%	26%	25%	22%
2009	25%	22%	31%	25%	19%	33%	28%	28%
2010	45%	32%	53%	42%	26%	46%	47%	41%
P value	0.059	<0.01	<0.01	<0.001	0.14	0.02	0.03	<0.001

Results from the multilevel modelling are shown in table 28. Results indicated the rate of HbA1c changes among women and men adjusted for potential confounding factors including age group, oral T2DM drugs intake, intake of combined oral T2DM drugs with Insulin, physical activity, co-morbidities including: coronary heart disease, hyperlipidaemia, hypertension, and duration of diabetes. Factors that have significant impact on HbA1c values are outlined in table 32.

In men, an annual average reduction of HbA1c level was 0.5% (95% CI:-0.56 ~ -0.43, $P<0.001$) as shown in table 28, which confirmed the results of table 21. Generally, HbA1c level of people who aged 60+ was significantly lower than for those aged 18-39 years by roughly 0.7% (95% CI:-1.19 ~ -0.14, P=0.01) during this period, but not for those aged 40-59.

Similarly to men, an annual average reduction of HbA1c level was 0.5% (95% CI:-0.57~-0.44, $P < 0.001$) in women as highlighted in table 28. In the same line, comparing with the 18-39 age group, women who were in successive age including those between 40-59 and above 60 years respectively had significantly lower HbA1c level on average 0.49% (95% CI: -0.98 ~ -0.004, P=0.05), and 0.77% (95% CI: -1.31~ -0.23, $p< 0.01$).

In men, prescribing oral anti-hypoglycaemic drugs was associated with roughly 4.2% (95% CI: -0.85 ~ -0.01, P=0.05) reduction in the HbA1c levels as recognized in table 28. However, this association was not significant among women.

Table 32: Results from multilevel modelling on blood glucose for men and women during 2008-2010.

HbA1c	Men				Women			
	B	P-value	95%CI		B	P-value	95%CI	
Year	-0.50	<0.001	-0.56	-0.43	-0.51	<0.001	-0.57	-0.44
Age								
40-59	-0.16	0.53	-0.64	0.33	-0.49	0.05	-0.98	-0.004
60+	-0.67	0.01	-1.19	-0.14	-0.77	<0.01	-1.31	-0.23
Oral hypoglycaemic drugs	-4.2	.05	-.85	-.01	-.005	0.99	-0.57	0.56
Oral hypoglycaemic drugs & Insulin	.46	.12	-.21	1.12	0.33	0.41	-.48	1.15

→Multilevel model was adjusted for age group, oral T2DM drugs intake (Y/N), oral T2DM drugs with Insulin (Y/N), physical activity (Y/N), coronary heart disease (Y/N), hyperlipidemia (Y/N), hypertension (Y/N), duration of diabetes (in years). All binary independent variables were using negative responses as references (Y=1, N=0). For age group, group 18-39 was used as a reference.
→ for multilevel analysis using Hba1c as a dependent variable, one observation was treated as an outlier (id=215) and excluded from the model.

Lipid control

Based on the number of subjects achieving the ADA standards of diabetes outcomes of care, the proportions of patients who reached the LDL target were not significantly different between women and men respectively at each year (56% vs. 55%, p=0.8 at 2008, 57% vs. 60%, p= 0.7 at 2009, and 70% vs. 74%, p= 0.4 at 2010) as seen in table 33. However, both genders had significant improvement of reaching the target across the years as outlined in table 30 and appendix 20.

In 173 men, proportions that reached the target for LDL increased consistently for the consecutive three years as shown in table 34. Though only significant differences were detected at age group 40-59, of which patients who reached the target increased from 53% at 2008 to 76% at 2010 (p <0.01). Similar results were found among women, a significant elevation in the number of women achieving the target between 2008 and 2010 respectively was calculated 53% to 71% (p=0.04). Non-significant differences were found for either young or old age group at each sex, though for females aged 18-39 years old, borderline significant difference was found (p=0.056). In 2010, although it was not statistically significant compared to women, men had the highest proportion of subjects achieving the targets of LDL (73.99% vs. 69.86%, p= 0.4 respectively).

Table 33: Proportions of men and women achieving the standard blood lipid targets: 2008-2010

Intermediate outcome of care	2008			P-values	2009			P-values	2010			P-values
Targets achieved for LDL:	**Women**	**Men**	**Total**		**Women**	**Men**	**Total**		**Women**	**Men**	**Total**	
Yes	118 (56%)	95 (55%)	213 (56%)	P=0.8	119 (57%)	103 (60%)	222 (58%)	P=0.7	146 (70%)	128 (74%)	274 (72%)	P=0.4
No	91 (44%)	78 (45%)	169 (44%)		90 (43%)	70 (40%)	160 (42%)		63 (30%)	45 (26%)	108 (28%)	

Table 34: Proportion of subjects archiving standard targets for blood lipid by age groups and sex: 2008-2010.

Clinical indicator (ADA target)	**Men (n=173)**				**Women (n=209)**			
LDL (<2.6mmol/l)	18-39 (n=44)	40-59 (n=78)	60+ (n=51)	Total	18-39 (n=53)	40-59 (n=96)	60+ (n=60)	Total
2008	52%	53%	61%	55%	55%	53%	63%	56%
2009	61%	55%	65%	60%	47%	58%	63%	57%
2010	66%	76%	78%	74%	70%	71%	68%	70%
P value	0.42	<0.01	0.13	<0.01	0.056	0.04	0.80	<0.01

Results from the multilevel modelling are shown in table 31. Results indicated the rate of LDL changes among women and men adjusted for potential confounding factors including age group, anti-hyperlipidaemia drugs, physical activity, co-morbidities including: coronary heart disease and hypertension, and duration of diabetes.

In both sexes, an average reduction of LDL level at a yearly rate was 0.15 mmol/l (95% CI: -0.2~-0.1, P<0.001) as outlined by table 35. None significant differences between age groups were reported.

Table 35: Results from multilevel modelling on blood lipid for men and women: 2008-2010.

	Men				Women			
LDL	**B**	**P value**	**95%CI**		**B**	**P value**	**95%CI**	
Year	-0.15	<0.001	-0.20	-0.10	-0.15	<0.001	-0.20	-0.10

→for multilevel analysis using LDL as a dependent variable, one observation was treated as an outlier (id=249) and excluded from the model.

Blood pressure control

In terms of blood pressure, in 2009 and 2010 respectively, overall women were more successful achieving the ADA targets for SBP compared to men (47% and 52%, P <0.01 vs. 34% and 41, p=0.04) as outlined in table 36. Nevertheless, no significant differences were found for the proportions of those who reached the SBP target during the three consecutive years from 2008 to 2010. Similarly to SBP, in 2009 as outlined in table 36 and Appendices 21 and 22, women had a higher proportion of reaching the DBP target than men (62% vs. 52%, P=0.05), but in 2010 the proportions between sexes were quite similar (74% female vs. 72% male, p=0.7).

For women, the proportions of those reaching the SBP target increased gradually from 2008 to 2010; however among those aged 40-59 years a drop in this proportion was detected between 2008 and 2009 (49% vs. 46%; respectively) as seen in table 37. At 2010, more than half of the women had met the SBP target (52%). In particular, older men (60+) had the lowest SBP target-met at 2010 (29%) followed by (42%) of men aged 40-59 years. Similar results were found for DBP; however reductions of target-met subjects in men aged 40-59 and (60+) were seen from 2008 to 2009 (reduced by 17% and 24% respectively).

Table 36: Proportions of men and women achieving the standard blood pressure targets: 2008 - 2010.

Outcome indicators	2008				2009				2010			
Targets achieved for SBP:	**Women**	**Men**	**Total**	**P-value**	**Women**	**Men**	**Total**	**P-value**	**Women**	**Men**	**Total**	**P-value**
Yes	94 (45%)	68 (39%)	162 (42%)	P=0.3	99 (47%)	58 (34%)	157 (41%)	P=0.006	108 (52%)	71 (41%)	179 (47%)	P=0.04
No	115 (55%)	105 (61%)	220 (58%)		110 (53%)	115 (66%)	225 (59%)		101 (48%)	102 (59%)	203 (53%)	
Targets achieved for DBP												
Yes	135 (65%)	117 (68%)	252 (66%)	P=0.5	130 (62%)	90 (52%)	220 (58%)	P=0.05	155 (74%)	125 (72%)	280 (73%)	P=0.7
No	74 (35%)	56 (32%)	130 (34%)		79 (38%)	83 (48%)	162 (42%)		54 (26%)	48 (28%)	102 (27%)	

Table 37: Proportion of subjects archiving standard targets for blood pressure by age groups and sex: 2008 -2010.

Clinical indicator (ADA target)	Male (n=173)				Female (n=209)			
	18-39 (n=44)	40-59 (n=78)	60+ (n=51)	Total	18-39 (n=53)	40-59 (n=96)	60+ (n=60)	Total
SBP(<130mmhg)								
2008	50%	37%	33%	39%	43%	49%	40%	45%
2009	36%	37%	25%	34%	51%	46%	47%	47%
2010	52%	42%	29%	41%	53%	51%	52%	52%
P value	0.27	0.75	0.69	0.32	0.59	0.77	0.44	0.39
DBP(<80mmhg)								
2008	77%	62%	69%	68%	70%	65%	60%	65%
2009	73%	45%	45%	52%	68%	60%	60%	62%
2010	77%	72%	69%	72%	79%	72%	73%	74%
P value	0.85	<0.01	0.02	<0.001	0.39	0.24	0.21	0.02

Results from the multilevel modelling are shown in table 38. Results indicated the rate of SBP and DBP changes among women and men adjusted for potential confounding factors including age group, anti-hypertension drugs, physical activity, and co-morbidities including: coronary heart disease and hyperlipidaemia and duration of diabetes.

Among men, the average annual reduction of SBP was 1.02 mm Hg (95% CI: -1.80~-0.24, P=0.01) as seen in table 38. However, this yearly rate reduction was not significant for DBP. Women had a lower average reduction of SBP level at a yearly rate 0.80 mm Hg (95% CI: -1.47 ~ -0.13, P=0.02) compared to men, whereas an average reduction of DBP level at a yearly rate was 0.71mm Hg (95% CI: -1.20~-0.22, P<0.01).

Unexpectedly, patients from both genders women and men respectively who were prescribed anti-blood pressure drugs had higher points in their S/DBP [7.6 mm Hg (P<0.001) and 3.9 mm Hg (P< 0.001) vs. 6.7 mm Hg (p<0.01), and 3.7 mmHg (p<0.001)].

Having regular physical activity was associated with lower S/DBP level in women although P-values were borderline significant (P=0.05 and 0.057 respectively). Also, for every 1-year increase of the duration of T2DM, the SBP level for women increased by 0.68 mm Hg (P<0.01, 95%CI: 0.29~1.06).

Table 38: Results from multilevel modelling on blood pressure for men and women: 2008-2010.

	Men				Women			
	B	P value	95%CI		B	P value	95%CI	
SBP								
Year	-1.02	0.01	-1.80	-0.24	-0.80	0.02	-1.47	-0.13
Anti-BP drugs	6.70	<0.01	2.55	10.85	7.62	<0.001	4.25	11.0
Physical activity					-2.78	0.05	-5.53	-0.03
Duration of T2DM (yrs)					0.68	<0.01	0.29	1.06
DBP								
Year	0.03	0.91	-0.55	0.62	-0.71	<0.001	-1.20	-0.22
Anti-BP drugs	3.65	<0.01	1.26	6.04	3.92	<0.01	1.69	6.14

→for multilevel analysis using SBP as a dependent variable, one observation was treated as an outlier (id=315) and excluded from the model.
→for multilevel analysis using DBP as a dependent variable, two observations were treated as outliers (id=313 & id=31) and excluded from the model.

Section four: Discussion

This final section of chapter five discusses the results addressed in section three and compares them with findings from studies carried out elsewhere. Discussion is classified into three main divisions including the process, intermediate outcomes of diabetes care, and differences in the control of these indicators among different age groups and genders. The main metabolic indicators for process and intermediate outcomes of care include glucose, blood pressure and lipid measurements.

5.12 Process of diabetes care

This study found that with regard to process measures, these were generally well met in the study period from 2008 to 2010, and the adherence rate to the guidelines was exceptional as reflected by the NWPOC score.

The findings from this study on the proportion of people with T2DM having their measurements performed at least once annually within 1-year of follow-up for the study period are comparable if not higher with studies carried out in the Gulf region (e.g., 180,), Middle East (e.g., 199, 200), and Western countries (e.g., 203, 204, 205).

Many reasons might enhance the adherence to the guidelines regarding process of diabetes care. The management agreement signed in 2006 with Johns Hopkins Medicine International and HAAD and the increase in the number of departmental audits might be some of the reasons helped in improving the process of diabetes care in the centre. The increase in the number of educational sessions provided to the people with T2DM in the centre helped increasing their awareness on the importance of attending appointments regularly; therefore the adherence rates to the appointments increased. Also, the establishment of new diabetes centres in Abu Dhabi motivated each centre to provide high quality of care. Changes in the healthcare professionals or employing new subjects might participate as well in improving the quality of T2DM care.

Based on the mission of Tawam hospital to provide high quality of healthcare, it uses performance innovation program which is designed to monitor, evaluate and continually improve the care and services delivered (230). The department of performance innovation has many responsibilities to improve the quality of healthcare such as supporting quality management activities, standardizing processes to meet hospital goals, supporting data aggregation, summarizing and analysing processes and providing training and ongoing facilitation for organization wide quality improvement teams. The performance innovation council was established at Tawam hospital to assume oversight role of quality innovations at the hospital (230). This council includes senior hospital management, key stakeholders from medical divisions, staff members of department of performance innovation, and invited guests (230).

As a consequence of following the performance innovation strategies at the hospital, compliance to the process of care increased; therefore the quality of care.

5.13 Intermediate outcomes of diabetes care

5.13.1 Glycaemic, blood pressure and lipid control

Despite the high rate of testing in this study, sub-optimal management of glucose and SBP was investigated; more than 50% of the study population did not achieve the desirable targets for the HbA1c and SBP in the following years 2008, 2009 and 2010. For instance, in 2010 only 41% achieved the target of HbA1c, and 47% meet the target of SBP. This finding reveals that excellent performance on process of diabetes care does not essentially translate into good metabolic control (200). There are other factors affect the metabolic control related the patients, disease itself and system. For example, compliance to the medications use and lifestyle of the people with T2DM have a great impact on the control of diabetes. However, in 2010 high rates of achievements of the DBP and LDL goals were found (73% vs. 72% respectively).

I noted that for outcomes of glycaemic and SBP control, similar results are reported for other countries in the region such as the GCC (180), Lebanon (198), and Egypt (200). For instance, the results of the systematic review I carried out on the quality of diabetes care in the GCC addressed in chapter four, section three revealed that management of T2DM in the GCC region – based on glycaemic-, blood pressure- and lipid- control indicators – to be suboptimal. Almost universally, fewer than 50% of patients reach targets for these clinical outcomes.

Nevertheless, comparing the findings from this study with some studies carried out in other GCC countries (e.g., for glycaemic control: 123,, and e.g., for BP control: 185, 186) the control of glucose and BP in this setting tends to be better. Still, high rate of blood pressure target achievement was attained in 83% of the sample of Afandi *et al*; the small sample (30 subjects) could be one of the reasons for this high achievement rate (180).

Comparing the findings with studies carried out in developed countries at various levels of healthcare, the results were consistent with a number of their findings. In the UK, the target of HbA1c ≤ 7.5% was achieved only in 43%-48%, and the target of blood pressure <140/85mmHg was achieved in 36%-59% (203). Additionally, in Netherlands, the goal of blood pressure 135/85 mmHg was achieved only among 20% of participants (231). Notably, lipid control findings were equivalent with studies carried out elsewhere (199-201). Yet noteworthy, participants at this study attained the target of LDL more successfully compared with people with diabetes in other Arab countries (e.g., 193, 199, 199-203).

5.14 Differences in care associated with gender and age

Findings from this study revealed variation in diabetes outcomes of care between younger and older patients as shown in the multilevel model. Compared to older individuals, younger individuals (<40 years old) have poorer HbA1c profiles. Although there were no significant differences of blood pressure level across age groups, it can be seen that during the three years proportion of those reached the target was consistently higher in younger age group than that of older age group. These findings concur with previous research that addressed the association between ageing and improved glycaemic control (175, 110), but an increment in the hypertension rate (175).

In summary, I found that glycaemic and lipid control tend to be similar between sexes, similar to the findings of studies carried out elsewhere (207), still in this study men had a slightly higher proportion of reaching the ADA targets. Unlikely to studies (175) that found women less successful in achieving the target goal for blood pressure, women performed better than men in this study on reaching the target of blood pressure, especially for the SBP in 2009 and 2010.

I noted an encouraging progress with regard to intermediate outcomes of diabetes control including glycaemic and lipid between 2008 and 2010. This finding is in line with the evident progress in the intermediate outcomes of DM care in the developed countries such as UK and USA (e.g., 127). The UAE is following several objectives of the national strategy for the control of diabetes, actions proceeding to implement two of these objectives which are: (1) support continuous monitoring and evaluation of diabetes care; and (2) improve and promote the quality of diabetes care at three levels of healthcare system might help in improving both the process and intermediate outcomes of diabetes care in healthcare providing centres in the UAE (88). Also, following the performance innovation strategies at the hospital helped improving the quality of diabetes care.

Furthermore, unpredictably the multi-level model showed that there is an increment in the levels of SBP / DBP in women and men who had been prescribed pharmacological medications to control high blood pressure. Similar results were found by Youssef et al in Egypt as patients who were prescribed anti-hypertensive drugs had about 11mmHg and 3 mmHg higher points in their S/DBP than those non-prescribed (199).

Several reasons can contribute to the poor S/DBP control among this group, and might be related to the disease process itself (232). There is also evidence which support the important role of patients related factors such as understanding of hypertension and its complications and the importance of adherence to treatment including medications use (233). Researchers have identified several factors affecting non-adherence and they categorized them into: patient related factors, treatment related factors, system related factors and healthcare professionals related factors (232).

People with T2DM play a key role in managing their disorder. Daily they perform roughly 95% or more of the management of diabetes without consulting healthcare professionals (232,233). They have to cope with several challenges they face in their daily lives such as glucose monitoring and medication regimen within the context of other goals, physical activity, decision about the diet, other health issues, family demand and other personal concerns (232, 233). Hence, adhering to the complex regimen including medication use and following healthy lifestyle may interfere with their coping with the disease.

Diet is considered as an important part of the treatment plan; therefore people with T2DM should know about their food and calories in each meal. Also, being aware about reading food labels can help people with T2DM to make a better decision about their food choices.

In T2DM, there is evidence that patient's adherence to medication is sub-optimal globally. For instance, a recent systematic review showed high rate of non-adherence to oral hypoglycaemic drugs and insulin (7-64% vs. 19-46%) (234).

Better glycaemic control was associated with adherence to the treatment of diabetes medications in many studies. For instance, a drop in the HbA1c levels by 0.16% ($p<0.001$) as a result of 10% increment in the adherence rate to oral hypoglycaemic drugs (calculated based on prescription refill data) was documented by Schectman *et al* 2002 (232). Equally, Ho et al found 0.05% reduction in HbA1c levels (95% CI 0.08%-0.01) due to improvement in the adherence to oral anti-diabetic medications (235). A further two studies also found similar results (236, 237).

Evidence showed that non-adherence to medications in chronic diseases such as T2DM and hypertension is common, and improving adherence to treatment including medication use could improve the treatment outcomes such as glycaemic and blood pressure control; therefore identifying variables that influence people with T2DM adherence to medications is essential.

In the west, several studies (e.g., 236-237) were carried out to explore predictors of non-adherence to pharmacological drugs in T2DM including medications used to regulate blood pressure as mentioned before. Nevertheless, no studies were found addressing the issue of adherence to diabetes treatment including medications in UAE. Some studies in the Arab countries reported the rate of non-adherence between 1.4%-27.1% (238, 239); however drawing a conclusion from this figure is limited by several flaws such as study design, sampling methods and sample size and methods of assessing and defining adherence used.

Complete investigation of the reasons for the increase in the blood pressure among subjects being prescribed anti-hypertensive drugs was not performed in this study; however non-adherence to the treatment is proposed to be one of the causes. Non-adherence is a common problem in all chronic conditions as mentioned before; principally it is problematic in T2DM and blood pressure due to the complexity of treatment regimen including the use of combined drugs and life long duration of the disease (236, 237).

"Clinical inertia" an issue associated with the healthcare professionals was suggested to be another reason not only for this paradox, but also for the sub-optimal control of HbA1c and blood pressure in this study. Phillips et al have defined clinical inertia in the comprehensive review they carried out as a failure of the healthcare professionals to initiate or optimize therapy when indicated (240). Therefore, for people with un-controlled blood pressure and glucose who are already on pharmacological treatment, regular review for the drugs prescribed is essential. More research should focus on clinical inertia and pattern of drug usage and their correlation with metabolic control in the UAE.

5.15 Strengths and limitations of the study

This is the first study in Al-Ain and UAE to examine the quality of T2DM care using longitudinal data from 2008 to 2010, and the first to investigate and assess any differences in T2DM care provided to different age groups and genders. The followed methodology allowed random selections of participants thus reducing the confounding effects of other contextual factors that could influence the quality of T2DM care. Also, the use of multi-level modelling allows for confounding variables and selects independents relationship with the quality indicators used in this study to assess the quality of T2DM care.

There are limitations to this study, the analysis was performed at a single centre in the Al-Ain, and choosing a sample from a hospital would be another limitation, as many people with T2DM are managed in the primary care settings. However the results of this study will most likely to be representative of care provided in other diabetes centres in Al-Ain, given the similarity in organizational, structure, followed guidelines, physician's training and possibly small difference in patient characteristics. Another caveat is the use of medical records to assess the care provided to people with T2DM that depend on the quality of documentation and might not necessarily reflect the actual care delivered or outcomes.

Data on BMI, patient's experience and quality of life was not possible to be collected in this study; therefore they were not included in the statistical analysis. Studying the association between these variables such as BMI and outcome of T2DM care is essential; hence we recommend future studies to consider studying these associations.

Also, the results that stated worse glycaemic and blood pressure control among people with T2DM been prescribed anti-blood pressure drugs were limited by lack of detailed information on: individual drugs, the cumulative doses and duration of treatment of each drug as they can interact with other factors influencing glycaemic and blood pressure control. Meanwhile, for people with T2DM with poor metabolic control, there is a call for reviewing the drugs profile and emphasising on improving the patient's adherence on drug use in the centre.

5.16 Implication of the study

This study provides useful baseline data about the quality of T2DM care in a diabetes centre, at a tertiary health care setting in Al-Ain. Results from this study are comparable with other studies elsewhere; however there are still rooms for further enrichment.

Identifying differences in diabetes care provided to different age groups and gender demonstrated in the study would assist healthcare professionals and policy planners and makers in addressing the problem and planning for quality improvement enterprises.

It is particularly worrying that younger Emirates with T2DM had worse glycaemic control than older patients; given that the risk for both micro and macrovascular complications over a long period of time would increase. Hence, further investigations for the sub-optimal outcomes of care among this group are needed to optimize the care provided.

As diabetes management relies on a great extent on the patient's life style, the use of interventions that are multi-faceted and holistic in approach would help in addressing the underlying causes of unhealthy lifestyle among people with diabetes (241). For instance, educational interventions targeting young population should be realistic, non-judgemental and focus on coping strategies (241).

At the diabetes centre level, supporting continued monitoring and evaluation of the diabetes care are highly recommended to tackle any difference in care, and to improve and promote the quality of diabetes.

However, as more than 70% of the UAE population is composed of expatriates that come from all over the world, more future research should target this group as well to investigate the quality of diabetes care and optimize its management.

5.17 Conclusion

This study demonstrates that there is an encouraging progress in the diabetes care reflected by the overall improvement in the mean of HbA1c, LDL and SBP, and the increment in the number of people reaching the target for the same indicators listed above for the consecutive years from 2008 to 2010. However, the results have shown that there is scope for additional enhancement, especially for a better glycaemic control among young patients and a better SBP control among males. Findings from this study can help healthcare professionals and policy makers and planners in comparing performance and planning for quality improvement initiatives.

Chapter 6: Qualitative approach

This chapter presents the qualitative approach used in this thesis. The chapter is classified into four main sections respectively including: literature review, methods, results, and discussion and conclusion.

6.1 Introduction

Measuring and improving quality of diabetes care remain important issues of concern worldwide (60-63). There is increasing evidence that diabetes care is suboptimal on the international level in terms of standards attained, degrees of variability and levels of accountability of health professionals (212, 204). Previous studies that have been local, observational or exploratory in nature have identified several factors influencing the quality of T2DM care. These studies often employed a theoretical framework that classified factors affecting the quality of diabetes care into three main categories: patient, healthcare professionals and organisational (242, 243). Factors related to patients (i.e., financial constraints, compliance with medications, life style recommendations and diet, gender issues, use of alternative medications, knowledge of diabetes and attendance to clinics) have been shown to affect the quality of T2DM care in previous studies (242). Other factors related to organisation and health professionals which include, availability of medications, heavy workload, waiting time at health centres (242-244), as well as motivation of the healthcare professionals, time with patients, role of nurses, shortage of staff, healthcare professionals' work time, team work, lack of feedback from specialists and lack of health professionals' training (242-244) have been shown to contribute to the explanation of variables that influence the care provided to people with T2DM.

While a number of these studies identified factors related to the quality of T2DM care from the patient perspectives, there has been less focus on the healthcare professional's experience in providing this type of care, and even less known of the experience of healthcare professionals working in the UAE's healthcare settings. Healthcare professionals' knowledge and attitudes towards diabetes care are essential in understanding the variables that might influence the care they provide to people with T2DM and ultimately the improvement of the quality of T2DM care. Moreover, factors influencing this type of care remain poorly defined and less investigated in the Middle East in general and the Gulf region specifically, despite the alarming prevalence known in this region.

The UAE has the second highest prevalence rate of diabetes worldwide (90% of cases of diabetes are of type 2) (1) as addressed in chapter one, two and four. With one of highest rates globally, diabetes is a major public health concern and financial burden in this country. Moreover, this disease represents a real challenge to the health planners, policy makers, people with diabetes and their families and healthcare professionals (84). Findings from the cohort study carried out and presented in chapter five revealed that the control of diabetes in the diabetes centre is suboptimal as reflected by the glycaemic and blood pressure intermediate outcomes. Another important finding is that younger subjects with T2DM tend to have poorer outcomes compared to the older subjects however; an encouraging improvement was witnessed from 2008 to 2010. As a consequence of the findings from the cohort study, I used the qualitative approach to identify factors both facilitators and barrier affecting T2DM care. To optimize the management of people with T2DM and increase the quality of diabetes care in the UAE, it is essential to understand all the general and country-specific factors that influence the care provided to individuals with T2DM.

Section one: Literature review

This section presents the literature review undertaken on the factors affecting the quality of diabetes care particularly type 2, along with the search method and outcomes of search. Findings from studies carried out in the developed and developing countries, particularly Arabic countries are addressed in sections 6.5.1 and 6.5.2 respectively. Summaries are provided at the end of each section. After that, factors affecting the quality of T2DM care are classified into: patient, healthcare professionals and organization and discussed comprehensively in section 6.5.3.

6.2 Aims of reviewing the literature

The literature review was undertaken to identify and discuss potential factors had been suggested to affect the quality of care provided to people with diabetes from the literature. The main aims of the literature review are: (1) to comprehensively appreciate the available factors documented in the literature affecting the quality of T2DM that could be investigated in this study, and (2) to setup the interview guide including the questions that will be used to collect the needed information from the healthcare professionals.

6.3 Search method

A review was carried out in Feb-2009/March-2010. Potential studies were identified by: (1) searching the electronic databases mainly EMBASE, MEDLINE, CINAHL and the Cochrane Library using various key words such as (quality of care, barriers to diabetes care, facilitators to diabetes care, healthcare professionals, diabetes mellitus, type 2 diabetes); (2) searching reference lists in the retrieved studies and other relevant articles; (3) contacting investigators and experts in the fields for information; and (4) hand searching two journals established in the Saudi Arabia and UAE respectively including Saudi Medical Journal, and International Journal of Diabetes and Metabolism to find studies carried out in the Arabic and Gulf countries.

The search was not limited to any language to enable the capture of any study published in other language than English including the Arabic. All papers from developing countries have been referred to along with significant either positive or negative findings from other publications.

6.4 Outcomes of the search

I found many studies carried out in the western countries; however there was shortage in studies focusing on the factors affecting the quality of diabetes care in the Arabic and gulf countries.

Factors affecting the quality of diabetes care either facilitators or barriers have been classified as mentioned in the introduction into three main categories including: patient, healthcare professionals and organization. The literature focuses on identifying these factors and investigating their relation to diabetes care. Diabetes care was assessed based on the outcomes of care including intermediate outcomes mainly glucose control and process of care outcomes.

6.5 Findings from the literature review

6.5.1 Studies from developed world

This subdivision is divided into two main parts which presents findings from the literature on the factors both facilitators and barriers affecting diabetes care in the developed world from a number of systematic reviews and studies. The first part talks about the findings from the systematic reviews, while the second part explains the findings from other studies carried out in the developed countries and were not included in the systematic reviews. A summary of the key findings from studies carried out in the developed world is provided after section 6.5.1.2.

6.5.1.1 Findings from the systematic reviews

The main factors associated with diabetes care included in the systematic reviews were: structured care, diabetes management programs, information technology, adherence to medication, patient-healthcare provider interaction, and the use of community health workers.

Structured care

Griffin et al performed a systematic review of Randomised Controlled Trials (RCT) of diabetes care in primary care settings, and they concluded that the un-structured care provided to people with diabetes in the primary care settings compared to hospitals was associated with greater mortality rates, poorer follow up and worse glycaemic control (244). For example, the rate of loss to follow-up was higher among subjects randomised to primary care centres (Peto odds ratio 3.05, 95% CI: 2.15 to 4.33) (244). Regarding metabolic control, specifically glycaemic control, the mean HbA1c was same or less in those been managed in the general practices as documented by the recent studies [the weighted difference in mean HbA1c % values was -0.005% (95%CI: -0.26 to 0.25)] (244). Further, the mortality rate in the general practice was significantly higher than in hospitals (Peto odds ratio 1.61, 95% CI: 1.03 to 2.51) (244).

Diabetes management programs

Analysis of the results of a systematic review to evaluate the effectiveness of diabetes management programs on treatment outcomes suggested that they have overall a modest impact on glycaemic control, but this impact was statistically significant (pooled estimate, 0.5-percentage point reduction; 95% CI, 0.3 to 0.6 percentage points) (245). Added to the improvement in the glycaemic control, these management programs improved other outcomes including screening for retinopathy and foot complications, SBP, and serum lipids (245). Nevertheless, diabetes disease management programs tend to not have a significant effect on other outcomes such as screening for nephropathy, hospital admissions and patient knowledge. This result might be affected by the small number of studies evaluating these related outcomes of treatment (245).

Information technology

There is a growing body of evidence that emerging information technology can assist improving diabetes care. Based on the results of a systematic review carried out by Jackson et al, several trials indicated significant improvement in glycaemic control reflected by reduction in HbA1c levels, as a consequence of using interactive computer-assisted technology in diabetes care (246). Also, significant enhancement in healthcare utilization, behaviours, skills and attitudes were indicated (246).

Adherence to medications

As discussed in chapter five, non-adherence to medications in T2DM is a common problem.

A review by Haynes showed that adherence to medication by people with chronic diseases tends to be only 50% (247). Therefore, Haynes concluded that "increasing the effectiveness of adherence interventions may have far greater impact on the health of the population than any improvements in specific medical treatments" (247).

In diabetes, a systematic review carried out to assess the adherence of people with diabetes to oral hypoglycaemic medications demonstrated a range of 36% to 93% (248). Furthermore, in people with T2DM who are on oral hypoglycaemic drugs, a review of six RCTs comparing self-monitoring of blood glucose or/ and urine glucose with standard care found an association between improving glycaemic control and self-monitoring blood glucose (248). Unlike the results from this meta-analysis, another meta-analysis of self-monitoring including eight RCTs showed no difference between the two methods including self-monitoring of blood glucose or/ and urine glucose with standard care (249). Hence, WeIschen et al concluded that more research should be carried out to evaluate the positive association of self-monitoring with glycaemic control (249).

Healthcare professionals-patients interaction

A systematic review was carried out to test the influence of modifying provider-patients interaction and healthcare provider consulting style on people with diabetes outcomes and self-care included eight publications, mainly RCTs (250). This systematic review concluded that focusing on patient's self-care behaviours and participation in diabetes care may be more effective than focusing on changing healthcare provider's consultation behaviours (250). Nevertheless, this systematic review was limited by the small number of studies analysed.

The use of community health workers

Community health workers have recently become involved in many community diabetes programs. Their effectiveness in improving the participant's knowledge and satisfactions had been supported by some studies (e.g., 251); however no data is available on their influence on health, quality of life and economic outcomes (251).

6.5.1.2 Findings from other studies

There are several studies (e.g., 252, 253) carried out in developed countries, and were not included in the systematic reviews. These have classified the factors both motivators and barriers to providing high quality of diabetes care into three main sorts namely: patient, healthcare professionals, and organization as mentioned earlier. These studies illustrated the dynamic interplay of patients, healthcare professionals and organisation factors in the management of diabetes. This classification is used in this chapter to discuss the findings from the literature on the potential factors influencing the care provided to people with diabetes in section 6.4.

Summary

In brief, systematic reviews conducted in the developed world showed a positive association between patient adherence to medications and structured recall system with improving the care provided to people with diabetes. However, ambiguous results found from reviewing other factors such as the use of information technology and the involvement of community health workers in diabetes care. Systematic reviews similarly to all research studies have their limitations, and most of the reviews included small number of studies; therefore their conclusions are uncertain. More studies both quantitative and qualitative are essential to identify factors affecting care provided to people with diabetes.

Notably, there are many factors related to patient, healthcare professional and organization influencing the diabetes care. A dynamic interplay between these factors has been demonstrated by a number of studies listed above.

6.5.2 Studies from Arab countries

Little work has been found regarding the factors associated with diabetes care in the Arab World.

In the Gulf region, few studies investigated the quality of diabetes care and factors related to it. In Saudi Arabia, a comprehensive review on the factors influencing the care provided to people in the primary care, not specific to diabetes investigated six key factors (254). These factors included: management factors, organizational factors, implementation of evidence-based medicine (EBM), professional development, problems at the interface with secondary care, and organizational culture (254). For instance, several organizations related obstacles have been identified to providing high quality of care such as poor information system, stressful work conduction and shortage of resources (254).

Another study was carried out in Saudi Arabia carried out by Khattab et al to assess the: (1) role of the characteristics of diabetes care, (2) people with diabetes and, (3) diabetes in the prediction of compliance with diet, medications and appointments in primary care settings (255). Diabetes care was measured using the score system developed by Chesover et al (253). They found higher compliance with diet among male ($p=0.01$), and people with good diabetes control ($p=0.01$). Adherence to appointments was associated positively with T2DM ($p<0.01$) and good diabetes care ($p<0.01$) (264). Overall, degree of diabetes control and duration of disease were closely associated with adherence to diet and appointments ($p<0.05$) (253).

In the UAE, particularly Abu Dhabi an analysis of predictors of poor diabetic control among people with diabetes attending both primary and secondary care identified possible confounding factors related to the location of care and degree of disease control (41). Attending primary care centre was associated with poor glycaemic control than attending hospitals ($p=0.03$) (41). Also, people with diabetes who have family history were better controlled than those without family history (p=0.015) (41). This finding may suggest the importance of 'peer pressure' among people with diabetes in the UAE.

In Oman, two qualitative studies were carried out to investigate factors influencing diabetes care from the perspectives of individuals with diabetes (229, 256). The first qualitative study was carried out at Muscat; using four focus groups discussion to explore the experience and views of subjects with T2DM regarding the medical encounters with their healthcare professionals in the primary care settings (229). The study explored some weakness regarding patient-healthcare professional's interactions and health care services in the primary settings (229). For instance, some patients experienced poor communication from the healthcare professionals reflected by for examples, un-friendly welcoming and poor attention to the patient due to the use of computers during the consultation time (229). Regarding patient centered care, patients stated that lack of encouragement to ask questions regarding the disease and it is management was common among healthcare professionals (229). Also, information about self-management such as self-monitoring of blood glucose and hypoglycaemia was lacking (229). Patients noted that they did not receive education about their diets and life style behaviors which play an important role in managing diabetes (229). Adding to this study, Al-Azri et al found several barriers to providing high quality of care to people with T2DM in primary care settings in Oman such as delays in getting appointments, language barriers with nurses, long waits for ophthalmology appointments, lack of referral to dieticians and lack of proper utilization of waiting areas (256).

Summary

Findings from studies carried out in Tunisia and other Gulf countries investigated different factors influencing the care provided to people with diabetes and they are related to patient, healthcare professional and organization. The main organizational factors identified are shortage of resources such as equipments and healthcare professionals, stressful workload, variation in care provided by primary/secondary settings, and lack of referral to dietician and ophthalmology. Other factors related to patients and healthcare professionals were reported such as patient-healthcare professionals interaction, language barriers between healthcare professional and patients, poor team-work, patient's characteristics such as sex and adherence to appointments and treatment.

6.5.3 Factors affecting quality of diabetes care

Facilitators and barriers to providing high quality of diabetes care related to the three chief players including patient, healthcare professional and organization separately are discussed in sections 6.5.3.1, 6.5.3.2, and 6.5.3.3 respectively.

6.5.3.1 Health care professionals related factors

In this part, I will list and explain the main findings on the factors related to the healthcare professionals affecting diabetes care based on the literature. These factors were: (1) physician characteristics, (2) physician's inertia, (3) healthcare professional's attitudes and beliefs, (4) patient/ healthcare professional's interactions (5) continuity of care, (6) clinical team, and (7) healthcare professional's motivation.

Physician's characteristics

I found one prospective, and a number of cross-sectional studies carried out mostly in the primary care settings to investigate the influence of physician's characteristics on the quality of care provided to people with diabetes using various outcome measures. They investigated characteristics included age, gender, interest and continual medical education attendance of the physicians.

Studies from the literature pointed out that the gender and age of the physicians influence the quality of the management of people with T2DM; however results of these studies are conflicting. Some studies (e.g., 257-259) indicated that higher quality of diabetes care was associated with younger and females physicians, but this is not always the case (e.g., 257, 258). For instance, in Netherland results from 895 randomly selected people with T2DM showed that females physicians used to document the blood pressure more frequently than males physicians (0.30, 95% CI: 0.12-0.71) (257). In the contrary, no alliance between glycaemic control and the sex of the general physicians was demonstrated among 610 individuals with T2DM in a study performed in Danish general practices as indicated by the multivariate linear random effects model ($p=0.76$) (258).

Other studies (e.g., 260) found differences in the Physician Decision Making (PDM) style between males and females physicians; nevertheless its impact on the quality of diabetes care is doubtful. For example, the adjusted analysis showed that female physicians had more participatory visits with their patients compared to male physicians (1.3 vs. 3.1, $p=0.03$; respectively) (260). Also Kenealy et al found that female physicians were much more likely than male physicians to refer all newly diagnosed people with diabetes to secondary services (Female: 68% and Male: 42.8%, $p< 0.01$) and routine shared care (Female: 74.7% and Male: 58.7%, $p = 0.007$) (261).

Many studies in the literature examined the association between the physician's characteristics including the interest of physicians on diabetes and improved glycaemic control. A positive association between the two listed variables has been proved by the following studies (262-264), except study (265) as no significant difference in improving glycaemic control was found among physicians with more or less interest in diabetes compared to other diseases ($p=0.44$ vs. $P=0.50$; respectively). In this study, several reasons were attributed to the negative association between physician's characteristics including interest in diabetes compared to other disease and the improvement in the average trend in HbA1c over time (265). One of the reasons was that other factors rather than those related to the physicians such as patients and organization related factors can better explain the overall enhancement in the glycaemic control (265).

Continual medical education is considered to be one of the important tools to update health professionals' knowledge; however studies found that even with appropriate knowledge, health professionals do not always adhere to the guidelines or the suggested advice (266, 267). Lawler et al demonstrated in their study that physicians confirmed their requisition for the annual eye test nearly for all their patients; yet only 43% of the patients said that they were refereed by their physicians (268). Added to the low rate of the eye test referral, only 58% of the patients had HbA1c test documented in their billing's system, while more than 75% of the physicians stated recommending HbA1c almost for all their patients (268). There are many causes for the lack of compliance to the guidelines by physicians as highlighted by Lawler et al including: deficiencies in the physician's knowledge, lack of physician's beliefs in the guidelines, patient's non-adherence, and implementation problems (268).

Health care professionals inertia

Phillips et al have defined clinical inertia in the comprehensive review they carried out as a failure of the physicians to initiate or optimize therapy when indicated (240). This has been identified by many studies (269-272) of diabetes care as a major obstacle to achieving the targets of blood glucose and pressure.

There are three major causes suggested for clinical inertia: (1) an overestimation of care provided; (2) the use of 'soft' reasons to avoid optimization of therapy; and (3) lack of training, education and practice organisation focused on achieving therapeutic targets (269-272).

Clinical inertia is multifaceted; further research is needed to investigate the association between clinical inertia and diabetes care.

Healthcare professionals attitudes and beliefs

Many studies have stated that doctors describe diabetes as a difficult disease to treat compared with other chronic conditions due to the complexity of treatment, unavoidability of future diabetes related complications, lack of effective drugs and behavioural changes required from the patients to achieve the treatment outcomes (273-275).

Based on the findings from interview studies and surveys (273-275), doctors believe that factors related to the organisation such as lack of: support staff or team to work with, time, peer encouragement, incentives are more important barriers to good quality of diabetes care than their knowledge or attitude.

Patient-healthcare professional interaction

Research has been carried out around the area of patient-healthcare professional interaction. Clinicians tend to view their own management based on the treatment plan and achieved outcomes while understanding the patient's concept about the disease and treatment is less considered or ignored in many cases (276). This could affect the treatment outcomes negatively as patients might not concur with the clinician's advice leading to clinician's frustration.

Patient's view of the healthcare professionals was identified by one study as a reason for not responding to the clinician's advice (277).

Continuity of care

Many studies focused on the continuity of care with a primary care provider and its association with the improving the quality of diabetes care. Some reported an association between continuation of care and improved patient satisfaction (273), while it was not always the case with outcomes of treatment (264). For instance in Muscat, capital of Sultanate of Oman a qualitative study was carried out to explore the perceptions of people with T2DM regarding the medical encounters and quality of interactions with the primary healthcare providers, found the lack of continuity of care with the same physician a barrier for good diabetes care (229). Added to this study Hanninen et al found continuity of care in people with T2DM tends to be a crucial factor of good Health-Related Quality of Life (HRQOL) as reflected by the HRQOL dimensions including: physical, role and social functioning, mental health, health perception and painlessness (264). Better mental health (2.48, 95% CI: 1.16-5.32), less pain (6.02, 95% CI: 1.82-19.92) and feeling healthier (3.45, 95% CI: 1.52-7.87) were found in patients who had a permanent physician- patient relationship for 2-years (264). Nevertheless, less satisfactory blood glucose control was reported among this group ($p=0.41$) (264).

Clinical team

Positive perceptions of teamwork and team climate are often cited in qualitative research as facilitators of good diabetes care (252).

Emphasizing on the importance of team work in treating diabetes is crucial. In Australia, a large population-based study linked the quality of diabetes care based upon process of care with the involvement of a diabetes educator in the management of people with diabetes (252). Similarly, two other studies (230, 262) proposed a relation between the quality of diabetes care with access to a dietician. For example, access to hospital dietician reduced the random HbA1c level by a mean of 1.06% (p=0.01) in a group of 310 diabetic subjects (262).

Healthcare professional motivation

Motivation of healthcare professionals' in the management of T2DM is a complex issue, and is seen as a collective term covering multiple matters such as the healthcare professional's interests and intentions when providing quality of diabetes care (271). Although "motivation" is an un-specified term (271), its influence on the quality of diabetes care has been indicated by previous research (e.g., 242, 243). Several authors linked health professional's motivation to better therapeutic outcomes for patients with diabetes (270, 272). Motivation was one of the common health professional factors alluded to by the healthcare professionals themselves in many studies (e.g., 242, 243). For instance, healthcare professional's motivation was identified as one of the top five factors associated with improving either the process or outcome of diabetes care in primary care centres in Tunisia (242). However, factors affecting the motivation of healthcare professionals in the Middle East in general and the Gulf region specifically remain poorly defined and less investigated despite the alarming prevalence rate in the region.

6.5.3.2 Patient factors

The main factors related to the patients influencing the diabetes care investigated by other studies were demographic variables and adherence to treatment. Other related factors were studied as well but less frequently such as health beliefs of the patients and knowledge of diabetes and psychological factors.

Demographic variables

The main patient's demographics have been tested in the literature as either potential barriers or motivators of care are: age, sex, duration of diabetes, BMI, treatment with insulin, existence of co-morbid diseases, smoking, educational level, and ethnicity.

Evidently as indicated by many studies (e.g., 265, 278, 279) longer duration of diabetes was associated with poor glycaemic control. For example, Pringle et al found patients who were diagnosed within the previous seven years (n= 153) had better control compared to those diagnosed eight or more years (n=153) previously (p=0.005) (265).

However, many studies have linked younger age to poor glycaemic control (e.g., 280). For instance, Glycaemic control as an example was better in older individuals diagnosed with T2DM in HANES 1999-2000 and HANES (III) (1988-1994) as reflected by the Odds Ratio (OR) for people aged between 20-44 and people aged ≥ 65 years (OR: 1 vs. 1.58; respectively) (281).

The association between gender of people with diabetes and the glycaemic control has been studied, but results are uncertain; however more evidence pointed out that females have poorer access to care than males (e.g.,262, 282) as addressed in chapter five, section one. For example, in the UK, one of the studies demonstrated that patient's sex –females vs. males- affects significantly the value of random HbA1c (p=0.01) (265). Also, some studies (e.g., 206) found that female with diabetes were less successful achieving blood pressure targets than males (206).

Furthermore, an association between BMI and poor glycaemic control was found in some studies (e.g., 226, 282), but this was not always the case in other studies (e.g., 280).

Further factors related to the patients associated with poorer diabetes care based on different outcome measures were investigated by other studies included smoking

(282), treatment with insulin (283-285), and existence of co-morbidities such as hypertension (283-285).

Added to these patient's related factors, some studies found significant influence of the socio-economic factors such as deprivation and social status of patient's and diabetes care as discussed earlier in chapters five, section one. For instance, in the UK many studies addressed the differences in the care provided to people with diabetes in deprived areas compared to those living in less deprived or privileged areas (e.g., 285). In the US for example, un-insured patients tend to receive lower quality of diabetes care compared to those insured as indicated by many studies (e.g., 285, 286).

Adherence

In the care of people with diabetes, several studies have confirmed the importance role of adherence, especially to medications as outlined by subdivision 6.5.1.1 and section four of chapter five.

There is great variation in the conceptual or operational definitions of treatment adherence. Closely related terms which have been used to refer to the concept are compliance, concordance, cooperation, mutuality and therapeutic alliance. The term "compliance" was defined by Sackett and Haynes as "the extent to which a person's behaviour (in terms of medication taking, following a diet, modifying habits, or attending clinics) coincides with medical or health advice" (287, 288). Failing to "comply" is usually associated with blame, whether this blame is placed on the doctors or patients (289, 290). Hence, terms like "adherence" or "concordance" are now more preferred. The term "adherence" emphasises the need for agreement on part of the patient to the prescriber's recommendations, and that there is no reason to blame patients should they wish not to follow the treatment (289). While concordance focuses on the consultation process in which the doctor and patient agree therapeutic decisions incorporating their respective views, and extends to involve supporting patients in medicine taking (292).

Though non- adherence is a common problem in all chronic conditions; principally it's problematic in T2DM due to the complexity of treatment regimen including drugs and life long duration of the disease as discussed in chapter five (292). Non-adherence has been the focus of many worldwide initiatives such as WHO, which addressed in its report 2003 that poor adherence to treatment of chronic conditions is a major public health problem (293). This problem imposes a recognizable financial burden upon modern health care systems (293, 288). In developed countries for instance, non-adherence was found to have a striking magnitude averaging about 50% (293).

Added to the financial burden on national economies, many consequences are associated with failure to take medications as intended such as therapeutic failure, disease progression, loss of productivity and the need for more aggressive treatment that can further increase the risk of drug-induced problem (294).

Research has identified several factors affecting non-adherence and they categorized them into: patient related factors, treatment related factors, system related factors and healthcare professionals related factors (295-297)

Type of drugs, degree of behavioural change required, complexity , duration, dosage all are examples of treatment related factors that might be associated with non-adherence to medications (297). However, communication is the most widely healthcare professional studied factor in relation to patient adherence to medications (272). Improving adherence to treatment could be achieved by adopting a patient-centred communication style (298). This style of communication involves a shift from focusing on the disease itself and it pathology toward thinking about the patient as an individual with problems (298). Several organizations related factors such as continuity of care and clinic waiting time are believed to influence patient adherence to medication (299).

Despite the decades of research on adherence, there is no “gold standard” to measure it. Measuring health outcomes is one of the used methods that have some limitations. This method is limited as there is no straightforward relation between adherence and health outcomes (300). Improvement in health could be due to other factors such as weight loss or adoption of healthier life style rather than following the prescribed regimen (296).

In T2DM, there is evidence that patients adherence to medication is sub-optimal globally as addressed in subdivision 6.2.1.4, and section four of chapter five. For instance, a recent systematic review showed high rate of non-adherence to oral hypoglycemic drugs and insulin (7-64% vs. 19-46%) (296, 297).

As explained in chapter five, better glycemic control was associated with adherence to the treatment of diabetes medications in many studies. For instance, drop in the HbA1c levels by 0.16% ($p<0.001$) as a result of 10% increment in the adherence rate to oral hypoglycaemic drugs (calculated based on prescription refill data) was documented by Schectman et al 2002 (301). Equally, Ho et al found 0.05% reduction in HbA1c levels (95% CI 0.08%-0.01) due to improvement in the adherence to oral anti-diabetic medications (302).

Other factors

There are other important patient's related factors, but are difficult to measure and complex such as health beliefs and physiological factors. Also, there are other important factors including stress, family role and late morning hyperglycaemia. Nevertheless, in 1990s Simmons et al aimed to identify and then quantify barriers to diabetes care using an exploratory qualitative study approach among people with diabetes in New Zealand (303). More recently, to achieve the same aim, a cross-sectional survey of roughly 4000 subjects with diabetes and healthcare professionals was undertaken by the same group (304). Several barriers to optimal diabetes care were identifies as displayed in table 39. These factors related to the patients are evolved around five main themes namely: educational, internal physical, external physical (system), psychosocial and psychological.

Table 39: Barriers to optimal diabetes care

Educational	Psychosocial	Psychological
• Low diabetes knowledge	• Lack of public awareness	• Health beliefs
• Low knowledge of services	• Lack of family support	• Public health beliefs
	• Communication difficulties	• Poor motivation • Low self- efficacy
Internal physical		• No symptom cues
• Physical effects of treatment		• Difficulty setting priorities • Family demands
External physical		• Negative perception of time
• Personal finance issues		• Emotional issues
• Poor physical access to service		• Precontemplative stage of change

(Modified from Ref No: 303, 304)

6.5.3.3 Organisational factors

Many cross-sectional observational studies have investigated the association between various organisational factors and the quality of diabetes care. Some identified factors tend to be specific to the study setting, and may not be transferred to other settings. However, among those transferable factors many have shown effects on diabetes care including: practice size and number of staff (227, 242, 243), co-operation between primary/secondary care (279, 243), consultation time (242), availability of the equipments in the health care setting (242, 243), structured records (227), availability of resources and treatment, particularly pharmacological treatment (220, 224), practice guidelines (220) and educational programs for people with diabetes (227).

Practice size and number of healthcare professionals

Many studies (e.g., 242, 243) found an association between the size of the healthcare setting and the number of healthcare professionals available with the quality of diabetes care. For instance, Campbell et al found from their analysis that large practices had higher scores for diabetes care than smaller practices; nevertheless higher score for access to care, and patient's satisfaction were assigned to smaller practices. This important finding in diabetes care emphasises that different types of practice may have different strong points (299).

Co-operation between primary-secondary settings

Diabetes is a chronic, multi-dimensional disease and even with high quality of care, particularly secondary prevention provided to people with diabetes in the primary care, expert help from the secondary practices is needed (49). Lack of co-operation between the primary-secondary care have been suggested as a barrier for providing high quality of diabetes care in some health systems (279). For example, in the UK results from 1320 questionnaires were reassuring and showed that roughly 80% of the practices receive adequate support from other healthcare professionals from secondary care settings, while already 60% have regular contact with them (267). In contrast, there was no communication between some primary practices with secondary care settings, yet still healthcare professionals feel adequately supported without contact with their colleague working at the secondary healthcare settings (267). If supposing integrated diabetes care is provided to the patients, then a management protocol for people with diabetes should be shared between primary-secondary settings; however only half of the participated practices shared patient management protocol with colleagues working at secondary hospitals (273).

Consultation time

Many studies (e.g., 273, 268) supported that the length of consultation is associated with improving the quality of diabetes care. For instance, among 60 general practices in England, the length of consultation was found to be a predictor of quality of care (273). They demonstrated that practices with 10 minutes consultation booking intervals had higher scores for quality of clinical care compared to those with five minutes consultation booking intervals for all the three chronic conditions including asthma, angina and diabetes (273). For diabetes, the mean adjusted clinical scores (maximum=100) for 5 and 10 minutes consultation booking intervals were (55.1 vs. 64.6; respectively) (273).

Other factors

Other organizational factors studied in the literature influencing diabetes care include presence of structured diabetes clinic (178), closeness of ophthalmologist (177), and access to health care services (286). Also, there is a growing body of evidence that link the improvement in the people with T2DM outcomes with the availability of structured recalled care (255).

Distance between the healthcare providing location from the patient's residence was studied as a factor affecting the healthcare. For instance, results from some studies (e.g., 242, 243) showed that longer distance between the home and the site of primary care is associated with poor chronic care in rural (242) compared to urban areas (243).

Section two: Methodology

Section two of chapter six presents the methodology employed in this research commencing with the qualitative work. The aim of the qualitative methodology is to explore and identify factors, both barriers and facilitators that influence the care provided to people with T2DM at the diabetes centre of Tawam hospital. This section explains the rationale and use of qualitative method and data analysis along with common concerns in qualitative methodologies including sampling, access, ethical and validity issues.

6.6 Aim, objectives and research questions

The main aim, objectives and research questions of this qualitative work are listed below.

Aim

- To identify factors both facilitators and barriers that affect the quality of T2DM care at the diabetes centre based on the perceptions and attitudes of healthcare professionals at Tawam Hospital, Al-Ain, UAE

Objectives

- to identify facilitators/ barriers to improving the quality of T2DM care related to the healthcare professionals work practices
- to develop a frame of knowledge from the opinions, understanding and experiences of the healthcare professionals regarding the care of people with T2DM to improve quality of diabetes care

Research questions

- What are the main factors affecting the quality of T2DM care from the perceptions, experience and attitudes of healthcare professionals working at the diabetes centre at Tawam hospital?
- What are the specific facilitators/ barriers to improving quality of T2DM care based on the experience, perceptions and attitudes of healthcare professionals at the diabetes centre at Tawam hospital?

6.7 Materials and design

6.7.1 Rationale for using qualitative approach

As described by Denzin and Lincoln in their book Handbook of Qualitative Research, qualitative research "is a multi-method in focus, involving an interpretive, naturalistic approach to its subject matter. This means the qualitative researchers study things in their natural settings, attempting to make sense of, or interpret, phenomena in terms of the meaning people bring to them" (305). The main goal of the qualitative research is the development of concepts that help us to understand social phenomena in natural settings, giving special consideration to the meanings, experiences and views of all the participants.

There are several potential strengths of the qualitative research that are applicable to the health care setting. In my case strengths that are related to this initial research are: (306-309)

- understanding the barriers to quality of T2DM care and identifying obstacles to change
- identifying facilitators to quality of T2DM care
- enabling access to areas not amenable to quantitative research like attitudes, perceptions and beliefs of healthcare professionals

The key focus of the research design is the consideration of best answer to the research questions. Based on the strengths listed above and the aim of this study to identify factors influencing T2DM care from the perceptions and attitudes of healthcare professionals; qualitative research was identified as an appropriate method to reach the goal of this research.

6.7.2 Why semi-structured interview?

After identifying the qualitative methodology for this study, the issue of developing and choosing appropriate research tools arise. This research aims to investigate and identify factors influencing the care provided to people with T2DM based on the beliefs, experience, attitudes and perceptions of healthcare professionals. In conformity with the aim of this study which depends on the healthcare professional's perceptions, beliefs and experiences; semi-structured interviews were chosen as a mode of data collection.

6.7.2.1 Definition and rationale

There are three types of qualitative research interviews including: unstructured, semi-structured, and in-depth interviews. The unstructured interviews are the least structured interview followed by depth and then semi-structured (310). The first type is characterised as a participant-guided approach, and is useful when the researcher knows little about what is inquired (311). Secondly, in-depth interviews are designed to answer one or two issues but with much more details. Besides these two modes of qualitative interviews, the semi-structured interviews are conducted on the basis of a loose structure consisting of open-ended questions that define the area needed to be explored (311).

"Semi-structured interviews are conducted on the basis of a loose structure consisting of open-ended questions that define the area to be explored, at least initially, and from which the interviewer or interviewee may diverge in order to pursue an idea or response in more detail" (310). This type of interviews, allows detailed exploration of participants' ideas about the topic being discussed (310). Within semi-structured interviews, a basic structure that defines the main topic is used; however discussing ideas and understandings that may not be expected by the researcher is flexible (312). This type of interviews gives the participants the freedom of response and description to illustrate the concepts (313).

Based on the purpose of this study which needs gathering data regarding the interviewees' experience, perceptions, attitudes, beliefs and recommendations; semi-structured interviews were used. A fixed set of topics were discussed with participants using a set of open-ended questions (312).

6.7.3 Sampling

6.7.3.1 Purposive sampling

In contrast to quantitative research, qualitative research aims to reflect the diversity within a given population, rather than aspiring to be statistically generalisable or representative (313). The qualitative method however, desires the perception gained from the study would show useful in other context that had likeness (313).

Given the similarity in the health system and structure; we believe that findings from this study could be generalized and beneficial to other diabetes centres that provide secondary/ tertiary care to people with diabetes in Al-Ain and Abu Dhabi.

Purposive or theoretical sampling is a specific type of non-probability sampling. In this sampling method, the process of sampling and data collection are guided by the objective of developing theory or explanation (314). Purposive sampling allows the researcher to select the most productive sample called 'information rich' to be included in the study and answer the research question (314). Based on the qualitative aspect and objective of this initial study, purposive sampling is the ideal method for selecting participants.

Homogenous purposive sampling was used to recruit participants as they were chosen to be 'information rich'. Nine semi-structured interviews were conducted with three diabetes specialists, two educators, two nurses, one dietician and one podiatrist. Table 40 provides a brief outline of some of the characteristics of the healthcare professionals who participated in this study.

6.7.4 Target population

Diabetes healthcare professionals working in the diabetes team including dieticians, specialist physicians, educators, nurses, podiatrists at the diabetes centre at Tawam Hospital.

6.7.5 Selection criteria

- Experience of the healthcare professionals at the diabetes centre at Tawam hospital (> one year)
- Job position of the health care providers (dietician, specialist physician , educators, nurse, podiatrist)
- Number of available healthcare professionals

6.7.6 Setting and participants

The study was carried out in a diabetes centre located at a tertiary hospital in Al-Ain, Abu Dhabi. This centre provides resourceful inpatient and outpatient service for all people with diabetes including obstetric patients (230). It focuses largely on educating the people with diabetes and their families regarding diabetes and its management and educating them on the insulin pump use (230). Additionally, the centre has several clinics such as diabetic foot and paediatrics diabetic.

This particular centre was chosen because of several reasons. Firstly, the study aims to identify factors affecting diabetes care both barriers and facilitators based on the perceptions, beliefs, experience and attitudes of the healthcare professionals. In this centre the diabetes care is provided through a team composed of different healthcare professionals such as physicians, nurses, diabetes educators and podiatrists. This would allow targeting the information rich subjects needed to achieve the study aim. Also, many of the healthcare professionals working in this centre are assigned to different primary care settings on regular basis; hence their experience and perceptions about the barriers and facilitators to healthcare professional's motivation in both settings would be utilised.

Interviews were conducted with diabetes healthcare professionals at the diabetes centre at Tawam Hospital, Al-Ain. They were usually undertaken at the offices of the healthcare professionals at Tawam hospital.

6.7.7 Sample recruitment

A list of the healthcare professionals who work in the diabetes centre was obtained from the head of the centre along with their hospital's email addresses and the date of joining the centre. Healthcare professionals who had worked in the centre for one year or more, managing people with T2DM and were available during the interview period were contacted by email (see appendix 23). From the ten healthcare professionals who were contacted, nine agreed to be interviewed; therefore the response rate was 90%.

The interviewer (LA) conducted all the interviews in English, audiotape them and later simultaneously transcribed them.

Table 40: participant's characteristics

Interviewee	Years worked in the profession
Diabetes Specialist 1	>3 years
Diabetes Specialist 2	>3 years
Diabetes Specialist 3	>3 years
Diabetes Educator 1	1-3 years
Diabetes Educator 1	1-3 years
Nurse 1	>3 years
Nurse 2	1-3 years
Dietician 1	1-3 years
Podiatrist 1	1-3 years

Range for total sample: 5-15 split between different specializations or duplicate.

6.7.8 Access issues

6.7.8.1 Ethical approval

In my case, ethical approval was granted for the study by Al-Ain medical district (refer to appendix 17). I therefore had official permission to visit the diabetes centre and interview the healthcare professionals, although further permission was required and obtained from the head of the centre.

6.7.9 Interviews

6.7.9.1 Data collection method

Prior constructing the interviews, two procedures were undertaken namely planning and designing the interview questions and piloting.

Planning and designing interview questions

Firstly, in the planning process the following steps were followed: (1) listing all important topics of interest to the aim of the study; (2) assembling appropriate questions; (3) listing additional items and response formats that need to be developed; and finally (4) relating the questions to the aim of the interview.

This was guided by literature review carried out on the factors that influence the care provided to people with T2DM addressed in section one. Also, I utilised from the semi-structured interview questions that were carried out by Hugh Alberti with key informants in Tunisia to explore factors influencing the management of diabetes (242).

Based on the findings from the literature on the factors that influence the T2DM care, which are chiefly classified and related to the patient, healthcare professional and organization as addressed in section one, and the planning process, the interview questions were written. Structurally, the interview was divided into nine key sections as detailed in section 6.5.3.

Questions

As the format of the questions can influence the answer and comprehensives of the response, it was very important to spend sufficient time planning and formatting accurate and well-designed questions that meet the aim of the research. Therefore, some steps were undertaken to support the process of questions formatting and they were: (315)

(1) Order and wording

Orders: the interview questions were divided into different sections, each section focuses on a specific theme. Under each section, questions were designed to explore and investigate more about the factors both motivators and barriers to diabetes care at the centre.

Wording: to avoid ambiguity and retain rapport, questions were formatted in a simple, short, familiar words and phrases. Questions were designed to be short because people usually do not remember long ones and tend to answer the last part of the question only. For instance, to ask participants about their perception of the working in the team, I asked the following question *"How do you perceive working with others?"* To avoid confusion double negatives or tagging "or not", and double barrelled questions where two questions are included in one question were never used. Tagging was avoided for the reason that the inadequate statement of the alternative opinion can be confusing.

(2) Questions form

The interview included a combination of open and closed questions for examples refer to the interview guide (refer to appendix 24). For the clarification of reasons and explanation, I started by asking close question, then I followed it with open ones. For instance, I wanted to identify barriers for the involvement of other healthcare professionals in the diabetes team; therefore I asked a closed question to list the suggested professions for involvement in the diabetes team. Then an open question was asked to identify barriers from involving them as addressed below.

- *Which other health professions do you think could be involved in the team?*
- *If any, what are the barriers from involving them?*

PROMPT IF NOT MENTIONED

What about lack of diabetes training?

What about lack of resources?

What about cost?

A combination of open and close ended questions was used because using open-ended questions can help in collecting rich information in some cases, but they are demanding for the respondent; therefore the gathered data could ranged from rich to poor.

(3) Type of questions

Questions were designed to be clear, specific, and in a case of complex questions they were split down into a series of simpler and shorter questions to be easier for understanding. For instance, I was looking to identify factors affecting the motivation of healthcare professionals in the diabetes centre, but as the term 'motivation' is not clear enough, I asked a series of questions as listed below.

- *How would you describe care providers' motivation in managing people with diabetes?*
- *What things do you think increase your motivation in managing people with diabetes in this centre?*

- *What things do you think decrease your motivation in managing people with diabetes in this centre?*

Some type of questions were avoided for specific reasons including: (1) leading questions as they bias respondent's replies; (2) loaded questions as they bias the respondent in a particular direction leading to biased answer (314, 315); (3) balance questions which are a form of leading questions as they lead to the failure in specifying alternatives clearly in the questions; and (4) attitude questions that are all worded positively as some people are automatic "yes" sayers instead for instance questions were asked in the format of " Do you think". For example, *what do you think are the barriers from spending adequate time with each patient?*

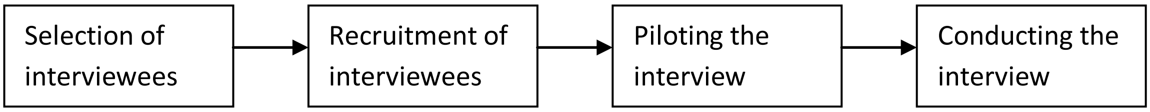
Piloting the interview questions

Secondly, after the planning process, piloting was carried out. Before piloting the interview questions with the population of interest, the interview questions were sent to two experts in the qualitative research (Y. P. and D. D) to acquire advice and feedback on the questions design. After receiving the feedback, some modifications were made on the questions, and they were tested on two colleagues to ensure validity and coverage; afterward questions were more formally developed and piloted. I used the "Think aloud" testing to ask some colleagues about what they think when they listen or read the interview questions and how they interpret with them to ensure the validity of the interview questions (315). Based on the comments from the experts and those abstracted from the pilot interviews, modifications on the interview questions were done. Then a debriefing session with the supervisor took place to help in changing any questions that were difficult to respondent or misunderstood to finalize the interview questions.

Finally, a second pilot was carried out with some participants before carrying out the initial interviews to modify any questions that were vague or difficult to understand.

6.7.9.2 Interview processes

Figure 11: Interview processes



As addressed in figure twelve, the interview underwent several steps starting with selection of information rich individuals; followed by the recruitment process where potential participants were contacted via emails and sent a cover letter explaining the purpose of the study and assuring the confidentiality (see appendix 23). This was finalized by piloting and conducting the interviews.

The interviewer plays an important role in the interview process, and many evidence pointed out that interviewer with good persuasion skills and who are motivated would probably achieve higher response rates (314-316). Hence, in this case I carried out several steps to minimize the interviewer bias including:

(1) I attended some training sessions and was trained by experts in social research to grasp the needed skills for carrying out semi-structured interviews and communicating effectively with the participants. In brief, I was trained on many essential skills including: appearing and speaking neutral and not being surprised or disapproving in relation to response, avoiding the judgmental manner, expressing polite interest, asking a question in a non-biasing and non-leading ways, and motivating interviewee to respond by making them feel valued.

(2) I reviewed the interview questions one by one with the research team composed of the supervisor and two researchers to ensure that I understand why each question is being asked, what does each question mean, and to clarify any final ambiguities.

(3) I followed the Patton strategies to keep or maintain control of the interview including: knowing the purpose of the interview; asking the right question to get the needed information; and giving appropriate both verbal and non-verbal feedback (332).

6.7.9.3 Recording the interview

There are different ways to record qualitative interviews including notes written at the time and afterwards and audio taping. In my case, I used audio tapes to record the interviews; permission of the participants was sought explaining the importance of audio tapes in helping the interviewers checking the accuracy of the reported interviewee views. In brief, this method was used rather than other methods to record the interviews because of several reasons including: writing notes at the time can interfere with the process of interviewing; and writing after wards can lead to missing out some details.

6.7.9.4 Interview guide

The concept of the interview guide was structured to cover all the factors both facilitators and barriers affecting diabetes care in the diabetes centre of Tawam hospital. From the literature review as addressed in section one, evidence reveals that factors influencing the care of diabetes are classified under three key groups namely patient, organization and healthcare professionals. Under each group as found from the literature review, several facilitators and barriers to providing high quality of diabetes care are listed.

Taking this in mind, the interview guide was designed to collect the needed data on the factors affecting diabetes care at the diabetes centre related to these three main active players in diabetes care (refer to appendix 24).

The interview guide is divided into nine main sections including: introduction; warm-up; overall factors affecting diabetes care; motivation of healthcare professionals; training healthcare professionals; team work; and healthcare professionals attitudes and beliefs. The final section included discussing other factors that were not mentioned or covered in the interviews, and recommendations to improve the care provided to people with diabetes in the centre. A brief summary of each section is documented below.

Introduction

The interview was started with giving an introduction about the interviewer, the study and its aim. Also, a brief explanation of the ethical issues such as confidentiality and anonymity was given.

Warm-up

After the introduction, some questions were asked to know more about the participants e.g., role in the management of diabetes, nationality and experience in the diabetes centre. Also, the participant's overall perception about the management of diabetes in the centre was viewed.

Factors affecting diabetes care

In this section, questions were asked to identify in general factors both facilitators and barriers to providing high quality of diabetes care in the centre.

Motivation of healthcare professionals

As motivation of healthcare professionals in the management of diabetes is a complex area, a question was asked firstly to describe motivation. After that, questions asked were focusing on the factors including both motivators and barriers to healthcare professional's motivation in the management of diabetes in the centre.

Training healthcare professionals

Training healthcare professionals is a wide topic; therefore to narrow it down, I started by asking a question regarding the meaning of training to each participant. Then this was followed by questions aimed to specify the sorts of training needed in the diabetes centre, and identify both barriers and motivators to training.

Team-work

I started this section by asking about the composition of the team that provide diabetes care in the diabetes centre. Then, I asked participants about their perceptions of the team they work with. Questions about the rewarding and problematic aspects of working with the diabetes team in the diabetes centre were asked.

After that, questions on the other health professions needed to be involved, and barriers for their involvement in the team were inquired.

Patient-healthcare professionals interactions

In this section, questions were asked to identify factors both barriers and facilitators for providing effective patient- healthcare professional interactions. Questions on the consultation time, and barriers for spending adequate time with patients were requested.

Healthcare professionals attitudes and beliefs about T2DM

I aimed in this section to understand and find the perceptions of healthcare professional in the diabetes centre on T2DM, and reasons for these perceptions. After that, I was looking to know if these perceptions about T2DM influence the management of diabetes in the centre.

Other factors/ recommendation

Participants were encouraged to list any other factor that I didn't mention or discuss in the interview. Also, I asked the participants if they have any recommendation to improve the care provided to people with diabetes in the centre.

6.8 Logistics

Materials needed for each interview included: interview guide, tape recorders, tapes and extra batteries.

6.9 Data analysis

Based on the nature of the qualitative research, the analysis of its data is a continual process commencing during data collection, and counting throughout the time of the study (316, 317). I used thematic analysis to analyse the data from the interviews. Further explanation on thematic analysis is provided below.

6.10 Thematic analysis

Definition and rationale

There are different approaches for the analysis of qualitative data including thematic content, grounded theory and frame work analysis. Based on the aim of the study to explore and identify factors both barriers and facilitators that influence quality of T2DM at Tawam hospital from the perceptions of healthcare professionals; thematic analysis was followed.

"It is the analysis of the data to categorize the recurrent or common themes" (317). This method was developed to meet the needs of investigating the experiences, meanings, and the reality of the participants which help achieving the study target (317).

Furthermore, I followed several processes in order to analyse the collected data thematically. These processes included the following: (315-317)

(1) Categorizing respondent's accounts in ways that could be summarized
(2) Comparing the accounts with each others to classify themes that are common and re-occur. In this step, I used the "scissors and paste" technique to ease the comparing process.
(3) Coding the identified themes, elements of coding may be predetermined by the research questions. The supervisor was asked during the data analysis stage to agree on the evidence for themes and codes. The simple, early system of classification evolved into more sophisticated coding.

Data included

Transcripts of semi-structured interviews with healthcare professionals at the diabetes centre of Tawam hospital.

Stages of analysis

All documents were systematically searched and coded into nodes based on the identified potential barriers or facilitators to T2DM care at the diabetes centre of Tawam hospital. During the analysis process and based on the new data collected, nodes were regularly reviewed and re-grouped or re-classified. However, both barriers and facilitators were coded into the same nodes during the coding process. Later, while investigating the most commonly coded nodes, the factors were identified as to whether it was a potential barrier or facilitator to good care or both.

As seen in figure thirteen, I followed five principal stages in the analysis of the data including: (1) familiarization, (2) generating initial codes, (3) searching for themes, (4) reviewing themes, defining and naming themes, and (5) producing the report. Each stage is described below.

(1) Familiarization

Familiarization started with the collection of data from the healthcare professionals at the diabetes centre, and then rechecking the transcripts to ensure accuracy. Before starting the coding process, I listened to the audio tapes repeatedly and read the transcripts to be familiar with the data.

(2) Generating initial codes

At this stage, the transcripts were read and re-read before giving initial codes. The initial codes were constructed manually using highlights and underlines, and then saved as Word documents. In my case, manual coding had many advantages: (1) it allowed me to code and abstract the themes in a much more casual position, as the coding could be done without switching on the computer; (2) I benefited from being close to the data in the constantly applied comparison technique.

To allow easier access to the data, I established five folders depending on the source of data including: diabetes nurse, educators, dietician, podiatrist and specialist physician. Each transcript was saved in the form of a Word document, and for coding process the right half of the page was kept blank, after printing each transcript individually the coded sentences were underlined for easy search. After accomplishing the coding for each transcript, all the codes were written on a separate page and put on the front page of the transcript with the notes indicating the location of the codes such as ‘ shortage of staff’ p.11, line 13.

To make the comparisons between different participants or within the same participant easier, I pulled all sub-categories in one document. By using constant comparison to identify the relationship between codes, themes and different levels of themes, these sub-categories were sorted into piles of themes. Following this process, the categories were formed, and any data that failed to enter the sub-categories were put in a temporary Word file.

(3) Reviewing themes

Sub-themes including mainly motivators and facilitators influencing the care provided to people with diabetes, and codes were refined by reading and reviewing extracts. Also, I used the input from the supervisor to refine and made these sub-themes and codes sound coherent. The unfitted codes were re-examined to be further refined.

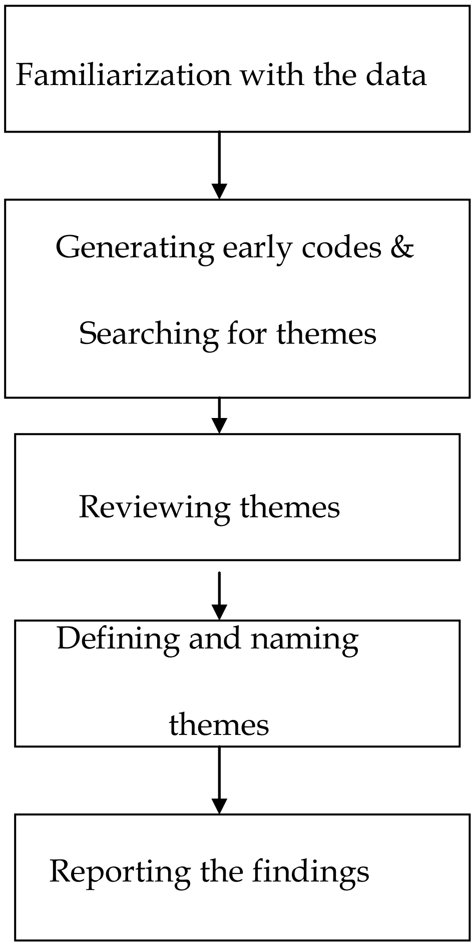
(4) Defining and naming themes

In this stage, I tried to draw the themes together to examine the meaning behind them and elaborated them to define and refine all of the themes. Four chief themes were generated namely: (1) motivation of healthcare professionals in the management of diabetes; (2) training healthcare professionals; (3) Emirate's cultural impact on the diabetes management; and (4) team-work. Under each main theme, sub-themes including facilitators and barriers for providing high quality of diabetes care were generated.

(5) Producing the report

I wrote the results that I found from the data analysis, and compared my findings with studies carried out elsewhere. After that, the report was submitted to the diabetes centre. To make the findings available for other healthcare professionals, policy makers, managers and researchers, results were submitted and accepted for publication in a scientific journal (see annex 1). Data from this report can be used as a baseline for other researchers in the UAE and Gulf countries as well to further identify the factors affecting diabetes care and optimize this care.

Figure 12: Flow chart for thematic analysis



6.11 Confidentiality and anonymity

Issues of confidentiality and anonymity are significant in the field of qualitative research, as particularly during the informal discussion times, participants may reveal more information than they intended. In my report, publication and thesis, all sources of quotes are given as a role of the source (nurse, diabetes educator, dietician, etc.) to protect confidentiality and anonymity of the participants.

6.12 Personal bias

In my case, there were two factors that could potentially affect the integrity of my research and its presentation. Firstly, I was requested to write a report of my findings to the Al-Ain medical district aiming to improve the care provided to people with diabetes at Tawam hospital. Potentially, I may have sought to present the findings in a favourable light. Secondly, my own positive experience of Tawam hospital and some of the healthcare professionals could influence my writing of the article, report and indeed this study. However, being aware of these potential biases I have sought in all results from the interviews to present both the potential positive and negative findings based on the barriers and facilitators to care identified. Using my reflexive approach, made these potential biases explicit and reflect on their potential impact.

6.13 Language issues

UAE is an Arabic country where Arabic is the first spoken language. However, based on the different cultural backgrounds of the healthcare professionals at the diabetes centre of Tawam hospital, English is used as a language of communication between them. Hence, all the interviews were carried out and transcribed in English.

6.14 Validity issues

The rigours or validity of qualitative research is an essential issue. I followed several steps to ensure the quality of the qualitative research and the obtained analysis was rigours: (313-317)

(1) I provided clear exposition of the actual followed data collection and analysis method including a short description on the method of coding development as presented in section 6.7.6.1 to ensure transparency and maximize reliability.

(2) I included sufficient data in the written account to allow the reader to judge whether the interpretation offered is adequately supported by the data, examples are available in section three.

(3) I discussed elements in the data that contradict or appear to contradict to maximize the validity. They are called disconfirming evidence "deviant cases". Examples are available in section three.

(4) I compared findings from this work with the findings from others in the same field to ensure that the work is comparative. Section four includes comparison of my findings with other studies in the same field.

(5) I followed the following steps to maximize reflexivity including: theoretical openness; awareness of the social setting of the research itself, awareness of the wider social context; getting rid of personal and intellectual biases at the outset of any research report to enhance the credibility of the findings; and methodological openness. Therefore, prior to the study, I wrote an initial declaration of all my beliefs and reflected on it during the analytical process.

(6) I used respondent validation by presenting back a summary of the findings orally to the participants; to compare my account with the participants, and to establish the level of correspondence between the two sets. The reactions and comments of the participants were noted

Section three: Results of the thematic analysis

This section presents the findings of the thematic analysis, describing the most frequently cited factors affecting the care provided to people with diabetes by healthcare professionals working at the diabetes centre, Al-Ain. The results fulfil the following objective: To identify factors both barriers and facilitators affecting the quality of T2DM care in the diabetes centre, Tawam hospital.

Four principal themes namely: (1) motivation of the healthcare professionals, (2) training healthcare professionals, (3) Emirate's cultural impact on diabetes care, and (4) team work were identified from the thematic analysis and discussed in this section respectively.

6.15 Coding

117 codes were identified from the semi-structured interviews.

6.16 Prioritising the factors

The frequency of each factor was coded, counted and classified based to its sources including diabetes specialist, nurse, educators, dietician and podiatrist. The aim was to give a general idea of the most frequently cited factors by the sources.

Quotations from interviews have been selected to represent the themes most commonly cited.

6.17 Results

As listed in table 41, healthcare professionals mentioned various factors influencing the care they provide to people with T2DM. Some of these mentioned factors were believed to be facilitators for providing or improving the quality of diabetes care, while others were believed to be barriers.

Under each chief theme, when applicable sub-themes including either facilitators and/ or barriers were documented. These motivators and/ or barriers were related to the three main active players in the care of T2DM as addressed in sections one and two including: patient, healthcare professional and organization. Added to those main players, other factors related to the culture such as language differences were identified and addressed in this section.

Noticeably, there was an obvious overlap between factors related to the patients, healthcare professionals and organisation affecting the T2DM care in the diabetes centre.

> *'I believe that the care we provide to diabetic patients is affected by many things related to patients, organization and healthcare professionals. Identifying these factors could play a role in improving the quality of diabetes care. The roles of care providers and patients are very important, and their co-operation can lead to successful management of the disease'. (Specialist Physician)*

Table 41: The top twenty factors influencing the quality of diabetes care at the diabetes centre

Factors	Total	Diabetes specialists	Nurses	Educators	Dieticians	Podiatrists
1. Motivation of care providers	8	3	2	2	0	1
2. Heavy workload	8	3	2	2	1	0
3. Patient's characteristics						
3.1 Patient's age	7	2	1	2	1	1
3.2 Cultural background of the patients	7	3	1	1	1	1
3.3 Patient's adherence to the management plan	7	3	1	2	1	0
3.4 Patient's co-ordination regarding behavioural changes	6	3	0	2	1	0
3.5 Patient's gender	5	1	1	1	1	1
4. Care provider- patients relationship	6	1	1	2	1	1
5. Poor role of the PHC sector	6	3	1	1	0	1
6. Language differences between care providers and patients	6	2	2	1	0	1
7. Effective team work	6	2	1	1	1	1

8. Lack of clinical pharmacist	5	2	1	1	1	0
9. Training healthcare professionals						
9.1 Training care providers on the skills needed for behavioural changes	5	1	1	2	1	0
9.2 Training care providers on communication skills	4	1	1	1	1	0
9.3 Training nurses on diabetes management	4	2	1	1	0	0
10. lack of general physician within the centre	4	3	0	1	0	0
11. lack of the involvement of the social workers with the centre	4	2	1	1	0	0
12. Shortage of diabetes educators	4	1	1	2	0	0
13. lack of patient's awareness regarding diabetes and its complications	4	1	1	1	0	1
14. Lack of resources	3	2	0	0	1	0
15. Lack of staff regular meeting	3	2	0	0	0	1
16. Lack of co-ordination with the lab department	3	3	0	0	0	0
17. Lack of organization	3	2	1	0	0	0

18. Time management skills of care providers	3	1	1	1	0	0
19. Non-adherence to the appointments by patients	3	2	1	0	0	0
20. Lack of ophthalmologist	3	2	0	1	0	0

6.17.1 Motivation of healthcare professionals (Theme one)

Motivation of healthcare professionals was seen as a collective term covering multiple issues such as the healthcare professional's interest and patient's role and response.

The healthcare professionals working at the diabetes centre described the term 'motivation' in different ways; however it was chiefly expressed as the interest to manage people with diabetes, desire to achieve treatment targets and prevent diabetes related complications.

> *'For effective management of diabetes all care providers should be motivated and interested about the disease and its management. They must know and update their knowledge regarding diabetes and its treatment'. (Specialist Physician)*

In this study, the identified potential factors were classified as either facilitators or barriers to the healthcare professional's motivation in the diabetes care as seen in tables 42 and 43 respectively. Several facilitators and barriers to the healthcare professional's motivation in the management of diabetes were identified and were sub-classified and related to the patient, healthcare professionals and organization as documented below.

Table 42: Facilitators to the motivation's of healthcare professionals

Facilitators	Total	Diabetes specialists	Podiatrist	dieticians	educators	nurses
Patients related						
Compliance to the treatment regimes	8	3	1	1	2	1
Awareness on diabetes and its complications	8	3	1	1	2	1
Appreciation of healthcare professional's efforts in the management of diabetes	7	3	1	1	2	0
Providing feedback to the healthcare professionals	7	2	1	1	2	1
Patient's characteristics	6	1	1	1	2	1
• Age	5	1	0	1	2	1
• Gender	4	1	1	1	1	0
• Educational level	8	3	1	1	2	1
Healthcare professionals relates						
Good communication skills	8	2	1	1	2	2
Good time management skills	6	1	1	1	2	1

Organization related						
Satisfaction of payment	9	3	1	1	2	2

Table 43: Barriers to the motivation of the healthcare professionals

Barriers	Total	Diabetes specialists	Podiatrist	dieticians	educators	nurses
Patients related						
Non-compliance to the treatment regimens	8	3	1	1	2	1
Lack of awareness on diabetes and its complications	8	3	1	1	2	1
Patient's characteristics						
• Literacy	8	3	1	1	1	1
• Elderly	7	2	1	1	2	1
Misunderstanding the role of diabetes educators	7	2	1	1	2	1
Preference to receive the entire management from the physicians	7	3	0	1	2	1
Fear from attending appointments with the podiatrist	6	2	1	0	2	1
	4	1	1	1	1	0
Un-willingness to spend sufficient time with healthcare professionals	8	3	1	1	2	1
Healthcare professionals related						
Perceptions and attitudes about diabetes	5	1	0	1	2	1

Organization related						
Heavy workload	8	3	0	1	2	2
Preference to receive care from the secondary/ tertiary care	6	3	0	1	1	1
Interruptions during consultations	6	1	1	1	2	1
Lack of incentives	1	0	1	0	0	0

Perceived facilitators to the motivation of healthcare professionals

Patient related factors

Participants attached importance to the role of patients in increasing their motivation. It was felt if patients co-operated with them, complied with treatment regimens or plans, followed their recommendations and instructions, and were aware of the nature of their disease then therapeutic targets can be achieved and diabetes related complications can be either prevented or delayed. Healthcare professionals expressed satisfaction when their efforts to manage each case were appreciated by their patients. Other interviewees felt satisfied when they received positive feedback from their patients regarding the care they provided.

> *'Enrolling patients in the treatment strategy is an important tool to achieve the desired targets. If the patient understands clearly what is needed from him/her then achieving the treatment targets would be easy. When the targets are achieved I feel satisfied and motivated to manage the case'. (Specialist Physician)*

> *'Active role of the patients in the management of their disease and their co-operation with the care providers are important. Patient is the main key and their active participation in the management plan is associated with providing high quality of diabetes care'. (Specialist Physician)*

> *'When patient's respond to my treatment instructions and recommendations and the targets are achieved I feel rewarded and motivated'. (Specialist Physician)*

When healthcare professionals were asked about patient characteristics that impacted their level of motivation, they identified characteristics including age, gender and educational level. For instance, participants noted that in most cases patient who are highly educated comply with treatment plans and achieve target outcomes more successfully.

> *'I feel motivated when I deal with patients who are educated, they can respond to my recommendations and instructions more easily and effectively compared to non-*

educated patients. I explain for them the diet plan they have to follow and discuss the reasons for that, they agree and adhere to the plan which assist achieving the treatment targets successfully'. (Dietician)

'Planning the treatment strategy with the educated patients is much easier than with illiterate. From my experience at the diabetes centre, I believe that educated patients reach the treatment much easier and quicker than illiterate patients'. (Specialist physician)

Healthcare professionals related factors

Good communication and time management skills were common themes among healthcare professionals who openly expressed that the nature of their effective interactions result in increased level of motivation regarding the management of their patients. Healthcare professionals at the diabetes centre also revealed that communication skills such as encouraging patients to take part in consultation, keeping good eye contact and attentive listening help to facilitate better interaction between healthcare professionals and the patients. In most of the cases, participants shared feeling pleased, highly motivated and satisfied when they were able to communicate effectively with their patients.

'Being friendly with the patients is important to build a good relationship. I try to listen to them and encourage them to ask any question so that we can communicate effectively'. (Diabetes Educator)

Organization related factors

Healthcare professionals at the diabetes centre showed satisfaction with regard to the amount of payment they receive and thought that they are well paid for the rigorous work they completed daily, and which, in turn increased their enthusiasm and motivation regarding the management of their patients.

Perceived Barriers for the motivation of healthcare professionals

Patient related factors

Healthcare professionals identified some patient-related factors as key barriers to motivation. Misunderstanding the role of diabetes educators, non-compliance with treatment plans including medication use and lack of awareness of diabetes and its complications were common themes that emerged among participants who openly expressed frustration over expected therapeutic outcomes.

> *'Patients at the diabetes centre are still not aware of the role of the health educators in diabetes management which do not only affect the treatment plan with some cases, but also the relationship between the healthcare provider and patients is affected negatively. The diabetes educators feel that some patients do not appreciate their efforts in diabetes management; therefore they become less motivated to be enrolled in the treatment strategy'. (Diabetes Educator)*

> *'Many patients are not aware of the complications related to diabetes, and the importance of effective management of the disease which make achieving the treatment goals challenging'. (Podiatrist)*

Patient's characteristics other than educational level, including patient's age was revealed by the healthcare professionals to be one of the barriers to deliver high quality of T2DM care. In specific, healthcare professionals commented that they felt communicating with people with T2DM at successive age challenging because of several reasons. One of the reasons is the need for providing intensive care for older patients as the prevalence of diabetes related complications is higher among this age group. Therefore, it's important to communicate effectively with those patients in order to reach the treatment goals and normalize their metabolic indicators such as HbA1c and blood pressure measurements. Effective communication with old people with T2DM obliges special skills as they might be exposed to hearing or vision deficits related to the age.

'It's very difficult to transfer information regarding the life style including exercises and changing food habits to illiterate and elderly patients. In many cases, they refuse to listen to us and refuse to follow the needed instructions'. (Dieticians)

'In the diabetes centre we deal with different age groups. I find treating elderly a challenging task due to the complexity of the disease accompanied by complications related to the age and diabetes. Also, communicating with this age group needs special skills'. (Specialist physician)

Some healthcare professionals acknowledged that some patients prefer to receive the entire management of their diabetes care from the diabetes specialists only, which reduce the motivation and involvement of other healthcare professionals in the management of those patients. When asked about the expected reasons for the preference to receive care from the specialist physicians, participants equated this to: (1) the lack of confidence on other healthcare professionals 'non-doctor staff' , and (2) lack of awareness of the role of other healthcare professionals rather than diabetes specialists in the management of diabetes which may contribute to disjointed care.

Participants also addressed the wide variation in patients' willingness to spend time with healthcare professionals in the centre. They believe that allocating sufficient time is important to deliver the needed information. Time allocated for each case is different depending on the complexity and the management plan. Healthcare professionals were upset with the number of people with T2DM who do not appreciate spending sufficient time with them, as they want only to collect their prescriptions rather than listings and discussing the treatment strategy with their healthcare professionals.

'There are some patients' related barriers to effective patient-professionals interaction. For example, some patients do not like spending time with healthcare professionals, they just want to take the prescription and run away. They do not want to listen to

the healthcare professionals' instruction or education, while others will stay, listen and take part in the management plan'. (Specialist Physician)

Participants mentioned that the issues of fear from attending appointments with a podiatrist among Emirates with T2DM results in not attending appointments with the podiatrist, poor interaction between the podiatrist and patients and reduction in the podiatrist's motivation to get involved in further management of patient care. This fear from attending the appointments with a podiatrist was linked to the stories patients hear from either their families or friends regarding the role of podiatrist in toe and feet amputation in diabetic patients.

'From my experience at the diabetes centre, I believe that some patients feel frightened from attending appointment with podiatrists and in many cases refuse to attend these appointments. A lot of these patients might hear some stories of toe amputations in one of their family members or friend and relate them to podiatrists'. (Podiatrist)

Healthcare professionals related factors

Healthcare professionals at the diabetes centre had various perceptions about diabetes including complex, difficult to manage, hard, needs intensive care and a multi-dimensional disorder. Interviewees declared that healthcare professionals' attitudes and beliefs about T2DM can act as a barrier to increased motivation. In most of the cases, healthcare professionals voiced concern about diabetes being a 'complex' disease that needs intensive care.

In this study, participants listed several reasons for their perception about this disorder as presented in table 44. The reasons included the following: complexity of treatment, behavioural changes required by patients, inevitability of future complications, lack of effective drugs, complications related to diabetes, the use of multi-drugs to manage the disease and the role of patients in the patients in managing diabetes.

However, diabetes related complications was the most common cited reason for the healthcare professionals' perception about T2DM followed by the complexity of treatment and the role of the patients to manage the disease.

> *'Diabetes is a complex disorder. It needs intensive care to be managed properly and to prevent the diabetes related complications from occurring. If occur, the management of the disease becomes harder'. (Podiatrist)*

Table 44: Reasons for the healthcare professionals' perception about T2DM

Reasons for care providers perceptions	Total	Diabetes specialists	Podiatrist	dietician	educator	nurse
Diabetes related complications	8	3	1	1	2	1
Complexity of treatment	7	3	0	1	2	1
Behavioural changes required by patients	6	3	0	1	2	0
Inevitability of future complications	5	3	1	0	1	0
Lack of effective drugs	3	2	0	0	1	0
The use of multi-drugs	4	3	0	1	1	0
The role of patients to manage the disease	7	3	0	1	2	1

Organizational related factors

Healthcare professionals commented on the undesirable effects of the burden of a heavy workload in their daily routine. In this study, participants expressed their discomfort regarding the heavy workload as recognized from the frequent reported words 'busy', 'stressful', 'tired'. Some healthcare professionals mentioned that many people with diabetes prefer to complete their management in the diabetes centre after their referral from the primary care settings even if their disorders become under-control, which increases the load on the centre. They expressed frustration that the workload increases their stress and reduces the quality of care they provide to their patients in some situations. Participants pointed out that they have a busy clinic; therefore the time they spent with each patient roughly 10-15 minutes, in some situations, is limited. Training and involving other healthcare professionals in the diabetes team was highly recommended by the participants. They suggested the involvement of more of the two healthcare professions that are already available in the centre including dieticians and educators. Other healthcare professionals that are not available in the centre and highly indorsed were: general physicians (GPs), clinical pharmacists, physiotherapists and ophthalmologists.

> *'Patients need to know more about their drugs and side effects, they should be educated enough about the importance of pharmacological treatment in managing diabetes. The availability of a clinical pharmacist would be helpful. He/ she can educate patients regarding the medication use. Patients will feel more comfortable to have this service available in the centres instead of waiting for long time roughly one hour in-front of the pharmacy to receive their medications'. (Nurse)*

> *'Care provided to diabetic patients at the primary care centres is not optimal; therefore once a patient is referred to the diabetes centre and the disease is under control she/he refuses going back to the primary care centres. Involving GPs in the centre would reduce the workload on the diabetes specialist and build patient's confidence in the ability of GPs to manage diabetes'. (Specialist physician)*

'I think our job at the diabetes centre keeps us busy all the time, we have too many patients which is really stressful; and we try to provide the same quality of care to all patients'. (Specialist Physician)

'We need GPs in the centre. They can help us to deal with simple cases that need only follow up, and can deal with the refill prescription. By doing so, our workload can be reduced and quality of the care provided to diabetic patients would be better'. (Specialist physician)

Some participants were not pleased with the number of interruptions during their consultations with patients by other healthcare professionals or patients. For instance, it was reported that some healthcare professionals seek advice from their colleagues on the management of some cases, while their colleagues are counselling other patients. Also, interviewees mentioned that some patients interrupt the consultation time to confirm the date or time of their following appointments or to ask for a refill prescription. Some healthcare professionals viewed interruptions as a hindrance in communication between the patient and healthcare professionals and limited the consultation time; and as a consequence motivation of delivering high quality of care would be reduced.

'In some occasions some of the healthcare providers interrupt me more than one time during patient counselling for advice on other cases which limits my time with the patient that I already communicating with'. (Specialist physician)

'Some patients interrupt me while I have other patients in the office either by coming to the office directly or by calling me to ask about the following appointment or medicines that they use. I feel by doing this, the time that I allocate to each patient is highly reduced'. (Specialist physician)

One of the participants stated that Lack of incentives could reduce their motivation regarding the care they provide. This healthcare professional, explained that applying an incentive system in the centre can increase the motivation of the healthcare professionals in the management of T2DM as they will feel rewarded for their hard and extra work they perform in some occasions.

> *'Many healthcare professionals are working very hard in the centre such as diabetes educators and nurses and in some situations they do extra duties, but they do not receive any incentives for that which decreases their motivation. While many countries in Europe, for instance UK and New-Zealand use the incentive system which is really rewarding'. (Podiatrists)*

6.17.2 Training (Theme two)

Participants described training as attending conferences, departmental meetings academic courses and workshops related to diabetes and its management. Others added being trained by other experts in the field of diabetes treatment, and being certified in specific areas related to diabetes management. For instance, some of the diabetes nurses at the diabetes centre attended specific training courses and became certified for example in the use of insulin pumps.

Training healthcare professionals on the patient's education, promoting behavioural changes (e.g. life style changes) and communication skills were highly advocated by the healthcare professionals at the diabetes centre. They supposed that being trained on skills needed for effective communication, patient education and promoting behavioural changes to Emirates with T2DM in the diabetes centre are essential to improve the patient-healthcare provider interactions and communications, and enhance achieving the treatment goals; therefore improve the quality of T2DM care.

Many factors both facilitators and barriers to training healthcare professionals at the diabetes centre have been listed and discussed by the participants. Factors tend to facilitate training healthcare professionals in the diabetes centre found to be solely related to the organization. Beside, perceived barriers to training were related to healthcare professionals and organizational factors.

> *'I think providing healthcare professionals with special training on the communication skills is required to improve the interactions between patients and*

healthcare providers and therefore enhance management of the disease as we didn't receive sufficient training during our academic study'. (Specialist physician)

'Good communication skills with the patients are very important, we should show that we care about them so that they feel comfortable and trust us. To achieve better outcomes we should improve the way we communicate through with people with diabetes. There is a room for improvement at the diabetes centre'. (Specialist physician)

'Big part of the management plan relies on the behavioural changes required by the patients; especially nutritional changes. In my opinion, providing us as diabetes care providers with courses on behavioural changes and related skills would be very useful'. (Podiatrist)

Perceived facilitators to training

Organizational related factors

Several facilitators to training have been cited by the nurses working at the diabetes centre including training nurses on diabetes and its management by holding regular nursing departmental presentations and meetings, and providing nurses regularly with useful resources such as educational materials.

'For us as nurses, we don't have any barriers for training and updating our knowledge regarding diabetes and its management. We have a lot of useful training sessions. I feel that I'm back to school days as I have a lot of materials to read when I'm back home'. (Nurse)

'We have regular weekly training sessions, which keep us updated and increase our knowledge on diabetes and its treatment'. (Nurse)

Perceived barriers to training

Organization related

Many barriers to training were associated with the organization. For instance, participants pointed out that due to the lack of accreditation from the hospital to some educational programs, healthcare professionals do not get involved in some useful courses. Also, they mentioned that they do not get involved in some useful training sessions due to the lack of co-ordination and co-operation with the hospital's continuous education department. Other obstacles for training related to the organization were heavy workload, shortage of staff in some occasions and lack of time.

> *'Some training programs are not accredited by the hospital's management department; therefore trainers would not benefit from attending these programs or apply what they learned. For example, we have some nurses who attended some educational courses and are certified as diabetes educators, but not accredited by the hospital. Therefore instead of educating patients they are doing other things'. (Specialist physician)*

> *'Sometimes, shortage in the number of staff can stop us from attending training activities related to diabetes and its management. For example, if my partner is on leave, I would be the only one in the centre and no one can take my place if I'm interested to attend a course or any training activity. Shortage of support staff is a problem'. (Dietician)*

> *'I'm a certified insulin pump educator, I can hold training sessions for other nurses and educators on the use of insulin pumps, but we have limited time. We have the option of meeting on the weekend but this option will not suit everybody. The second option would be either coming earlier about 30 to 60 minutes before the working time or spending the same amount after working hours which is again not the ideal option for everyone'. (Diabetes educator)*

> *'We do not find it easy to apply for a training course or attend some related sessions. The process is long, and we have to complete a lot of paper work. Also, the continuous education department at the hospital do not co-ordinate with us properly or ease the application process'. (Dietician)*

Further organizational impediments to training healthcare professionals in the diabetes centre that were less cited included financial barriers, lack of organization and lack of resources

'For me as healthcare professional, I think the high cost of some training activities can halt me from getting involved in such activities'. (Educator)

'Some people name it lack of staff and it could be, but I believe that in any department, organization is important. I think it is all about organization not shortage of staff. If well planned and organized then shortage of staff would not present as a barrier to training'. (Specialist physician)

<u>Healthcare professionals related</u>

Participants mentioned that lack of healthcare professional's interest in attending the specific training sessions is worrisome. Many of the healthcare professionals such as nurses are not interested in diabetes; therefore their lack of interest regarding this chronic disorder and its management would reduce their enthusiasm to attend related training activates such as seminars and workshops. As a consequence, participants commented that healthcare professionals should be interested about diabetes and aware about the nature of its management before getting involved in the management of people with diabetes.

'A lot of care providers such as dietician and nurses are not interested in diabetes and do not find it an attractive field; therefore they do not like to attend any activities related to the disorder or not keen to update their knowledge regarding diabetes'. (Specialist physician)

6.17.3 Cultural impact (Theme three)

Healthcare professionals at the diabetes centre talked about the significant influence of the Emirate's culture on the behaviours and beliefs of Emirates with T2DM. In this study, they cited different barriers "country-specific" to providing or improving high quality of T2DM care related to the Emirate culture as listed in this section.

'I believe that the Emirate culture affects the behaviours of all Emirates. For those with T2DM, changing some of the behaviours which are risky or nu-healthy is a difficult task'. (Dietician)

Perceived barriers related to the Emirate culture

Healthcare professionals at the diabetes centre addressed and attached high importance to the impact of the Emirate's culture on life style behaviours and health beliefs. Participants believed that changing health risk behaviours that are related to the Emirate's culture is a difficult task, and needs special skills and competencies that are not taught, to convince the patients to adapt to new, and at times untraditional, desired behaviours. Also, interviewees expressed their worries about the common health beliefs among Emirate people with T2DM, and identified patient's cultural beliefs as a key barrier to achieve the treatment goals; therefore reduce the healthcare professionals' motivation. This worry was equated to the use of traditional-herbal medicines in the management of their patient's glucose level without the use of pharmacological medicines.

> *'It's very difficult to communicate with the Emirate patients regarding lifestyle changes; especially nutritional changes. For example, eating too many dates is believed not to raise the sugar levels. Special training for health professionals working in the diabetes field on the behavioural changes would be very useful'. (Dietician)*

Given the fact that healthcare professional workings at the diabetes centre are multinational, one of the participants expressed his concerns about language difference between the healthcare professional and patient. This healthcare professional felt that the presence of a translator cannot solve this issue completely as language difference could act as an obstacle for delivering the needed information to the patient; therefore the communication between them would be affected.

> *'I'm a healthcare provider coming from Europe and I find it difficult to communicate with the Emirate people with diabetes even with the presence of a translator'. (Podiatrist)*

6.17.4 Team work (Theme four)

The diabetes team members at Tawam hospital are composed of diabetes specialist, nurse, educator, podiatrist and dietician. Facilitators and barriers to effective team work were identified and listed in this part. Factors tend to facilitate team-work in this study setting was related to the healthcare professionals and organization factors as addressed in subdivision 6.11.4.1. In the contrary, identified barriers to the effective team-work in the diabetes centre were related to the organizational and cultural factors as outlined in subdivision 6.11.4.2.

Perceived facilitators to effective team work

Healthcare professionals related

Participants perceived co-operation between the team members at the diabetes centre as the principal facilitator to the effective team work. They feel satisfied with the level of co-ordination and co-operation between the team members in the centre and they believe that all of them work hard to deliver high quality of care to people with T2DM.

> *'From my experience at the diabetes centre, I feel satisfied working such co-operative team members'. (Nurse)*

Organization related

Interviews at the diabetes centre expressed their satisfaction about the work environment, and they described it as an encouraging, respectful and pleasant place to work in. They feel that the work environment encourages them to co-operate with other team members and to deliver high quality of diabetes care.

> *'I'm very happy to work in this centre. It's an excellent place where you feel respected and encouraged to co-operate with your colleagues to deliver outstanding care to people with diabetes in Al-Ain'. (Specialist physician)*

Perceived barriers to effective team work

Cultural related factors

Healthcare professionals working at the diabetes centre are multinational; therefore they have different cultural backgrounds and different first spoken languages. Interviewees stated that differences in the language and culture between the healthcare professionals in the diabetes centre could be one of the barriers to the effective team work as these differences limit the communication between the team members.

> *'I believe that we do not communicate effectively as team members due to the different cultures we belong to. We come from different countries and have different behaviours. These differences work as barriers between us as care providers'. (Specialists physician)*

Organizational related factors

Some participants mentioned that lack of feedback is one of the barriers between the team members in the diabetes centre. Therefore, they suggested holding regular meetings in the department to enhance the communication, promote feedback and get rid of the cultural barriers between the team members.

> *'We work with complicated cases; therefore the communication and providing feedback between all the team members is essential to come up with an action plan that help in achieving the treatment goals, but due to lack of feedback and communication between the healthcare providers the quality of care provided could be affected negatively. For example, some patients would not be referred to the neurologist as a result of lack of communication'. (Podiatrist)*

Section four: Discussion

This final section of chapter six discusses the results addressed in section three and compares them with the findings from studies carried out elsewhere. Discussion was classified based on the main themes outlined in section three including motivation of healthcare professionals, training healthcare professionals, team work and Emirate's cultural impact on diabetes care. Under each theme, I discussed the findings on the factors both facilitators and barriers affecting diabetes care in the diabetes centre and compared them with other studies. Then, the limitations and strengths of this qualitative work were addressed along with its implication.

6.18 Motivation of healthcare professionals

I identified several facilitators and barriers to the motivation of healthcare professionals regarding the management of T2DM in the diabetes centre that were associated with healthcare professionals, patients and organization. Facilitators and barriers were divided under these three main classifications as explained below.

<u>Healthcare professional related factors</u>

In this study, I found that healthcare professional's interest in diabetes can increase their motivation to provide optimal care to subjects with T2DM. Similarly to findings from the other studies (262, 263). In the contrary, Hansen et al did not find a significant difference in glycaemic control among physicians with more or less interest in diabetes compared to other diseases (279). Several reasons might attribute to this finding as addressed in section one of this chapter.

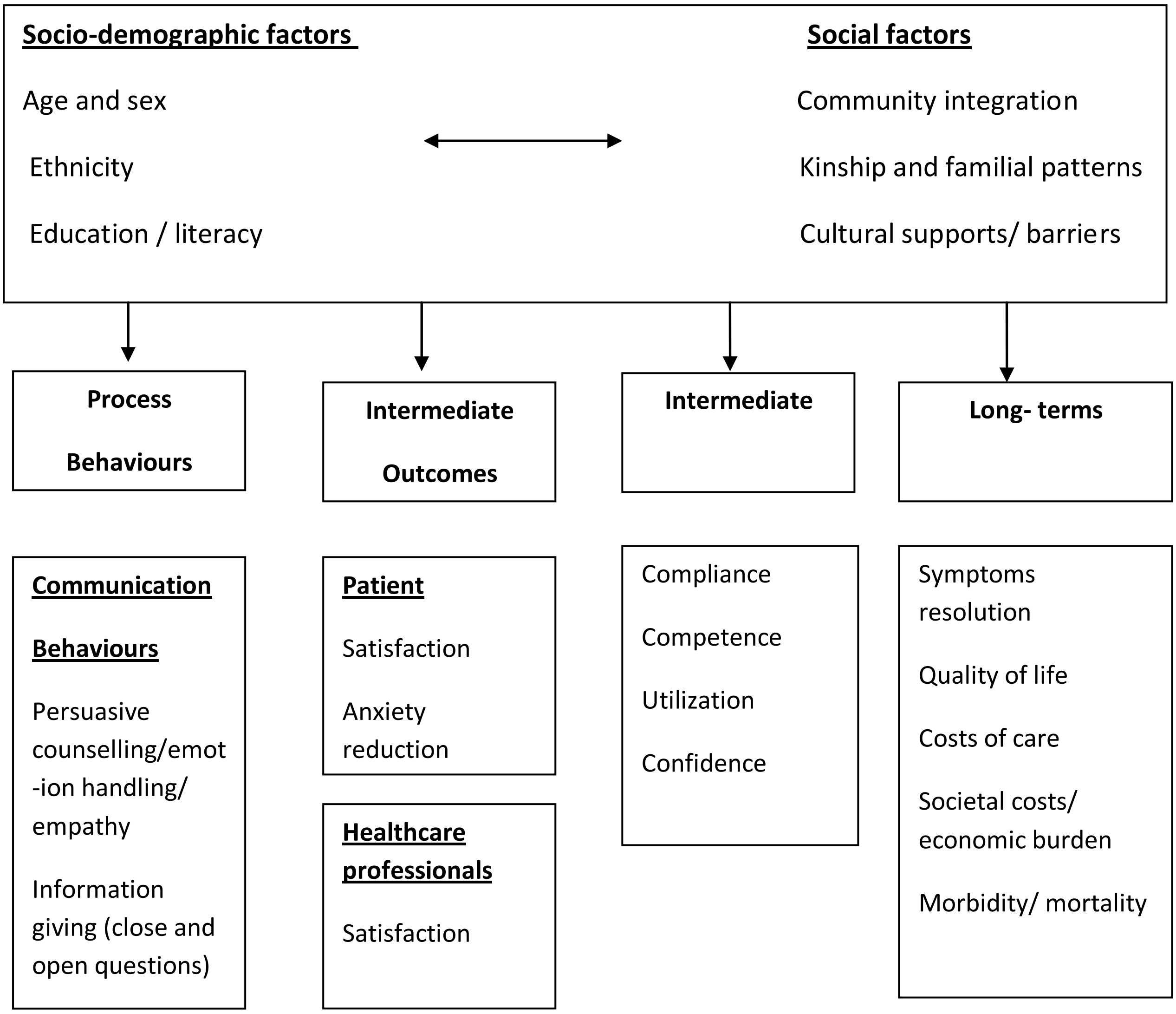
In terms of healthcare professional's perceptions and attitudes about T2DM, I found that in this setting, healthcare professional's perceptions about T2DM can de-motivate them regarding the management of the disease. Healthcare professionals at the diabetes centre described T2DM as a difficult disease to treat compared with other chronic conditions due to the complexity of treatment, unavoidability of future diabetes related complications, lack of effective drugs and behavioural changes required by the patients to achieve the treatment outcomes similar to findings from other studies (264). Besides, some physicians in this study consider T2DM as a 'mild' disorder compared with other health problems similar to findings by Walker et al (318).

Added to these findings, many healthcare professionals in this study believed that factors related to the organisation such as lack of support staff or team to work with, lack of time and peer encouragement are considered more important barriers to their motivation and good quality of diabetes care than their beliefs or attitudes about diabetes. Many studies in the literature demonstrated comparable findings (e.g., 274, 275, 245) as addressed in section one of this chapter.

Relationship between the healthcare professionals and individuals with diabetes was seen as an important factor affecting the motivation of healthcare professionals in the diabetes centre. This relationship is affected strongly by the communication between these two panels. Despite the widespread acknowledgment of the importance of communication between healthcare professionals and people with diabetes, this subject is not always emphasized during academic study or medical training (319). Dr. Aus Alzaid raised the issue of the importance of effective communication between people with diabetes and healthcare professionals, and stated that this important skill was not accentuated enough by training healthcare professionals practicing in Saudi Arabia (320). Research from developed world indicated that communication between healthcare professionals and patients are consistently weak (319). However, there is strong evidence demonstrating that effective communication between healthcare professionals and people with diabetes can increase treatment outcomes, patient's satisfaction, compliance with therapeutic regiments and appointments (319). As seen in figure 14, improving communication between healthcare professionals and patients is linked with short, medium and long term outcomes. For instance, in medium term, better utilization of the health services and enhanced compliance to the therapeutic regimes could be attained. Reduction in the mortality, morbidity and enhancing education can be achieved as a long term outcome (319).

"Unfortunately, effective communication does not always occur naturally, nor it is easily acquired. Even when client and provider come from the same geographic area and speak the same language, they often have different educational, socio-economic and cultural backgrounds. Moreover, their expectations about the health encounter may be different, or they may be faced with other problems, such as lack of privacy during the encounter, or time constraints due to heavy patient loads" (319). As a consequence, empowering healthcare professionals with essential skills to communicate effectively with people with diabetes is important.

Figure 13: Factors affecting healthcare professionals- patient communication



(Modified from reference No: 319)

Patient related factors

Findings from this study confirm that successful involvement of Emirates with T2DM in the management of diabetes is essential and can increase clinical outcomes, healthcare professionals' motivation, and therefore the quality of diabetes care. Emirates with T2DM should be empowered with knowledge and education about the disease and how to carry self-management on daily life. Application of knowledge and techniques should be guided by a relevant, coherent educational philosophy to empower patients (317). People with T2DM play a chief role in managing their disorder, daily they perfume roughly 95% or more of the management of diabetes without consulting healthcare professionals (242, 243). They have to cope with several challenges they face in their daily lives such as glucose monitoring and medication regimen within the context of other goals, physical activity, decision about diet, other health issues, family demand and other personal concerns (240, 242). Low knowledge about diabetes found to be one of the educational patients' related barriers to optimal diabetes care (320). Therefore, more emphasis should be placed on educating Emirates with T2DM; and their families on the disorder, methods to carryout self-care tasks and to cope with the complex health systems.

In Oman for instance, people with diabetes noted that they did not receive sufficient education about their diets and life style behaviors which play an important role in managing diabetes (321). Also, in another study carried out in Oman, lack of knowledge among people with diabetes was common; particularly information about self-management such as self-monitoring of blood glucose and hypoglycaemia was lacking (195). Moreover, in the UAE Al Kaabi et al concluded that dietary practice among 409 people with diabetes in Al-Ain was inadequate (141). These results might be affected by the fact that 50% of the sample was illiterate.

Besides that, Habiba et al identified factors both facilitators and barriers affecting weight management among people living in the Gulf (321). They found that despite the awareness of the risks and complications related to overweight/ obesity; people did not follow any strategy to control their weight such as getting involved in physical activities or following healthy diet (321). As a consequence, different strategies should be used focusing on educating people with diabetes, and emphasizing on promoting health to both chronically ill people and healthy individuals to improve and control people's health.

In terms of T2DM, using medical approach as a primary source for patient education or health promotion would not be sufficient as T2DM is caused by multi-factors that were mentioned earlier in chapter one. Involving other effective sources than healthcare professionals in promoting health and education people with diabetes, including community, schools and urban planners can help reaching and promoting health to a wider population, and delivering better health services (322). More research studies focusing on the perspectives of Emirates with T2DM on the care they receive should be carried out in the UAE in order to optimize diabetes care. To provide optimal diabetes care; it's essential to see through the eyes of Emirates with T2DM, in sequence to increase their satisfaction on the level of knowledge and education they receive from the healthcare professionals. Also, the level of knowledge and education should be measured to identify the related educational barriers to providing optimal diabetes care; therefore effectively implement patient-centred model.

Furthermore, I found in this setting some Emirates with T2DM miss-understand the role of some healthcare professionals such as educators. Therefore, these healthcare professionals' motivation to manage those patients is reduced. A recent editorial made by Dr. Aus Alzaid at the British Journal of Diabetes and Vascular Disease stated that Saudis with diabetes expect the physicians to be the primary source for treatment and knowledge; therefore they dismiss the role of other healthcare professionals (320). For that reason, more awareness on the role of the healthcare professionals rather than the physician in T2DM management as optimizing the metabolic control, delaying or preventing the disease related complications and improving the quality of life should be disseminated not only to people with T2DM, but other members of society also. Lack of knowledge on the service was identified elsewhere as a personal educational barrier to providing high quality of diabetes care (320). Therefore, Emirates with T2DM being treated in the centre should be introduced and informed about the services offered by the centre, and the multidisciplinary management they receive from the diabetes team members.

Also, due to the worries they have regarding toes/ foot amputations, those individuals with T2DM do not attend appointments with podiatrists. Physical effect of the treatment is one of the patient's related barriers 'internal physical' identified by Simmons et al (304). Also, emotional issues, lack of public awareness and lack of family support could be other barriers for those Emirates with T2DM to utilize from the podiatry services provided in the centre (304).

Furthermore, participants addressed the problem of patient non-compliance to medications in this setting, which can delay the achievement of treatment goals or lead to the development of diabetes related complications. In T2DM, there is evidence that patients adherence to medication is sub-optimal globally as addressed in section one of this chapter. For instance, a recent systematic review showed high rate of non-adherence to oral hypoglycaemic drugs and insulin (7-64% vs. 19-46%; respectively) (302). The involvement of a clinical pharmacist in the diabetes team, which is highly suggested by the healthcare professionals in the diabetes centre would help not only enhancing the adherence of people with diabetes to their medications through education, but the load on other healthcare professionals regarding education about the pharmacological treatment would be reduced also.

Organization related factors

In this study, participants were satisfied with the amount of payment they receive; however one of them pointed out on the need to implement an incentive system similarly to other western countries such as UK in order to increase healthcare professionals motivation; therefore quality of diabetes care. As in the study carried out in Tunisia, lack of incentives was seen as a barrier for healthcare professionals to provide optimal care (242, 243). In the UK since the establishment of QOF in 2004, substantial improvements in the quality of diabetes care have been reported as reflected by the QOF indicators (174). Nevertheless, in the UAE healthcare professionals are well paid, therefore introducing the incentive system alone would not be the effective solution to motivating healthcare professionals; and therefore improving quality of diabetes care. Using and combining different strategies to motivate healthcare professionals and increase the quality of T2DM care would be useful.

Our finding regarding workload and how it can increase healthcare professionals stress and reduces their motivation, and the quality of care they provide to people with T2DM in the diabetes centre, concur with findings from other studies (e.g., 242, 243). In Saudi Arabia for instance, stressful work conditions was seen as an obstacle for providing optimal care to people with chronic diseases (255).

Diabetes is a chronic, multi-dimensional disease and even with high quality of care, particularly secondary prevention provided to people with diabetes in the primary care, experts help from the secondary practices is needed (43). In this study, I found people with diabetes prefer to complete receiving their care from the diabetes centre after referral from the primary care setting, which add more work load on the centre. Preference to complete the management in the secondary rather than primary care might be due to several reasons mentioned by the participants such as poor care provided in the primary setting and beliefs among Emirates that care provided in the secondary/ tertiary settings is superior. Results from a study carried out in a primary care centre in Abu Dhabi in the late 1990's among Emirates with diabetes was associated with poor glycaemic control for those attending primary care settings than attending hospitals ($p=0.03$) (41). However, recently this might not be the case, as many indicators reported by the health bodies in the UAE such as MOH showed improvement in the primary care performance. Despite this, more studies should be carried out to evaluate and improve the quality of diabetes care in the primary care settings in the UAE.

The principal role of the primary care setting in the management of diabetes particularly type 2, should be reinforced through communication and co-operation across the primary and secondary/ tertiary care settings in the UAE. Attachment of diabetes physicians to the primary care settings on regular bases is suggested to increase the confidence of Emirate people with diabetes on primary care. Lack of co-operation between the primary-secondary care has been suggested as a barrier for providing high quality of diabetes care in some health systems (e.g., 242). In Saudi Arabia, Al-Khattab et al identified several barriers in their comprehensive review for providing optimal care to chronic diseases in primary care settings. One of these barriers was problem at the interface with secondary care (255). Therefore, if people with diabetes are to be managed in both settings a management protocol should be shared between the primary- secondary settings (255).

Furthermore, I found in the diabetes centre some Emirates with T2DM are not willing to spend sufficient time with their healthcare professionals to discuss the management of their conditions, which is an important area that needs more attention. Many studies (e.g., 242, 243) supported that the length of consultation is associated with improving the quality of diabetes care as addressed in section one of this chapter.

Interruption from other healthcare professionals and patients during consultation time was another important issue mentioned by healthcare professionals at the diabetes centre as a barrier for healthcare professional's motivation, providing good patient communication and high quality diabetes care. Also, these interruptions were believed to disturb the privacy of consultations. Similarly, findings from another study demonstrated that interruptions during consultation time by other colleagues or patients disrupt the privacy of consultation between patients and healthcare professionals (229). Lack of a regulations regarding the consultation time could be one of the causes for these interruptions; therefore establishing specific guidelines that protect the privacy of consultation time in the centre is highly suggested.

6.19 Training healthcare professionals

Training healthcare professionals on the patient's education, promoting behavioural changes (e.g. life style changes) and communication skills were highly advocated by the healthcare professionals at the diabetes centre, and believed to improve diabetes care. In the same line, Al-Mandhari et al stated that to increase the quality of diabetes care in Oman several interventions should be initiated, one of these interventions is training healthcare professionals on the skills needed for behavioural changes (323).

One facilitator to the training was highlighted by the nurses and was related to the organizational factors. Besides that, a number of barriers have been listed and discussed by the participants affecting training healthcare professionals, and these barriers were related to healthcare professionals and organization as addressed below.

Healthcare professionals related factors

Lack of interest in diabetes was one of the barriers to get involved in the training related activities. Studies found in the literature focused on the association between healthcare professionals' interest in diabetes and intermediate outcomes, specifically improvement in glycaemic control (e.g., 265) as addressed in section one, however no studies yet investigated the association between healthcare professionals' interest in diabetes and involvement in diabetes related training.

On the other hand, as documented in section one many studies in the literature focused on the continual medical education, which is considered to be one of the important tools to update health professionals' knowledge; however studies found that even with appropriate knowledge, health professionals do not always adhere to the guidelines or the suggested advice (266, 274).

Organization related factors

The departmental training that nurses receive on regular bases was seen as a facilitator for training; therefore using the available departmental resources would play an important role in training healthcare professionals on the needed skills.

A number of barriers to the involvement of the healthcare professionals in the training activities in the diabetes centre related to the organization were listed. These barriers include lack of resources, lack of time and shortage of staff, equally to findings from studies carried out elsewhere (242, 243). Also, lack of co-operation and co-ordination between the hospital's continuous education department and diabetes centre was identified as a barrier for the involvement of healthcare professionals in the diabetes related activities.

6.20 Team work

There is a growing body of evidence (e.g., 264, 242) as pointed out in the literature review section one of this chapter on the importance of effective team work in improving the care provided to people with diabetes. In this setting, I found facilitators to effective team work are related to the healthcare professionals and organization. However, barriers to effective team work found in this study are linked to the organizational and cultural factors.

Organization related factors

The environs of work described as 'pleasant' , 'excellent' and 'respectful' was seen as a motivator to effective team work in the diabetes centre, similar to studies carried out elsewhere (263, 291).

Healthcare professional related

Positive perceptions of teamwork and team climate are often cited in qualitative research as facilitators of good diabetes care, similar to the finding from this study (264, 242).

Cultural related factors

In this study, as the healthcare professionals belong to different ethnicities, I found cultural and language difference between the team members act as barriers for effective team-work. These differences tend to limit the communication and feedback between the team members; therefore holding regular meeting was highly suggested by the participants to overcome this barrier. Others suggested the implementation of a feedback system.

6.21 Emirate's cultural impact on diabetes care

The Emirate culture had a significant impact on behaviours and health beliefs of the patients attending the diabetes centre. In the Arab world, local traditions and religious conditions and attitudes influence the control of diabetes and other diseases significantly (324). The residents of the Emirates, like other people living in the surrounding Gulf countries, have special behaviours and beliefs with regard to health issues and nutrition. For example, consuming large amount of dates is believed to cure many diseases as this fruit is mentioned in the Holy Quran. Dates are rich in nutrition and have several health benefits; however for people with T2DM controlling the amount of dates consumed is important (324). Health beliefs and physiological factors are not only difficult, but complex to be measured; nevertheless Simmons et al identified psychosocial and psychological barriers to improving diabetes care related to the patients such as patient's health beliefs and public health beliefs (304). Understanding health beliefs in the UAE, specifically those related to T2DM is essential; they define the unique perspectives of individuals within a culture (324). According to Jackson health beliefs affect healthcare professional's behaviour, perception of health and decision to access and follow through with health care treatment by patients (325). The assumptions of healthcare professionals regarding the cultural needs of Emirates with T2DM and lack of cultural understanding of health beliefs could be obstacles for providing competent care (325). Hence, general understanding of the Emirate culture, which is an Arabic Muslim culture, and related health beliefs regarding T2DM in the UAE could improve the diabetes care. This can be achieved through discussion with people with diabetes and their families, better dialogue with religious authorities and improvement of communication between healthcare professionals and people with diabetes (325).

6.22 Strengths and limitations of the study

To my knowledge this is the first study carried out in the UAE to identify factors affecting the quality of T2DM care from the perceptions, attitudes and experience of healthcare professionals. The followed approach in this study using the qualitative method helped identifying the facilitators/motivators and barriers to improve the quality of T2DM care based on the perceptions, attitudes and experience of healthcare professionals. Another strength of this study is the diversity of healthcare professionals providing such care and the ability to compare and contrast their experiences and perceptions.

A major limitation of this study is the small sample size; however, this did not seem to affect the findings as participants were selected to contribute 'rich' information. Another limitation is that the study was conducted in one specialist diabetes centre, and the findings may not be generalisable to other diabetes centres in the UAE. However, I believe that findings from this study could be especially informative and beneficial to other diabetes centres that provide secondary and tertiary care to people with diabetes living in Al-Ain given the similarity in the health system and structure to that of the larger Abu Dhabi area.

6.23 Implications of the study

Findings from the interviews revealed a number of factors that contributed to healthcare professionals' level of motivation in the management of diabetes care that are not currently fully addressed in the UAE. Specifically, from a cultural perspective, findings suggest providing diabetes healthcare professionals with knowledge about the Emirate culture may be an important step in developing culturally-sensitive and culturally-appropriate training programs. Increased knowledge about culture-specific health beliefs related to T2DM and "risky behaviours" such as sedentary lifestyle and food intake may provide an opportunity to improve clinical decision-making and thus improve quality of T2DM care. Also, findings from this study suggest involving the patient in the management plan and enabling them to be a full partner and an expert in managing diabetes. This could be achieved by effective education and support not only from healthcare professionals but also families and the society.

Furthermore, in the diabetes centre level, our findings have implication for involving other healthcare professionals such as GPs and clinical pharmacists in the diabetes team to improve metabolic control, adherence to medications and reduce workload; therefore enhance the quality of T2DM care.

As more than 70% of the UAE's population is composed of expatriates that come from all over the world, future research should focus on the motivation of the healthcare professionals providing diabetes care not only to Emirates, but to expatriates living in the UAE also to optimize the care provided to `all people with diabetes.

In this study, I focused on the health care professionals' perceptions, experiences and attitudes to identify the factors affecting the quality of care provided to people with T2DM. However, I believe that identifying the factors affecting diabetes care need the involvement of both healthcare professionals and patients. Consequently, more studies should be carried out focusing on the patient's and healthcare professional's perceptions, experiences and attitude as both have a crucial impact on the quality of diabetes care.

Chapter 7: Discussion and conclusion

This final chapter is classified into two main sections. The first section combines and presents the key findings from previous chapters. The previous chapters four, five, and six have presented independently the key results from the systematic reviews, quantitative and qualitative components of this thesis.

The second section of this chapter presents a discussion of the main findings within the context of previous relevant work. Also, the strengths and limitations along with the implications of this study for clinical practice and policy level are addressed. Finally, a conclusion of this thesis is provided.

Section one: Summary of key findings

This section presents a summary of the main results obtained from this thesis, firstly results from the systematic reviews. Secondly, a description and examination of quality of diabetes care in Al-Ain, particularly from Tawam hospital's diabetes centre for the consecutive years from 2008 till 2010 are provided. Finally, the factors influencing the care provided to people with T2DM from the perceptions, attitudes and experiences of healthcare professionals practicing at Tawam hospital's diabetes centre are identified and outlined.

7.1 Summary of the systematic reviews main findings

Chapter four presents the comprehensive results of the systematic reviews carried out as part of this thesis. However, in this subdivision I will highlight the key findings.

7.1.1 Prevalence of T2DM in the GCC

- The descriptive results from the review indicated that prevalence of T2DM in the GCC countries ranged between 4.3%-34.9% for studies published between 1980 and 2009.
- The study was also suggestive that the prevalence of T2DM increases with age (at least to 50-60 years), and that urban residence is associated with higher prevalence rates.
- The sub-analysis suggested that the estimated prevalence had increased across the three time periods including: (1) 1980-1989; (2) 1990-1999; and (3) 2000-2009 respectively (3.58% [95% CIs, 1.94-5.23; 2 studies]; vs. 4.01% [95% CIs, 3.58-4.43; 10 studies]; vs. 5.06% [95% CIs, 4.02-6.09%; 10 studies]). The differences in the estimated prevalence rate of T2DM in the GCC countries between the three periods was not statistically significant p=0.9.
- The subgroup analysis by country indicated that the estimated prevalence rates of T2DM between GCC countries are comparable.

7.1.2 Prevalences of overweight, obesity, hyperglycaemia, hypertension and dyslipidaemia in the GCC

- The reported prevalence rates of overweight (BMI 25 to < 30) in adults ranged from 26.3 % to 48 % in males, and 25.2 % to 35 % in females.
- The reported general prevalence rates of obesity (defined as BMI $\geq$ 30) in adults ranged from 13.05 % to 37 % in males, and 16 % to 49.15 % in females.
- The relatively comprehensive study of IGT is suggestive of a recent and on-going increase in prevalence, with the latest published figures suggesting rates of perhaps 10 – 20 % in the adult population.
- There has been relatively little research of the prevalences of hypertension and dyslipidaemia in the GCC region and a lack of consistency in definitions used for study. Accordingly, estimates of prevalence vary: between 6.6 and 33.6 % for hypertension, between 2.7 and 51.9 % for dyslipidaemia, and it is unclear what additional factors may have impacted on these ranges.

7.1.3 Quality of T2DM management in the GCC

I found management of T2DM in the GCC region – based on glycaemic-, blood pressure- and lipid- control indicators – to be suboptimal.

Glycaemic control

- Consistently, < 50 % of patients achieved target glycaemic control.
- Plotting the values across time, there was no obvious indication of recently improving/declining control. Process measures were less commonly investigated, and of variable outcome (0.4 – 98 % achieved).

Blood pressure control

- The < 130/< 80 mmHg or < 130/< 85 mmHg targets respectively were met in between 6.8 % and 32 % of patients with a history of hypertension, and between 14.2 and 42.1 % of the remaining samples, with one exception.

Dyslipidaemia control

- The definitions of dyslipidaemia used were variable and utilised various aspects of the lipid profile. LDL was the most commonly used clinical outcome, with a consistently applied target of < 2.6 mmol/L. This was met in approximately 30 - 50 % of patients, including in the cases of populations being entirely with or entirely without a history of dyslipidaemia.

7.2 Summary of the quantitative study main findings

Chapter five presents the comprehensive results of the cohort study carried out as part of this thesis. However, in this subdivision I will highlight the key findings.

7.2.1 Process of T2DM care measures

- Outstanding achievement rates of recording of HbA1c, LDL, SBP and DBP during 1-year of care for the following years: 2008, 2009 and 2010 were found.
- The frequency of measurements of the listed indicators was three times or more in some cases annually for the consecutive years from 2008 to 2010.

7.2.2 Intermediate outcomes of T2DM care measures

Glycaemic control

- The proportions of patients who reached the HbA1c target were not significantly different between women and men respectively at each year [(22% vs. 18%, p=0.3 at 2008), (28% vs. 25%, p= 0.5 at 2009), and (41% vs. 42%, p= 0.9 at 2010)].
- The proportions of people with T2DM who reached the target increased across years at each age group for both genders; however significant differences of these proportions across the three years were only found at older age group (> 40 years old) for both sexes.
- Results from the multilevel modelling indicated in men an annual average reduction of HbA1c level was 0.5% (95% CI:-0.56 ~ -0.43, P<0.001). Generally, HbA1c level of people who aged 60+ was significantly lower than for those aged 18-39 years by roughly 0.7% (95% CI:-1.19 ~ -0.14, P=0.01) during this period, but not for those aged 40-59. Prescribing oral anti-hypoglycaemic

drugs was associated with roughly 4.2% (95% CI: -0.85 ~ -0.01, P=0.05) reduction in the HbA1c levels.

- Results from the multilevel modelling indicated in women an annual average reduction of HbA1c level was 0.5% (95% CI:-0.57~-0.44, P < 0.001). Women who were in successive age including those between 40-59 and above 60 years respectively had significantly lower HbA1c level on average 0.49% (95% CI: -0.98 ~ -0.004, P=0.05), and 0.77% (95% CI: -1.31~ -0.23, p< 0.01).

Blood pressure control

- Overall women were more successful in achieving the ADA targets for S/DBP respectively compared to men [(47% vs. 52%, P <0.01), and (34% vs. 41%, p=0.04)] vs. [(62% vs. 52%, P=0.05), and (74% vs. 72%, P=0.7)].
- The proportions of those meting the SBP target increased gradually from 2008 to 2010; however among those aged 40-59 years a drop in this proportion was detected between 2008 and 2009 (49% vs. 46%; respectively).
- Results from the multilevel modelling indicated in men an average annual reduction of SBP was 1.02 mm Hg (95% CI: -1.80~-0.24, P=0.01); however this yearly rate reduction was not significant for DBP.
- Results from the multilevel modelling indicated in men an average annual reduction of DBP was 0.71mm Hg (95% CI: -1.20~-0.22, P<0.01); however in women the average reduction of DBP level at a yearly rate was 0.80 mm Hg (95% CI: -1.47 ~ -0.13, P=0.02).
- Results from the multilevel modelling indicated that in women and men respectively who were prescribed anti-blood pressure drugs, had higher points in their S/DBP [(7.6 mm Hg, P<0.001 and 3.9 mm Hg, P< 0.001) vs. (6.7 mm Hg, p<0.01 and 3.7 mmHg, p<0.001)].

Lipid control

- The proportions of patients who reached the LDL target were not significantly different between women and men respectively at each year

[(56% vs. 55%, p=0.8 at 2008), (57% vs. 60%, p= 0.7 at 2009), and (70% vs. 74%, p= 0.4 at 2010)].

- Both genders had significant improvement of reaching the target across the years; however only significant differences were detected at age group 40-59, of which patients who reached the target increased from 53% at 2008 to 76% at 2010 (p <0.01).
- Results from the multilevel modelling indicated in both sexes an average reduction of LDL level at a yearly rate was 0.15 mmol/l (95% CI: -0.2~-0.1, P<0.001).

<u>Improvement from 2008 to 2010</u>

- The quality of T2DM care improved gradually from the year 2008 till 2010 as reflected by the 4vOOc score. The mean of the score increased gradually from 2008 to 2010 respectively [2.27 (95% CI: 2.18-2.37) vs. 2.62 (95% CI: 2.52-2.71)].
- The glycaemic control improved significantly in the consecutive years from 2008 to 2010. Comparing the reduction in the HbA1c level with the baseline data from 2008 with 2010 respectively, a substantial improvement was found: [8.5% (95% CI 8.33-8.67) vs. 7.5% (95% CI 7.36-7.63); P <0.001].
- The DBP control did not show any significant differences as reflected by the mean DBP level during the three years. However, range of 95% CI for mean DBP level at year 2009 and 2010 was not overlapped, hence it can be concluded that a significant reduction was found for these two years. A minor reduction in the SBP was found from 2008 to 2010.
- The lipid control improved significantly from 2008 to 2010. The average level of LDL was 2.60 mmol/L (95% CI: 2.51-2.70) at 2008, which was then reduced by 0.17 mmol/L to 2.27 mmol/L (95% CI: 2.21-2.33) at 2010.

7.3 Summary of the qualitative study main findings

Chapter six presents the comprehensive results of the qualitative study carried out as part of this thesis. However, in this subdivision I will highlight the key findings.

- Factors both facilitators and barriers to providing high quality of diabetes care in the diabetes centre, found to be related to the patient, healthcare professionals, organization and Emirate's culture. A dynamic interplay between these factors has been demonstrated.
- Four chief themes emerged from the thematic analysis including motivation of healthcare professionals, training healthcare professionals, team work and Emirate's cultural impact on diabetes care. Factors both facilitators and barriers to providing high quality of diabetes care related to these chief themes are addressed under each theme when relevant.

7.3.1 Motivation of healthcare professionals

Factors related to the healthcare professionals

Facilitators/ motivators

- Healthcare professional's interest in diabetes is suggested to increase their motivation to provide optimal care to subjects with diabetes in the diabetes centre.

Barriers

- Healthcare professionals at the diabetes centre described diabetes as a difficult disease to treat compared to other chronic conditions due to the complexity of treatment, unavoidability of future diabetes related complications, lack of effective drugs and behavioural changes required by the patients to achieve the treatment outcomes. These perceptions and attitudes about diabetes were suggested to de-motivate the healthcare professionals themselves regarding the management of the disease.

Factors related to the patients

Facilitators/ motivators

- Successful involvement of Emirates with T2DM in the management of diabetes.

- Awareness about the disease, its complications and the importance of its management.
- Patient's characteristics such as education.

Barriers

- Patient non-compliance to medications, which can delay the achievement of treatment goals or lead to the development of diabetes related complications.
- Patient's characteristics such as old age and low educational level.
- Miss-understanding the role of some healthcare professionals such as educators.
- Preference to receive the entire management by the diabetes physician only.
- Un-willingness to spend sufficient time with healthcare professionals for consultation.
- Low attendance rates to the appointments with podiatrists due to the worries people with T2DM have regarding toes/ foot amputations.

<u>Factors related to the organization</u>

Facilitators/ motivators

- Satisfaction with the amount of payment.

Barriers

- Lack of an incentive system.
- Heavy workload.
- Shortage of staff in some occasions.
- Lack of communication and co-operation between the primary and secondary/ tertiary care settings.
- Interruption from other healthcare professionals and patients during consultation time.

7.3.2 Training healthcare professionals

Factors related to the healthcare professionals

Facilitators/ motivators

- Arranging regular departmental training sessions.

Barriers

- Lack of interest in diabetes.

Factors related to the organization

Barriers

- Lack of resources.
- Lack of time.
- Shortage of staff.
- Lack of co-ordination between the continuous education department at the hospital and the diabetes centre.

7.3.3 Team work

Factors related to the organization

Facilitators/ motivators

- The environs of work described as 'pleasant', 'excellent' and 'respectful'.

Factors related to the healthcare professionals

Facilitators / motivators

- The positive perceptions of teamwork and team climate.

Barriers

- Cultural and language differences.
- Lack of feedback.

7.3.4 Emirate's culture impact on diabetes care

Barriers

- Special behaviours and beliefs with regard to behaviours, health issues and nutrition.
- The use of herbal medicines.

Section two: Overall discussion

The second section of this chapter presents a discussion of the main findings from the systematic reviews, quantitative and qualitative components of this thesis within the context of previous relevant work. Further, the previous section summarized the key findings from the systematic reviews, quantitative and qualitative components of this thesis; however in this section I will compare the results of this study with results from the previous literature reported in chapters four, five, and six.

Also, the strengths and limitations along with the implications of this study for clinical practice and policy level are addressed.

7.4 Systematic reviews: What do these reviews add to the literature?

It's important to acknowledge that these systematic reviews are the first have been undertaken in the countries of the GCC. There were several methodological challenges; in particular, the different populations studied and methods used to assess glycaemic status, define diabetes and its adverse outcomes such as hypertension and hyperlipidaemia.

7.4.1 Prevalence of T2DM in the GCC

Comparing the findings from this systematic review with other literatures, this systematic review:

- Provides additional evidence on the prevalence of diabetes chiefly type 2, which is increasing at an alarming rate in the GCC.
- Supports the evidence linking age with increased prevalence of T2DM. The study was suggestive that prevalence increases with age (at least to 50-60 years). The importance of age as a risk factor is consistent with previous data discussed in chapter four (section one), from many contexts.
- Supports the evidence linking geographical location with increased prevalence of T2DM. The study was suggestive that urban residence is associated with higher prevalence.

- Adds to the body of evidence that the risk of T2DM is related to the risk factors such as obesity/ overweight and physical inactivity. I found that the observed high prevalence of diabetes in the GCC states is likely to be associated with the high prevalences of risk factors for T2DM in this region.

7.4.2 Prevalences of overweight, obesity, hyperglycaemia, hypertension and dyslipidaemia in the GCC

Comparing the findings from this systematic review with other literatures, this systematic review:

- Provides additional evidence that the prevalence of overweight and obesity are high in the GCC. The prevalence of overweight to be 25 – 50 %, obesity 10 – 50 %, relatively found to be high in females and higher with advancing age to threshold levels between 30 – 40 and 50 – 60 years.
- Support evidence that demonstrated an increment in the prevalence of hyperglycaemia in the recent years.
- Supports evidence linking advancing age to increased hyperglycaemia.
- Suggests association between female sex in increased prevalence of hyperglycaemia in the GCC.
- Indicates that the prevalences of hypertension and dyslipidaemia are increasing in the GCC, which would be in keeping with a more widespread trend as addressed in chapter four (section two).

7.4.3 Quality of T2DM management in the GCC

Comparing the findings from this systematic review with other literatures, this systematic review:

- Adds new evidence to the growing body of evidence that the quality of T2DM care is suboptimal globally. The management of T2DM, as indicated by the three major intermediate outcome measures (glycaemic control, blood pressure and lipid profile), to be sub-optimal in the GCC countries. However, for both clinical- and process- outcomes, similar results are reported for other countries in the region such Lebanon (203) and Egypt (204-206). In comparison with a selection of reports from various levels of healthcare in the UK (204, 205), USA (206, 207) and Australia (211), clinical outcomes in the GCC countries were generally lower, but this was not always so.

- Shows that with regard to intermediate outcomes of diabetes control, there has been evident progress in at least the UK and USA (207, 208), which I have not observed here to be the case in the GCC region.
- Indicates that a number of secondary prevention strategies have been established and believed to help in raising the quality of management in this region.

7.5 Quality of T2DM care in Al-Ain

It's important to acknowledge that this is the first study in Al-Ain, and UAE to examine the quality of T2DM care, and assess any improvement in this care using longitudinal data from 2008 to 2010. Also, it's the first study to investigate any differences in the care provided to different age groups and genders in Al-Ain and UAE.

Comparing the findings from this quantitative study with other studies carried out in the developed countries and other Arab countries, this study:

- In terms of process of diabetes care, shows that the proportion of people with T2DM having their measurements performed at least once annually within 1-year of follow-up for the study period are comparable if not higher with studies carried out in the Gulf region (e.g., 87,89,90), Middle East (e.g., 204-206), and Western countries (e.g.,207).
- Adds to the available body of evidence that the management of T2DM particularly focusing on glucose and SBP is sub-optimal. More than 50% of the study population did not achieve the desirable targets for the HbA1c and SBP in the following years 2008, 2009 and 2010.
- Supports the evidence revealing that excellent performance on process of diabetes care does not essentially translate into good metabolic control.

- Shows better glycaemic and blood pressure control in this setting compared to other GCC countries (e.g., for glycaemic control: 84, 87, and e.g., for BP control: 89, 90).
- Indicates that the quality of T2DM control, particularly glycaemic, blood pressure and lipid are consistent with studies carried out in developed countries at various levels of healthcare (e.g., 202).
- Supports the evidence that found association between ageing and improved glycaemic control (222, 210), but an increment in the hypertension rate (305). As in this study, compared to older individuals, younger individuals (<40 years old) have not as good HbA1c profiles. Although there were no significant differences of blood pressure level across age groups, it can be seen that during the three years proportion of those reached the target was consistently higher in younger age group than that of older age group.
- Indicates no differences in T2DM care between women and men similarly to many studies discussed in chapter five.
- Does not support findings from other studies (e.g., 176, 216) discussed in chapter five that relate gender –women- to poorer achievement of standards of care. In this study, women performed better than men on reaching the target of blood pressure, especially for the SBP in 2009 and 2010.
- Indicates an encouraging progress with regard to intermediate outcomes of diabetes control including glycaemic and lipid between 2008 and 2010. This finding is similar to the evident progress in diabetes care in the developed countries such as UK and USA (e.g., 208, 210).
- Shows that subjects with T2DM being prescribed drugs to regulate their blood pressure had poorer outcomes compared to those were not prescribed drugs. Similar results were found in Egypt, patients who were prescribed anti-hypertensive drugs had about 11mmHg and 3 mmHg higher points in their S/DBP than those non-prescribed (205). Several reasons have been suggested such as adherence to medications and clinical inertia.

7.6 Factors affecting the quality of T2DM care in Al-Ain

It's important to acknowledge that this is the first study in Al-Ain and UAE to identify factors both facilitators and barriers that affect the quality of T2DM care at the diabetes centre based on the perceptions and attitudes of healthcare professionals. Also, this is first study to develop a frame of knowledge from the perceptions, understanding and experiences of the healthcare professionals regarding the care of people with diabetes.

It's essential to recognize the dynamic interplay in the interactions between the factors affecting the quality of diabetes care in this study including: patients, healthcare professionals, organization, and cultural factors.

Factors related to the patients

Comparing the findings from this qualitative study with other studies carried out in the developed and other Arab countries, this study:

- Supports the evidence on the important rule of adherence in achieving the treatment outcomes. Non-adherence to treatment was identified as one of the patient's related barriers to achieving the standard therapeutic targets in Emirates with T2DM being treated in the diabetes centre.
- Adds more evidence to other qualitative studies that stressed on the importance of patient's health beliefs and education in improving diabetes care.
- Supports the evidence from other qualitative studies which demonstrated that empowering people with T2DM in the management plan could improve the outcomes of care.
- Suggests that Emirates with T2DM should be educated and aware about the services they receive from the diabetes centre, and the multidisciplinary management they receive from the diabetes team members.
- Suggests that more attention and awareness on the importance of spending sufficient time with the healthcare professionals is required and should be spread to people with T2DM.

- Proposes several barriers to improving quality of diabetes care related to the patient's demographics such as old age and literacy in the diabetes centre similarly to findings of many studies addressed in the chapter six.

Factors related to the healthcare professionals

Comparing the findings from this qualitative study with other studies carried out in the developed and other Arab countries, this study:

- Reveals that healthcare professionals motivation is the most important factor in this setting similar to findings elsewhere (254, 255).
- Supports the evidence from the literature that links healthcare professional's interest in diabetes to increasing the motivation of healthcare professionals.
- Adds to the evidence from the literature on the influence of the healthcare professional's perceptions and attitudes about diabetes on the care they provide to people with T2DM in the diabetes centre. Healthcare professionals at the diabetes centre described diabetes as a difficult disease to treat compared with other chronic conditions due to the complexity of treatment, unavoidability of future diabetes related complications, lack of effective drugs and behavioural changes required by the patients to achieve the treatment outcomes similar to findings from other studies (254, 255).
- Supports the idea that shortages of staff, heavy workload, teamwork and communication between primary/secondary care all are potentially important areas as demonstrated by many studies in the literature.
- Adds more evidence to the growing body of evidence on the importance of communication between healthcare professionals and people with T2DM and its rule in increasing the quality of T2DM care. Therefore, training healthcare professionals on the skills needed for educating patients, promoting behavioural changes (e.g. life style changes) and communicating with people with T2DM effectively were highly advocated by the healthcare professionals at the diabetes centre, and believed to improve diabetes care.
- Supports the evidence from the literature on the positive perceptions of the teamwork and team climate as facilitators of good diabetes care.

- Provides insight on the importance of cultural and language difference between the team members as they act as barriers for effective team-work.

Factors related to the organization

Comparing the findings from this qualitative study with other studies carried out in the developed and other Arab countries, this study:

- Shows that participants are satisfied with the amount of payment they receive.
- Supports findings from other studies that providing incentives can improve the quality of diabetes care. The need to implement an incentive system similarly to other western countries such as UK in order to increase healthcare professional's motivation was pointed out by one of the participants in this study. Similarly to the study carried out in Tunisia, lack of incentives was seen as a barrier for healthcare professionals to provide optimal care (254). In the UK since the establishment of QOF in 2004, substantial improvements in the quality of diabetes care have been reported as reflected by the QOF indicators (344). Nevertheless, in the UAE healthcare professionals are well paid, therefore introducing the incentive system alone would not be the effective solution to motivating healthcare professionals; and therefore improving quality of diabetes care. Using different strategies to motivate healthcare professionals and increase the quality of T2DM care would be useful.
- Supports the evidence that associates the workload with increasing healthcare professionals stress and reduces their motivation and the quality of care they provide to people with T2DM. Findings from the diabetes centre concur with findings from other studies (e.g., 254, 255). In Saudi Arabia for instance, stressful work conditions was seen as an obstacle for providing optimal care to people with chronic diseases (269).
- Supports the idea of the need to strengthen the communication and co-ordination between the primary/ secondary care in the UAE. Attachment of

diabetes physicians to the primary care setting on regular bases is suggested to increase the confidence of Emirate people with diabetes on primary care.

- Supports evidence that Interruption from other healthcare professionals and patients during consultation time is a barrier for healthcare professional's motivation, providing good patient communication and high quality diabetes care. Also, these interruptions in the diabetes centre were believed to disturb the privacy of consultations. Similarly, findings from another study carried out in Oman, demonstrated that interruptions during consultation time by other colleagues or patients disrupt the privacy of consultation between patients and healthcare professionals (239).
- Proposes that good time management and organization skills could improve the care provided to people with T2DM in the diabetes centre in Al-Ain.

Factors related to the Emirate's Culture

In terms of the influence of Emirate's culture on the quality of T2DM care in Al-Ain, this study:

- Indicates that the Emirate's culture has a significant impact on behaviours and health beliefs of the Emirates with T2DM.
- Emphasises on the importance for the healthcare professionals to understand health beliefs in the UAE, specifically those related to T2DM as they define the unique perspectives of individuals within a culture (338).

Quality measurement

As discussed in chapter one, Maxwell identified six dimensions to measure the quality of healthcare believing that quality of care can't be measured using a sigle dimension (64, 65). Based on the findings from this thesis, I used these six dimensions to measure the quality of T2DM care in the diabetes centre.

1- Acceptability: more research should be carried out to measure the satisfaction of people with T2DM on the care they receive, and identify any obstacle based on the beliefs of the people with T2DM; therefore improve the quality of

T2DM care. Also, standards of communication between healthcare professionals and people with T2DM should be assessed aiming to enhance the communication between the two panels. Privacy of consultation should be ensured in the centre as many healthcare professionals raised the issue of interruptions during the consultation by other patients and healthcare professionals; thus more regulations should be initiated to protect the privacy and confidentiality of consultation time.

2- Effectiveness: the overall results from the cohort study showed that the care provided to people with T2DM is suboptimal based on the glycaemic and blood pressure measurements. Despite the suboptimal control, the improvement in the results between 2008 and 2010 was positive and emphasized the possibility of improving the quality of T2DM care in the centre. More research should be carried out to assess the technical effectiveness measuring the adequacy of equipments and staffing in the department. However, results from the qualitative study indicated the need for increasing the number of dieticians in the centre to reduce to the workload because only one dietician is available. Also, involving a clinical pharmacist would improve treatment outcomes; so the quality of T2DM care.

3- Efficiency and economy: more research should focus on the unit-cost and compare it with the unit-cost with other diabetes centres in Abu Dhabi.

4- Access: Emirates with T2DM from all the UAE cities can be transferred to this centre from their primary care settings. Also, they can book appointments directly from the centre. However, long distance for people travelling from other emirates to Abu Dhabi would be one of the barriers to the services provided by the centre. More research should assess the referral waiting times.

5- Equity: based on the results from the cohort study equal services were provided to people from different age groups and genders. However, compared to older individuals, younger individuals (<40 years old) have poorer HbA1c profiles; therefore this specific age group should be targeted by special educational programs. Also, the use of intensified and supervised lifestyle modifications could improve the treatment outcomes among this groups.

6- Relevance to need for the whole community: based on the population needs this centre was established.

7.7 Strengths and limitations of the study

Principal strength

The main strength of this study is using respectively both quantitative and qualitative approaches to examine the quality of T2DM care in Al-Ain, and identify factors affecting it. Additionally, as this study is one of the first to be carried in Al-Ain, findings are more likely to be transferable to Abu Dhabi and other cities in the UAE.

Strengths of the systematic reviews, quantitative and qualitative studies are addressed below. However, the limitations of them are explained in chapters four, five and six respectively.

Strengths of the systematic reviews

- The first systematic reviews have been undertaken in the countries of the GCC to estimate the prevalence rates of T2DM and its adverse outcomes, and to examine the quality of T2DM management.
- The use of focused research questions.
- The use of rigorous search strategies.

Strengths of the quantitative study

- The first study in Al-Ain and UAE to examine the quality of T2DM care using longitudinal data from 2008 to 2010.
- The first study in Al-Ain and UAE to investigate and assess any differences in T2DM care provided to different age groups and genders.

- The followed methodology allowed random selections of participants thus reducing the confounding effects of other contextual factors that could influence the quality of T2DM care.
- The use of multi-level modelling allows for confounding variables, and selects independents relationship with the quality indicators used in this study to assess the quality of T2DM care.
- The longitudinal analysis of data used appropriate statistical analysis for comparison such as repeated measures data for process, and intermediate outcomes for each patient at each year from 2008 till 2010. Hence, any potential bias caused by patient's difference is excluded.
- The use of different quality indicators including process and intermediate outcomes of care to assess the quality of T2DM care.

Strengths of qualitative work

- The first study in Al-Ain and UAE to identify factors influencing the care provided to people with T2DM.
- The use of reflective approach in this study improved the validity of the results.
- The use of 'rich informative' subjects in the sample including members of the diabetes team to collect the needed data.
- The interview guide and thematic analysis both were revised by two experts in the qualitative field.

7.8 Implications of the research

This research has important implications for clinical practice in Al-Ain and UAE as well other GCC countries, as many of findings are likely to be transferable to these countries.

The implications of the systematic reviews, quantitative and qualitative works are discussed in details in chapters four, five and six respectively. Further, it's recommended that healthcare professionals, managers, and policy makers in the

UAE take these results into consideration in order to develop and implement culturally appropriate innervations to improve the quality of T2DM care.

Several strategies have been followed to disseminate the results from this research nationally and internationally. On the level of the UAE, a full report of the study was submitted to the HAAD for consideration. In addition to my aim to improving the quality of T2DM care in Al-Ain and UAE, it is hoped that results from this study will be helpful to other GCC countries. With this in mind, the results from this study have been presented at several international conferences (IDF congress in Dubai 2011, International Diabetes Epidemiology Group in UAE 2011 and Society for Academic Primary Care meeting 2010 in UK). In addition, to publicise the findings from this study, the three systematic reviews have been published, and the quantitative and qualitative components of this research have been accepted for publication in scientific journals. Copies of all published paper have been included in annex one.

7.9 Future research needs

Following findings from this study, future research needs are classified into two main areas including: worldwide, and within Al-Ain and UAE.

Worldwide

- As many studies in the literature and results from this study supports the influence of healthcare professionals motivation on diabetes care, more research studies are needed worldwide focusing on assessing the relation between healthcare professionals motivation and diabetes care, and identifying factors affecting the motivation of healthcare professionals to optimize diabetes care.
- In multicultural societies, the role of cultural health beliefs play a crucial role in diabetes management; therefore more research studies should focus on cultural health beliefs of people with diabetes.

Within Al-Ain and UAE

- In the diabetes centre level, results from this study showed that there is improvement in the care provide to people with T2DM in the diabetes centre in Al-Ain; however in light of glycaemic and SBP measurements, the control of this two variables were suboptimal. Therefore, more studies should be carried out to investigate the reasons for the suboptimal control of these indicators.
- More research studies should be carried out to assess the medication use and adherence among T2DM subjects to improve the clinical outcomes of care.
- Results showed that T2DM is influenced by many factors including patients, healthcare professionals, organization and Emirate's culture from the perceptions and attitudes of healthcare professionals. However, the perceptions and attitudes of patients who play an active rule in the management of diabetes was not sought; therefore more research studies focusing on patient's side are needed.
- As primary care in the UAE is providing care to people with T2DM, assessing and evaluating this care and identifying the motivators and barrier to improve the quality of T2DM care in this setting are required.
- More studies and RCTs should be performed in the UAE to help initiating culturally appropriate quality improvement interventions.

7. 10 Conclusion

The crisis of diabetes, chiefly type 2 is challenging healthcare professionals, people with diabetes, policy makers and healthcare planners globally. Overall findings from this thesis indicated the need for emphasizing on the three chief components of the global strategy including surveillance, prevention and management to prevent NCDs including T2DM in the UAE.

An important finding from the systematic reviews carried out as part of this thesis indicated the dramatic raise overtime in the prevalences of T2DM, obesity, overweight, hypertension and hyperlipidaemia in the UAE and other GCC countries.

The ‘obesogenic’ and ‘diabetogenic’ environments, which are becoming the norm in the UAE and other GCC countries; especially among people at younger age are the main causes for these epidemics. The abundance of “energy-dense- food”, frequent snaking, low fruits and vegetables intake, and high rate of soft drinks consumption in the regions were associated with the rapid growth in the prevalence of overweight/ obesity (326). The Emirate’s culture impact on the health beliefs and behaviours play an important role in increasing the prevalence rates of diabetes and its adverse outcomes in the UAE, and negatively affect the treatment outcomes in people with T2DM as found from the qualitative study. Acting on the modifiable risk factor that increase the risks of T2DM such as overweight and obesity is important and can help prevent or manage diabetes and its related complications effectively.

To act on these risk factors and reduce the burden of T2DM and its adverse outcomes, concerted efforts are required at all local levels in the UAE including the government, public, media and medical community (323). Policy makers in the UAE made several decisions that have a good impact on T2DM and its adverse outcomes. For instance, since 2009 the UAE started using the policy tools to ban high fat snacks and fast food in all public and private schools to act on the high prevalence rates of overweight/ obesity among school population. Additionally, many achievements from the national diabetes strategy in the UAE were outlined in 2009 in terms of spreading awareness to the people with diabetes and the society, and promoting health. In terms of spreading awareness to the society, some actions are already undertaken in the UAE such as promoting awareness on healthy diet and physical activity. Despite all these efforts, the prevalence rates of T2DM and its adverse outcomes are growing progressively. There is a need in the UAE to conduct more research studies on the life-style interventions to prevent T2DM epidemic and its adverse outcomes from escalating, and improve the treatment outcomes in people with T2DM. These research studies would help decision planners and makers, managers and healthcare professionals to plan and execute better quality culturally-sensitive interventions. Collaboration and joint planning between different health in the UAE should be strengthened through the development of national planning framework.

The WHO most effective interventions implemented to reduce the risk factors for the NCDs including T2DM, especially un-healthy diet included several actions such as initiating regulations to reduce salt, sugar and fat intake in food, and promoting public awareness about diet and physical activity. In the UAE, adopting such interventions would be useful, also to increase the outcomes of preventive programs, policies on taxation and trade food urban planning would be effective if set with the consideration of public health. Behaviours changes programs encouraging physical activity and healthy diet should be initiated and should target people at different age groups including those at schools, universities and workplaces. By targeting people from different ages, more awareness on the key modifiable risk factors in the UAE such as physical inactivity, obesity and un-healthy nutrition would be emphasised. The comprehensive and integrated actions led by the UAE's government are important to support these interventions.

Another significant finding from this study reflected by the quantitative constituent and systematic review on the quality of T2DM in the GCC is that a large proportion of Emirates with T2DM (roughly > 50%) received sub-optimal care as reflected by glycaemic and blood pressure control, particularly systolic blood pressure. This finding is a clear indicator for the need to improve the care provided to those people. Despite the fact that DM care tends to be sup-optimal worldwide, improving this care in a country with an alarming prevalence of DM is essential to help delaying or preventing the expensive DM related complications and improve the quality of life to the patients. One of the objectives of the national diabetes strategy in the UAE for 2009-2018 is to improve and promote the quality of diabetes care at the three levels of healthcare system. To achieve these objective several actions should be implemented as outlined in the national strategy such as supporting monitoring and evaluating of DM care, and promoting and supporting research in diabetes. The recent establishment of the diabetes registry to monitor the onset and prognosis of diabetes in the UAE is considered as an important action. Continuous audits and more research studies are needed to investigate the reasons for the poor outcomes for the control of diabetes, and barriers from improving care provided to people with diabetes.

T2DM care is influenced by many factors including patient, healthcare professional and organization. Findings from the qualitative study I carried out emphasised on the need of empowering Emirates with T2DM with the needed knowledge and education to increase healthcare professional's motivation and treatment outcomes. Emirates with T2DM should be involved successfully in the management plan. They should be the centre of focus; and should be provided with regular updates on their process and intermediate outcomes of care measurements by their healthcare professionals to enable them evaluate and monitor their clinical improvement. Involvement of people with diabetes in the management of their disorders requires good healthcare professionals-patients relationship that could attained through effective communication as was outlined by the qualitative study. Communication between healthcare professionals and subjects with diabetes is like art, therefore healthcare professionals should be trained on the skills needed for effective communication. Findings from the qualitative study carried out in the diabetes centre emphasized on the need to train healthcare professionals on the needed skills for effective interpersonal communication as it was believed to improve treatment outcomes, healthcare professional's motivation and the quality of diabetes care. Specific programs were used in developing countries including Egypt, Trinidad and Honduras to assess the efficacy of specific techniques in enhancing interpersonal communication between patients and healthcare professionals not specified to diabetes. Overall improvement in the treatment outcomes was demonstrated as a result of effective communication between healthcare professionals and their patients. Policy planners and makers and healthcare professionals could utilize from the programs and strategies used in developing countries to enhance communication between healthcare professionals and people with diabetes in the UAE. This can be achieved by developing local appropriate initiatives. Enhancing communication between healthcare professionals and people with diabetes in the UAE has the potential of making the health system more efficient and cost effective in the long term (319).

Additionally, as findings from the quantitative study showed that subjects with T2DM being prescribed anti-hypertensive drugs had poorer control compared to those were not on pharmacological medications; more attention should be given to the proposed causes for this finding including adherence to medications, clinical inertia and side effects from the medications. Healthcare professionals at the diabetes centre commonly cited that non-adherence to treatment is an obstacle for achieving the treatment outcomes; as a result the educational programs should highlight the significant of compliance to therapeutic regimes. Having clinical pharmacists within the diabetes centre would help increasing the adherence of people with T2DM to their medications. The qualitative and quantitative components of this thesis emphasized on the importance of identifying factors affecting adherence to medications among people with T2DM in the UAE. As the national diabetes strategy in the UAE aims to promote research focusing on diabetes; more studies should focus on identifying factors that influence adherence to medications and clinical inertia in T2DM as these important areas didn't receive any attention yet.

Another worrying finding demonstrated from the quantitative study and was supported by the findings from the literature review on the quality of T2DM care worldwide is that, younger Emirates with T2DM were having worse glycaemic control compared to older patients; given that the risk for both micro and macrovascular complications over a long period of time would increase. This sub-optimal T2DM care could be influenced by many factors related to the patients, healthcare professionals or organization. People with diabetes at younger age should be targeted by specific educational programs, and interventions aiming to improve the management of diabetes among them. Findings from the qualitative study indicated that many Emirates with diabetes, particularly those at young age are not willing to spend sufficient time with the healthcare professionals to discuss the management plan instead they prefer collecting their prescriptions and run away. As there is strong evidence linking sufficient consultation time to better health outcomes as highlighted in chapter six; this could be one of the reasons participating in the poorer achievement of treatment outcomes among young subjects with T2DM compared to older subjects.

To manage T2DM effectively, people with diabetes should adhere to the therapeutic regime including medication use, self-management and behavioural changes needed to achieve the required therapeutic goals. In the UAE, people with diabetes should have a better understanding and awareness that medical approaches used to manage diabetes do not depend solely on the use of pharmacological drugs; therefore they should pay attention to the consultation with healthcare professionals. Educational programs with emphasis on the importance of consultation time are needed to change this attitude among Emirate with diabetes.

Another key finding from the qualitative study is the importance affect of healthcare professional's motivation on diabetes care. In order to increase their motivation, many actions should be implemented as discussed before in chapter six. The workload was one of the main factors that de-motivate healthcare professionals in the diabetes centre; therefore it should be reduced by reinforcing the role of primary care in the management of diabetes. Despite the large efforts of the health bodies in the UAE to strengthen the role of primary care in the management of NCDs including T2DM, still Emirates with T2DM prefer to receive their care from secondary/ tertiary settings. The cause of the preference to receive care from secondary/ tertiary care in the UAE is that Emirates with T2DM consider the care in the primary care settings to be poor compared with secondary/ tertiary settings. Lack of confidence on the role of GPs in the management of diabetes is another concern among Emirates with diabetes. To enhance the perceptions of Emirates with T2DM on the effective role of primary care in the management of diabetes several actions have been suggested by the healthcare professionals as discussed in chapter six. In brief, attaching GPs in the secondary/ tertiary care settings, and involving the diabetes specialists in providing care at least once weakly in the primary care settings would increase the confidence of people with T2DM on the GPs, and primary care settings. Another important factor that found from the qualitative study reducing the motivation of healthcare professionals is dismissing the role of non-physicians such as educators, dieticians and pharmacists in the management of diabetes. This issue needs attention from healthcare professionals and policy planners and makers as it can affect the treatment outcomes negatively. Emirates with T2DM should have a better understanding on the role of other non-doctor staff in the management of diabetes in order to enhance the relationship with those healthcare professionals, increase their motivation and therefore increase the quality of care.

The overall improvement in the quality of diabetes care in the diabetes centre demonstrated by the quantitative study, and reflected by the improvement in the intermediate outcomes indicators for the consecutive years from 2008 to 2010 is encouraging. Another encouraging finding was the outstanding achievement in the process of diabetes care as reflected by the proportion of participants had the measurements for the metabolic indicators documented yearly from 2008 to 2010, and the high frequency (≥ 3 times) for each measurement performed annually. This is a clear indication that HAAD is working hard to improve the quality of services to the population of Abu Dhabi. HAAD is looking to develop a strong, sustainable health care system in the capital of the UAE. Since 2009, HAAD focuses on improving the medical outcomes and public health for people living in Abu Dhabi.

In conclusion, giving the alarming raise in the prevalence of diabetes chiefly T2DM in the UAE continues dialogue between advocates of diabetes control and policy planners and makers is essential to improve the quality of care, and reduce its burden. More research should be performed in the country level to meet the local needs, and help policy planners and makers developing local appropriate strategies and interventions to tackle the epidemic of T2DM and improve care to people with diabetes.

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Appendices

Appendix 1: PRISMA checklist --'Prevalence of T2DM management in the states of the GCC: a systematic review'

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	50
INTRODUCTION			
Rationale	2	Describe the rationale for the review in the context of what is already known.	50-51
Objectives	3	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	51
METHODS			
Protocol and registration	4	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	52
Eligibility criteria	4	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	52
Information sources	6	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	52
Search	7	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	52-53
Study selection	8	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	53-54
Data collection process	9	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	54
Data items	10	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	55

Risk of bias in individual studies	11	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	54-55
Summary measures	12	State the principal summary measures (e.g., risk ratio, difference in means).	55
Synthesis of results	13	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	55

Appendix 2: PRISMA checklist –'the prevalences of overweight, obesity, hyperglycaemia, hypertension and dyslipidaemia in the states of the GCC: a systematic review'

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	68
INTRODUCTION			
Rationale	2	Describe the rationale for the review in the context of what is already known.	68-69
Objectives	3	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	69
METHODS			
Protocol and registration	4	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	69
Eligibility criteria	4	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	69
Information sources	6	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	69
Search	7	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	69
Study selection	8	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	70
Data collection process	9	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	70

Data items	10	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	69-70
Risk of bias in individual studies	11	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	69-70
Summary measures	12	State the principal summary measures (e.g., risk ratio, difference in means).	71
Synthesis of results	13	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	71

Appendix 3: PRISMA checklist –'the quality of T2DM management in the states of the GCC: a systematic review'

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	89
INTRODUCTION			
Rationale	2	Describe the rationale for the review in the context of what is already known.	89-90
Objectives	3	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	90
METHODS			
Protocol and registration	4	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	90-91
Eligibility criteria	4	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	91
Information sources	6	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	91
Search	7	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	90
Study selection	8	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	91
Data collection process	9	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	90-91
Data items	10	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	90-91
Risk of bias in individual studies	11	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	91

Summary measures	12	State the principal summary measures (e.g., risk ratio, difference in means).	92
Synthesis of results	13	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	92

Appendix 4: Review protocol -'Prevalence of T2DM management in the states of the GCC: a systematic review'

Background

The World Economic Forum rates chronic diseases one of the 'top 6' Global Risks (1). They carry enormous levels of morbidity and have become major bearers of mortality. Diabetes mellitus is a chronic metabolic disorder caused by defects in insulin secretion, insulin action, or both. If ineffectively controlled, the resulting chronic hyperglycaemia is associated with numerous disabling complications, and the International Diabetes Federation (IDF) 2010 estimate suggests that diabetes mellitus accounts for 6.8 % of all-cause mortality in the 20 – 79 age group (2). 90 % of cases of diabetes mellitus are of type 2 diabetes mellitus (3), a form of diabetes characterised by insulin resistance with a relative or real insulin deficiency. Over the past 3 – 4 decades there has been a global expansion in the prevalence of type 2 diabetes, associated with population growth, ageing, urbanisation and lifestyle changes (4, 5). These trends pose a particular risk to low- and middle- income countries, where most diabetes and most deaths from diabetes occur (5), where a greater proportion of individuals affected by type 2 diabetes are of working age (< 70 years; 6), where changing demographics predict the greatest increases in prevalence, lifestyle changes anticipate relatively high increases in prevalence, interventions are likely to be fewer, and individuals generally pay a larger share of health costs.

The states of The Co-operation Council for the Arab States of the Gulf (GCC) exhibit some of the highest rates of type 2 diabetes in the world. Five of the International Diabetes Federation's IDF 'top 10' countries for diabetes prevalence in 2010 and in 2030 are projected to be in this region (1). Currently, the IDF estimates suggest that in 2010 the ranking of countries by highest prevalence of diabetes starts as follows (2):1. Nauru, 2. United Arab Emirates (UAE), 3. Kingdom of Saudi Arabia (KSA), 4. Mauritius, 5. Bahrain, 6. Reunion, 7. Kuwait, 8. Oman, 9. Tongo, 10. Malaysia.

The anticipated prevalences for diabetes 2010-2030 in the Gulf countries are: United Arab Emirates (UAE) 18.7-21.4%, Kingdom of Saudi Arabia (KSA) 16.8-18.9%, Bahrain 15.4-17.3%, Kuwait 14.6-16.9% and Oman 13.4-14.9% (1). Rates in Qatar are also relatively high (15.4 % comparative prevalence). Prevalence estimates for 2030 (based only on anticipated changes in population size and demographic; 7) suggest the same will be true then. These likely underestimates (7) nevertheless anticipate prevalence in the IDF's 'Middle East-North Africa' region will be 93.9 % higher in 2030 (2).

The recent and rapid socio-economic development of the GCC countries has been associated with this rising prevalence. The IDF suggests that even in the absence of further economic development (that is, based on changes in population demography alone), the number of people with diabetes in its Middle East-North Africa region will increase 94% from 2010 to 2030. Only the Sub-Saharan African region is expected to see a greater increase in the number of cases of diabetes (98%) during this period (1).

Review question

A literature search was used to identify material relevant to the following review question:

- What is the prevalence of type 2 diabetes in populations of the GCC region?

Inclusion criteria

Types of studies

Studies that used designs from the used list of acceptable methods including: observational study (cross sectional, descriptive, ecological, cohort, case-control).

Types of participants

Subjects residing in the GCC countries at all ages, sexes and ethnicities were included, resident and expatriate populations, urban and rural, of all socioeconomic and educational backgrounds in the GCC.

Exclusion criteria

- Studies that used qualitative methods such as focus group and based on opinions
- Studies where population is mainly pregnant women with type 2 diabetes, or people with other types of diabetes

Study selection

Study collection will be conducted in two stages: (1) an initial screening of the title/abstract against inclusion criteria to identify any relevant paper will be carried out by one reviewer (L.A) ; (2) screening of the full paper that identified to be relevant from the first stage, and it will be carried out by 2 reviewers (L.A and A.M). If disagreement regarding any study eligibility appears, it would be resolved through discussion and asking for the opinion of the third reviewer (A. M).

No limitations on publication type, publication status, study design or language of publication will be imposed.

Data extraction/quality assessment

The data captured for each study will include data relating to, (1) methods (study design, recruitment, measurement tools, analysis); (2) participant characteristics (3) setting, and (4) outcomes (those observed, their definitions, results of analysis, length of follow-up). Study quality was assessed using a checklist adapted from the Centre for Reviews and Dissemination guidelines (8). Data extraction will be performed, in duplication, by two reviewers (L.A, A.M).

Data synthesis

Synthesis will include summarising the results of the data extraction process, considering the strength of evidence relating to each of our questions, and examination of results inconsistent with our formed proposals.

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Appendix 5: Research questions using PICO-'Prevalence of T2DM management in the states of the GCC: a systematic review'

- Research question: What is the prevalence of type 2 diabetes in the populations of the GCC region?

Patient/Population	AND	**Outcomes**
People living in the GCC		Prevalence of: type 2 diabetes
GCC: Qatar, United Arab Emirates UAE, Kingdom of Saudi Arabia KSA, Kingdom of Bahrain, Sultanate of Oman, Kuwait		**Prevalence:** statistics, epidemiology **Type 2 diabetes mellitus:** Diabetes mellitus, Non-insulin dependent diabetes mellitus, T 2 DM, impaired glucose tolerance, MODY or NIDDM, diabetes insipidus

Appendix 6: search strategy- 'Prevalence of T2DM management in the states of the GCC: a systematic review'

Search strategy to identify studies from electronic databases

The followed steps for the search strategy included: (1) formatting a well defined review question to maintain the transparency for the review process; (2) revising the review question using PICOS elements (Population, Intervention, Comparators, Outcomes, Study design) (appendix 2); (3) defining the inc/exclusion criteria for the study; (4) producing a list of synonyms abbreviations and spelling variants; (5) combining the PICOS elements using Boolean logic (AND, OR); (6) devising a search strategy using both indexing terms and free text; (6) reviewing the search strategy; (7) pilot the search strategy on one database EMBASE; (8) review the search strategy with another colleague (w. I); (9) repeat the search strategy and finalize it.

Describing electronic database searches

The Medline and Embase were searched separately on 15/07/2009 and the search was repeated on 03/07/2010 (via Dialog and Ovid, respectively; 1950 to July week 1, and 1947 to 2010 July) using the following search strategy:

Type 2 diabetes

(1) exp diabetes mellitus, non-insulin-dependent/

(2) exp insulin resistance/

(3) impaired glucose toleranc$.tw.

(4) glucose intoleranc$.tw.

(5) insulin$ resistanc$.tw.

(6) (MODY or NIDDM).tw.

(7) ((typ$ 2 or typ$ II) adj diabet$).tw.

(8) ((keto?resist$ or non?keto$) adj diabet$).tw.

(9) ((adult$ or matur$ or late or slow or stabl$) adj diabet$).tw.

(10) (insulin$ defic$ adj relativ$).tw.

(11) pluri?metabolic$ syndrom$.tw.

(12) 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11

(13) exp diabetes insipidus/

(14) diabet$ insipidus.tw.

(15) 13 or 14

(16) 12 or 15

(17) Exp prevalence/

(18) Exp epidemiology/

(19) Stat$.tw.

(20) 17 or 18 or 19

The states of The Co-operation Council for the Arab States of the Gulf (GCC)

(21) ((Saudi or emirates or Kuwait or Oman or Bahrain or Qatar) adj5 (middle east* or Arab*)).mp. [mp=title, original title, abstract, name of substance word, subject heading word, unique identifier]

Prevalence of type 2 diabetes in the GCC

(1) 21 and 20

(2) 16 and 20

<u>Describing journal hand searches</u>

1 International Journal of Diabetes and Metabolism searched for the period 1993 to 2009

2 Saudi Medical Journal for the period 2000 to 2010

<u>Describing the methods used to search relevant internet sources</u>

1 The International Diabetes Federation (2009) IDF (http://www.diabetesatlas.org/) was searched using the on-site search engine. The section of the website labelled Diabetes Atlas 4th ed. was searched in detail.

2 The World Health Organisation (2009) WHO (http://www.WHO.int/mediacentre/factsheets/fs312/en/) was searched using on-site search engine. The section of the website labelled Fact sheet N 312 Diabetes was searched in detail.

Describing other searches included

1 The reference lists of included studies in the review were scanned for relevant studies.

Appendix 7: Quality assessment- 'Prevalence of T2DM management in the states of the GCC: a systematic review'

Ref/dates of study	Quality assessment checklist (1)
Al-Lawati &Jouilahti/ 1991	1-Y, 2-Y, 3-Y, 4-Y, 65-N, 6-N, 7-NA
Asfour et al/ 2000	1-Y, 2-Y, 3-Y, 4-Y, 5-N, 6-N, 7-NA
Al-Lawati et al/ NR	1-Y, 2-Y, 3-Y, 4-Y, 5-N, 6-N, 7-NA
Balasy & Radwan/ 1989[2; 9]	Full article not available for assessment
Townsend/ NR	1-Y, 2-Y, 3-Y, 4-N, 5-Unclear, 6-N, 7-NA
Glasgow et al/ 1995	1-N, 2-partially, 3-N, 4-N, 5-N, 6-Y, 7-NA
El-Hazmi et al/ NR	1-Y, 2- Incomplete, 3-Y, 4-Y, 5-Y, 6-N, 7-NA
Bacchus et al/ NR	1-Y, 2-Incomplete, 3- Y, 4- Y, 5-N, 6- Some, 7-NA
Fatani et al/ NR	1-Y, 2-Y, 3-Y, 4-Y, 5-N, 6-N, 7-NA
Anokute et al/ 1985-1987	1-Y, 2-Y, 3-Y, 4-Y, 5-Y, 6-N, 7-NA
Abu-Zeid and Al-Kassab/ 1989	1-Y, 2-Incomplete, 3-Y, 4-Y, 5-N, 6-N, 7-NA
Abdella et al/1989-1990	1-Y, 2-Y, 3-Y, 4-N, 5-Y, 6-N, 7-NA
Al-Lawati & Mohammed / 1991	1-Y, 2-Y, 3-Y, 4-Y, 5-N, 6-N, 7-NA
Mahfouz et al/1993	1-Y, 2-Y, 3-Y, 4-Incomplete, 5-N, 6-N, 7-NA
El-Hazmi et al/ 1991	1-Y, 2-Y, 3-Y, 4-Y, 5-N, 6-N, 7-NA
El-Hazmi et al/1991	1-Y, 2-Y, 3-Y, 4-Y, 5-N, 6-Some, 7-NA
Al-Nuaim/ 1991-1993	1-Y, 2-Incomplete, 3-Y, 4-Y, 5-Y, 6-Some, 7-NA
Al-Shammari et al/ 1993-1994	1-Y, 2-Y, 3-Y, 4-Y, 5-Y, 6-N, 7-NA
Al-Mahroos & McKelcue/ 1995-1996	1-Y, 2-Y, 3-Y, 4-Y, 5-N, 6-N, 7-NA
Al-Mahroos and Al-Roomi/ NR	1-Y, 2-Y, 3-Y, 4-Y, 5-Y, 6-N, 7-NA
Al-Nozha et al/ 1995-2000	1-Y, 2-Incomplete, 3-Y, 4-N, 5-Y, 6-N, 7-NA
Malik et al/ 1999-2000	1-Y, 2-Y, 3-Y, 4-Y, 5-Y, 6-N, 7-NA
Al-Asi/ 2000	1-Y, 2-Y, 3-Y, 4-Y, 5-N, 6-N, 7-NA
Al-Moosa et al/ NR	1-Y, 2-Incomplete, 3-Y, 4-Y, 5-N, 6-Y, 7-NA
Moussa et al/ 2000-2002	1-Y, 2-Incomplete, 3-Y, 4-Y, 5-N, 6-Y, 7-NA
Baynouna et al/ 2004-2005	1-Y, 2-Y, 3-Y, 4-N, 5-Y, 6- N, 7-NA
Saadi et al/ 2005-2006	1-Y, 2-Y, 3-Y, 4-Y, 5-N, 6-Y, 7-NA

Bener et al/ 2009	1-Y, 2-Y, 3-Y, 4-Y, 5-Y, 6-Some, 7-NA

R: rural residents; U: urban residents; SR: self-reported diagnosis; PD: previous diagnosis; CBG: capillary blood glucose; RBG: random blood glucose

Quality assessment checklist (1)

Was the aim of the study stated clearly?

Was the methodology stated? And was it appropriate?

Were appropriate methods used for data collection and analysis?

Was the data analysis sufficiently rigours?

Were preventive steps taken to minimize bias?

Were limitations of the study discussed?

In systematic review, was search strategy adequate and appropriate?

Appendix 8: Summary of studies- prevalence of T2DM in the GCC region (A)

Ref/dates of study	Country	Sampling			Population characteristics		
		Population sampled	Response rate	Sample size	% male	Age Range (years)	Nationality; U/R
Al-Lawati &Jouilahti/ 1991	Oman	Households	91%	5096	41.9	20 to > 80	U/R mix
Asfour et al/ 2000	Oman	Households	93% (males 92%, females 94%)	5838	49.8	20 to > 80	Omani; U/R mix
Al-Lawati et al/ NR	Oman	Households	83%	5847	Urban: 48.8; Rural: 50.3	20 to > 60	
Balasy & Radwan/ 1989[2; 9]	UAE	Health centre[4]		15175	NR[8]		
Townsend[2; 9]/ / NR	UAE	PC		336	NR [8]	>20	U/R mix
Glasgow et al[2] / 1995	UAE	PC		< 33 % of > 29809	NR[8]	>30	U/R mix
(El-Hazmi et al[2] / NR	KSA	Households	95%	25337	46.2	< 14 to > 60	Saudi
Bacchus et al/ NR	KSA	Working [3]		1385	100	< 15 to > 65	Saudi, R
Fatani et al/ NR	KSA	Households	-	5222	53.1	15 to >55	

Anokute et al/ 1985-1987	KSA	University	-	3158	100	Mean ages by subgroup: 31, 23 and 41 years	86.3 % Saudi; U
Abu-Zeid and Al-Kassab/ 1989	KSA	Households	87%	1419	49.4	10 to > 60	98 % Saudi; 'semiurban'/R
Abdella et al/1989-1990	Kuwait	Households	-	261387[7]	Approximately: 50	< 20 to > 60	Kuwaiti; U/R mix
Al-Lawati & Mohammed / 1991	Oman	Households	-	4682	42.8	>20	U/R mix
Mahfouz et al/1993	KSA	PC	-	600132	NR[8]	$\geq$ 5	
El-Hazmi et al/ 1991	KSA	Household	-	23493	46	2-70	Saudi
El-Hazmi et al/1991	KSA	Household	Roughly 95%	2060	48.5	14 to >50	Saudi
Al-Nuaim/ 1991-1993	KSA	Households	69%	13177	52	15 to >60	Saudi
Al-Shammari et al/ 1993-1994	KSA	Working[5]	-	2990	NR[8]	Unclear	94.7% Saudi
Al-Mahroos & McKelcue/	Bahrain	Households	59-70%	2002	58.6	Males: 40 – 59 Females: 50 – 69	Bahraini

1995-1996							
Al-Mahroos and Al-Roomi/ NR	Bahrain	Households	59-70%	2013	58	Males: 40 – 59 Females: 50 – 69	Bahraini
Al-Nozha et al/ 1995-2000	KSA	Households	98.2%	16197	47.6	30-70	Saudi
Malik et al/ 1999-2000	UAE	Households	89%	5844	42.7	< 14 to > 60	UAE residents; '80 % U'
Al-Asi/ 2000	Kuwait	Working[6]	89.4%	3282	85	54 % < 40	62 % Kuwaiti
Al-Moosa et al/ NR	Oman	Working	96%	5847	Urban: 48.8; Rural: 50.3	20 to > 60	
Moussa et al/ 2000-2002	Kuwait	School-children		128918	41	6 – 18	Kuwaiti
Baynouna et al/ 2004-2005	UAE	Households	40.8%	817	49.3	20 to > 60	Emirati
Saadi et al/ 2005-2006	UAE	Households		2396	49.1	18 to > 70	Emirati; U
Bener et al/ 2009	Qatar	PC	77.9%	1117	51.1	20 – 59	U/ ‘semiurban’

Summary of cross-sectional studies investigating prevalence of type 2 diabetes within populations of the GCC region

R: rural residents; U: urban residents; SR: self-reported diagnosis; PD: previous diagnosis; CBG: capillary blood glucose; RBG: random blood glucose

1. Abstract only reviewed (full paper not available); 2.Full data unavailable; 3. Government/ municipal salaried workers; 4. Nature of clinic unclear; 5. Employees of Saudi National Guard and dependents; 6. Employees of Kuwait Oil Company; 7. N = 130364 (urban group), 131023 (rural group); 8. Males and females included; 9. Pilot study; 10. Rates of diabetes as subject of consultation (not rates of diagnosis) investigated; 11. Until 59 years, no trend thereafter; 12. Falling after 60 years in one clinic; 13. Age significantly associated with DM (multiple logistic regression analysis): peak age DM 40 - 49 years

Appendix 9: Summary of studies - prevalence of T2DM in the GCC region (B)

Ref/dates of study	Diagnostic criteria		Results		Study limitations
	Criteria followed	Method of screening	Prevalence of DM	Others	
Al-Lawati &Jouilahti/ 1991	WHO 1985		Overall prevalence of DM (Males: 9.7 Females: 9.8)	Mean BMI increased from 24.3kg/m2 in 1991 to 25.2/kg/m2 in 2000 among males (P<0.001). Among females, it decreased from 26.3 kg/m2 to 25.8 kg/m2 (P<0.001) In both gender, mean BMI increased with age and peaked in the age group (40-49)	No statistical analysis; Characteristics of population studied unclear
Asfour et al/ 2000	WHO 1999/ SR	OGTT	Crude prevalence of DM: 10% in both gender. Prevalence of DM rose through life in both gender to a maximum of > 30%	IGT was more common in female than male: 13% vs. 8% respectively. In both gender, the prevalence of IGT increased with age, it peaked in the age group (60-69)	Limitation of the study not discussed Steps taken to minimize bias not discussed
Al-Lawati et al/ NR	WHO 1999	FPG	Prevalence of DM among male and female: 11.8% vs. 11.3% respectively (P=0.275)	Prevalence of DM rose with age and exceeded 20% in both genders at the age of 50 years IGT was more prevalence among males than females 7.1% vs. 5.1% (P<0.001)	Dates of investigation unclear
Balasy & Radwan/ 1989	NR		Age adjusted prevalence rate for DM: 5.69% Prevalence of DM among males vs. females: 1.81% vs. 2.58% respectively	The age specific prevalence of DM was steadily increasing until age 59 in both genders.	
Townsend/ NR	WHO 1980	Random capillary blood sampling in non-diabetic subjects was compared with OGTT in	Overall prevalence unclear 6.2% , > 30 years found to be diabetic 19% of subjects >20 years had IGT - in previously undiagnosed: 4.8	There was no apparent correlation of undiagnosed DM with BMI	Dates of investigation unclear; Characteristics of study population not well documented (e.g. sex)

		known diabetic samples			
Glasgow et al/ 1995	Previously diagnosed	NR	The rate of DM from the two databases for UAE citizens >30 years: 5.7% and 11.2%	In one of the databases the rate of DM increased from 1.4% in the age group 30-34 years to between 8.9% and 11% in the age group > 40-44 years. At the other database, the DM rates increased from 21% in the age group 30-34% to 21.6% in the age group 60-64, and decreased to 4.2% in people ≥ 65 years.	Rates of diabetes as subject of consultation (rather than rates of diagnosis) investigated. Diagnosis of DM not confirmed
El-Hazmi et al/ NR	WHO 1980/1985	FPG	The prevalence of T2DM and IGT: 5.63% and 0.5% respectively in males, in females: 4.53% and 0.72% respectively	The prevalence of T2DM was 0.12% and 0.79% in people< 14 and people aged 14-29 years respectively. In the age ≥ 60, the rate increased to 28.8% and 24.9% in males and females respectively.	Dates of investigation unclear; Results by sex (*table 3) not available
Bacchus et al/ NR	WHO 1980	FPG and OGGT	No diabetic cases in people <24 years 0.3%: age group 25-34 years 2.6%: age group 35-44 years 9.6%: age group 45-54 years 11%: age group 55-64	65% of people with DM were overweight vs. 26% of people without DM	Sample not representative for the whole population Recruitment process not specified
Fatani et al/ NR	Random CBG > 11 mM/ WHO 1980 (OGTT)	ICT, OGGT	overall prevalence DM 4.3 %; prevalence DM lower in men (2.9 %) vs. women (5.9 %; p< 0.001) Overall prevalence IGT 1.1 %;	In subjects > 15 years, prevalence 4.0 % in men, 9.5 % in women (p < 0.001) prevalence of DM higher in higher income groups (p < 0.001) Age, income and BMI were associated with blood glucose by multiple logistic regression analysis (p < 0.004, p < 0.0001 and p < 0.045 respectively)	Dates of study unclear Selection method of houses for sampling not reported
Anokute et al/ 1985-1987	2x fasting CBG > 7.8 mM	FPG	overall prevalence 'positive' FBG (unconfirmed DM): 6.0 %	The age specific prevalence increased with age to a maximum of 33.8% for the age group ≥ 50	Recruitment procedure not reported No statistical analysis

				years.	Sample not representative for the whole population (male university community)
Abu-Zeid and Al-Kassab/ 1989	PD/ 2-hour fasting post-meal CBG > 11.1 mM	FPG and IGT	Overall prevalence DM 4.6 %, higher in men (5.5 %) than women (3.6 %; p < 0.05);; overall prevalence IGT: 3.7 %; higher in women (4.9 %) vs. men (2.5 %; p < 0.01)	Prevalence by sex was statistically significant (P<0.05) Prevalence rose with age steadily, it peaked among age people aged ≥ 45 years (P<0.001)	Statistical tests not well described
Abdella et al/1989-1990	WHO 1985 (2)		Overall prevalence DM: 7.6 %	prevalence in urban area: 5.6 %; prevalence in rural area: 10.0 %; prevalence generally increased with age in both sexes in both areas; prevalence was generally greater in females (neither tested for significance) Mean BMI was 31.8±6.3 and 28.5±5.1 in females and males respectively	Only cases sufficiently severe to merit hospital clinic attendance were identified
Al-Lawati & Mohammed / 1991	WHO (1985)/ADA (1997) criteria for DM	OGGT	Prevalence of DM: 10.5 % by WHO criteria, 8.2 % by ADA criteria Prevalence of IGT 10.5 % by WHO criteria, 5.7 % by ADA criteria	The difference in the prevalence of DM was less profound (10.5% by the WHO criteria vs. by ADA, P<0.0001)	Characteristics of population studied unclear
Mahfouz et al/1993	'Hospital-confirmed' (following repeat RBG > 7.8 mM)	Random blood glucose	Prevalence DM 9.7 % in males, 9.8 % in females Prevalence IGT 8.1 % in males, 12.9 % in females		Sampling method not clear Nature of population registered with health centres not specified
El-Hazmi et al/ 1991	WHO 1980/1985	OGGT and IGT	The prevalence of T2DM: 4.9% The prevalence of IGT: 0.7%	The prevalence of DM peaked in the age group≥ 30 years (P<0.001)	Limitation of the study not discussed Steps taken to minimize bias not discussed
El-Hazmi et al/1991	WHO 1980/1985	OGGT and IGT	The overall prevalence of T2DM: 6.89%; IGT: 0.77%	73% of female both diabetic or non-diabetic were estimated to be either obese or overweight compared to 50% of their male counterparts	Limitation of the study not discussed Steps taken to minimize bias not discussed
Al-Nuaim/ 1991-1993	WHO 1985	OGGT and IGT	Overall prevalence DM: 12 % in urban males, 7 % rural males, 14 % urban females, 8 % rural females Overall prevalence IGT: 10 % in urban	Age adjusted prevalence DM significantly higher in urban vs. rural population (p = 0.0001 for both male and female groups)	Limitation of the study not discussed Steps taken to minimize bias not discussed

			males, 8 % in rural males, 11 % in urban females, 8 % in rural females	Prevalence of obesity (BMI > 30 kg/m2) among males and females respectively was 15% and 24% (P=0.001)	
Al-Shammari et al/ 1993-1994	Previously diagnosed	-	Overall prevalence DM 12.2 %		Methods not well described Demographics of total population not available Diagnosis not confirmed; sample misses more problematic cases ('referred to hospital clinic') Sample not representative for the whole population (National Guard employees and dependants)
Al-Mahroos & McKelcue/ 1995-1996	WHO 1985	OGGT and IGT	Overall prevalence DM: 29.8 %; prevalence DM in males 40 - 49: 22.9 %; in males 50 - 59: 29.6 %; in females 50 - 59: 35.4 %; in females 60 - 69: 37.6 % Overall prevalence IGT: 17.9 %; prevalence IGT in males 40 - 49: 16.6 %; in males 50 - 59: 15.8 %; in females 50 - 59: 19.4 %; in females 60 - 69: 22.4 %; OR for DM in women 1.27 (95 % CI 0.96 - 1.66)	28% of subjects had BMI≥ 30 kg/m2, only 42% rated themselves as overweight.	Limitation of the study not discussed Steps taken to minimize bias not discussed
Al-Mahroos and Al-Roomi/ NR	Treatment/ WHO 1985	OGGT and IGT	overall prevalence DM 30 %		Method of blood sampling not reported
Al-Nozha et al/ 1995-2000	ADA 1997	OGGT and IGT	Overall prevalence DM 23.7 %; prevalence higher in males: 26.2 % (95 % CI 25.2 - 27.2) vs. females 21.5 % (95 % CI 20.6 - 22.4; p < 0.0001) (significance unclear); overall prevalence IFG 14.1 % (no gender difference)	DM more prevalent in urban (25.5 %) vs. rural (19.5 %) areas (p < 0.0001); rates of DM increased with advancing age	sample selection method not clear Limitation of the study not discussed Steps taken to minimize bias not discussed
Malik et al/ 1999-2000	WHO 1999	OGGT, IFG and IGT	overall prevalence DM: 21.4 % (95 % CI 20.4 - 22.4 %); prevalence in men	Roughly 22% of the sample had BMI (35-39.9)	Selection of subjects intentionally biased towards

			20.4 % (18.8 - 22.0 %); prevalence in women 22.3 % (20.9 - 23.7 % Prevalence in UAE citizens 25 %, expats 13 - 19 % Prevalence IFG: 4.5 % (3.7 - 5.3 %) in men, 7.2 % (6.3 - 8.1 %) in women (significantly higher in women, $p < 0.01$)	40% had (BMI 25-29)	UAE citizens
Al-Asi/ 2000	Medication/ FBG > 7 mM		Overall prevalence of DM: 17%	Overall prevalence of overweight (BMI 25-29.9) was 48% , obesity (BMI >30) : 27%	Sample not representative for the whole population
Al-Moosa et al/ NR	SR/ WHO 2000	FPG	overall prevalence DM: 11.6 % (11.8 % in males, 11.3 % in females; 17.7 % in urban population, 10.5 % in rural population); urban residence significantly associated with DM (adjusted OR) = 1.7 (95% CI 1.4–2.1), for every 5 year increase in age, 1.2 greater odds of DM (95 % CI 1.4 - 2.1)	The prevalence of obesity (BMI≥30) among sample : 21.5%	Dates of investigation unclear Secondary data collection
Moussa et al/ 2000-2002	Previous diagnosis of T2DM (made by WHO 1985 (2) and ADA 1998, 2000 criteria	FPG	Overall prevalence DM: 34.9 per 100000 (95 % CI 24.7 - 45.1); males 47.3 per 100000 (CI 28.7-65.8); females 26.3 per 100000 (CI 14.8-37.8); significantly higher prevalence T2DM in males ($p = 0.05$) ($p = 0.013$ on age-adjusted data)) and with advancing age ($p = 0.026$).		Secondary data collection
Baynouna et al/ 2004-2005	ADA 2005/ medication/ SR	OGGT and IFG	Overall prevalence DM 23.3%; prevalence by age and gender: males: 5.1 % 20 - 29 years, 11.1 % 30 - 39 years, 29.5 % 40 - 49 years, 35.5 % 50 - 59 years, 55.9 % > 60 years; females: 1.7 % 20 - 29 years, 5.3 % 30 - 39 years, 26.2 % 40 - 49 years, 27.1 % 50 - 59 years, 43.3 % > 60 years; overall prevalence IFG not reported, but prevalence reached 20 % 'as early as' 20 - 24 years in males, 35 - 39 years in	Prevalence of obesity (BMI ≥30) was greater in females than males (46.5% vs. 28.3%, $P<0.01$ respectively)	Statistical analysis was not described clearly Study limitations not discussed

			females		
Saadi et al/ 2005-2006	Self-reported + current oral medication/insulin, or WHO 1999	OGGT and IGT	Overall prevalence DM: 10.2 % (9.4 % in males, 11.1 % in females); prevalence in 30 - 64 years population: 20.6 % (17.7 % in males, 22.1 % in women); prevalence IGT: 22.8 % (19.7 % in males, 24.3 % in females)		Potential of under- or overestimation of the reported rate of diabetes diagnosis (10.2%) based on disease reporting rate % of subjects out of those sampled households (2455) was underwent testing was small
Bener et al/ 2009	Self reported and currently taking oral medication or WHO 2006 criteria	OGGT and IGT	Overall prevalence DM: 16.7 % (15.2 % males, 18.1 % females); overall prevalence IGT: 12.5 % (12.3 % males, 12.8 % females); age significantly associated with DM (p = 0.0001, multiple logistic regression analysis); peak age DM 40 - 49 years (58 %)	Central obesity was common in 76.3%, p<0.001	

Summary of cross-sectional studies investigating prevalence of type 2 diabetes within populations of the GCC region

Appendix 10: Review protocol- 'Prevalences of overweight, obesity, hyperglycaemia, hypertension and dyslipidaemia in the GCC: a systematic review'

Background

The increasing prevalence of diabetes mellitus, particularly type 2 diabetes mellitus, is well documented (1). Type 2 diabetes is currently estimated to account for approximately 90 % of the global diabetes burden (2). Together with similar trends in other non-communicable diseases, it leads to risks not only for individuals, but for health systems, social systems, and state economies – those less established being at particular risk. This risk is in part to do with an anticipated relatively dramatic rise in countries with relatively young populations, and economic infrastructure, as they undergo the apparent and predicted increases in prevalence of diabetes associated with changes in lifestyle/economic development, and population growth. Even when based on changes in population size and demographic alone (3), the highest predicted future increases are expected in the International Diabetes Federation's 'African' region (estimated: 98.1 % increase 2010 – 2030), followed by the 'Middle East-North Africa' region (estimated: 93.9 % increase 2010 – 2030; 4). The Middle East-North Africa region already carries some of the highest rates of diabetes in the world. Indeed, the countries of the Co-operation Council for the Arab States of the Gulf (GCC) include those currently ranked 2, 3, 5, 7 and 8 for diabetes prevalence among the 216 countries for which data are available (4).

I anticipated that this high prevalence in the GCC states is associated with higher prevalences of risk factors for type 2 diabetes in this region. The International Diabetes Federation suggests the following as risk factors for type 2 diabetes: age, obesity, family history, physical inactivity, race/ethnicity and gestational diabetes. Of the modifiable risk factors, physical inactivity appears (on scoping searches) to have been surprisingly little studied in this region, although it is likely to be correlated with overweight/obesity, which has been relatively well considered.

Review question

A literature search was used to identify material relevant to the following review question:

- What are the prevalences of overweight/obesity, hyperglycaemia, hypertension and dyslipidaemia in the GCC region?

Inclusion criteria

Types of studies

Studies that used designs from the used list of acceptable methods including: randomized controlled trial, observational study (cross sectional, quasi-experimental and interventional).

Types of participants

Type 2 diabetic patients at all ages, sexes and ethnicities were included, resident and expatriate populations, urban and rural, of all socioeconomic and educational backgrounds in the GCC.

Types of outcome measures

Prevalence rates of: hyperglycaemia, hypertension, obesity/overweight and dyslipidaemia.

Exclusion criteria

- Studies that used qualitative methods such as focus group and based on opinions
- Studies where population is mainly pregnant women with type 2 diabetes, or people with other types of diabetes

Study selection

Study collection will be conducted in two stages: (1) an initial screening of the title/abstract against inclusion criteria to identify any relevant paper will be carried out by one reviewer (L.A) ; (2) screening of the full paper that identified to be relevant from the first stage, and it will be carried out by 2 reviewers (L.A and A.M). If disagreement regarding any study eligibility appears, it would be resolved through discussion and asking for the opinion of the third reviewer (A. M).

No limitations on publication type, publication status, study design or language of publication will be imposed.

Data extraction/quality assessment

The data captured for each study would include data relating to, (1) methods (study design, recruitment, measurement tools, analysis); (2) participant characteristics (3) setting, and (4) outcomes (those observed, their definitions, results of analysis, length of follow-up). Study quality will be assessed using a checklist adapted from the Centre for Reviews and Dissemination guidelines (6). Data extraction will be performed, in duplication, by two reviewers (L.A, A. M)

Data synthesis

Data synthesis will include summarising the results of the data extraction process, considering the strength of evidence relating to various questions formulated *a priori* , and examination of results inconsistent with our formed proposals.

In addition to examining the prevalence of the particular risk factors in the GCC states, we were interested in the following:

7. any trends in prevalence across time
8. any differences by country
9. any trends in prevalence associated with age
10. sex differences
11. location (urban/rural) differences
12. prevalence in children

In the cases of hypertension and dyslipidaemia, synthesis will be limited by the number of studies indentified, and in these cases description and discussion suffices.

References:

1. Zimmet P, Alberti KGMM and Shaw J. Global and societal implications of the diabetes epidemic. *Nature* 2001; **414**: 782 – 787.
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Appendix 11: Research question using PICOS- ' Prevalences of overweight, obesity, hyperglycaemia, hypertension and dyslipidaemia in the GCC: a systematic review'

- **Research question:** What are the prevalences of overweight/obesity, hyperglycaemia, hypertension and dyslipidaemia in the GCC region?

Patient/Population	AND	Outcomes
People living in the GCC		Prevalence of: overweight/obesity, hyperglycaemia, hypertension and dyslipidaemia
GCC: Qatar, United Arab Emirates UAE, Kingdom of Saudi Arabia KSA, Kingdom of Bahrain, Sultanate of Oman, Kuwait		**Prevalence:** statistics, epidemiological data **Overweight/ obesity** **Hyperglycaemia:** hyperglycemia, impaired glucose tolerance **Hypertension:** high blood pressure, hypertensan, systolic/diastolic blood pressure **Dyslipidaemia:** hyperlipidaemia, hypercholesterolemia, hypercholesterolaemia, hypertriglycerdaemia, hypertriglycerdemia

Appendix 12: Search strategy- 'Prevalences of overweight, obesity, hyperglycaemia, hypertension and dyslipidaemia in the GCC: a systematic review'

Search strategy to identify studies from electronic databases

The followed steps for the search strategy included: (1) formatting a well defined review question to maintain the transparency for the review process; (2) revising the review question using PICOS elements (Population, Intervention, Comparators, Outcomes, Study design) (appendix 1); (3) defining the inc/exclusion criteria for the study; (4) producing a list of synonyms abbreviations and spelling variants; (5) combining the PICOS elements using Boolean logic (AND, OR); (6) devising a search strategy using both indexing terms and free text (MeSH search term used were the name of the GCC countries with each of the included risk factors, as well as the following terms: 'prevalence', 'epidemiological data', 'statistics'; (6) reviewing the search strategy; (7) pilot the search strategy on one database EMBASE; (8) review the search strategy with another colleague (w. I); (9) repeat the search strategy and finalize it.

Describing electronic database searches

The Medline and Embase were searched separately on 15/07/2009 (via Dialog and Ovid, respectively; 1950 to March week 4, and 1947 to 2010 March 21 to July 2010) using the following search strategy:

Hyperglycaemia

(1) Exp hyperglycemia/
(2) Exp blood glucose/
(3) Blood glucose$.tw.
(4) High blood glucose$.tw.
(5) 1 or 2 or 3 or 4 or 5

Blood pressure

(6) exp hypertension/

(7) hyperten$.ti.

(8) blood pressure$.tw.

(9) (blood adj pressure).ti.

(10) 6 or 7 or 8 or 9

<u>Blood lipid</u>

(11) exp cholesterol/

(12) exp hyperlipidemia/

(13) cholesterol$.tw.

(14) lipid$.tw.

(15) hyperlipid$.tw.

(16) 11 or 12 or 13 or 14 or 15

<u>Obesity/overweight</u>

(17) obesity/

(18) exp weight gain

(19) body mass index/

(20) body mass index.tw.

(21) (overweight or over weight).tw.

(22) (adipos $).tw.

(23) fat overload syndrome$.tw.

(24) (overeat or over eat).tw.

(25) (overfeed or over feed).tw.

(26) obes$.tw.

(27) weight gain.tw.

(28) 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27

GCC

(29) ((Saudi or emirates or Kuwait or Oman or Bahrain or Qatar) adj5 (middle east* or Arab*)).mp. [mp=title, original title, abstract, name of substance word, subject heading word, unique identifier]

Hyperglycaemia and GCC

(30) 5 and 29

Hypertension and GCC

(31) 10 and 29

Hyperlipidaemia and GCC

(32) 16 and 29

Obesity/overweight and GCC

(33) 28 and 29

Describing journal hand searches

- International Journal of Diabetes and Metabolism searched for the period 1993 to 2009
- Saudi Medical Journal for the period 2000 to 2010

Describing the methods used to search relevant internet sources

- The International Diabetes Federation (2009) IDF (http://www.diabetesatlas.org/) was searched using the on-site search engine. The section of the website labelled Diabetes Atlas 4th ed. was searched in detail.
- The World Health Organisation (2009) WHO (http://www.WHO.int/mediacentre/factsheets/fs312/en/) was searched using on-

site search engine. The section of the website labelled Fact sheet N 312 Diabetes was searched in detail.

- American Heart Association (2010) (http://www.americanheart.org/presenter.jhtml?identifier=4756) was searched using on site search engine. The section Metabolic Syndrome was searched in detail

Describing other searches included

- The reference lists of included studies in the review were scanned for relevant studies.

Appendix 13: Review protocol- 'Quality of T2DM management in the GCC: a systematic review'

Background

The Co-operation Council for the Arab states of the Gulf (GCC) exhibit some of the highest rates of T2DM in the world with rates reaching 35% in some population (1). Five of the IDF's 'top 10' countries for DM prevalence in 2010 and in 2030 are in this region (UAE, KSA, Bahrain, Kuwait and Oman) (1). The recent and rapid socio-economic development of the GCC countries, correlated with a shift in prevalence in various (types of) diseases, including T2DM, has characterised the changes in disease burden anticipated and appearing in current low- and middle-income countries. However prevalence in the GCC region is still increasing and the IDF anticipates based only on changes in population, age and urban/rural distribution of population (i.e. assuming no change in prevalence rates and thus probably an underestimation) that it will undergo a 93.9 % increase by 2030 (1). Only the Sub-Saharan African region is expected to see a greater increase in prevalence (98.1 %; IDF, 2009) (1). Due to the high prevalence of DM in the GCC and increased economic cost to society, this disease represents a real challenge to the health care planners. The increased cost includes its effects on morbidity, employment, productivity, premature mortality and the increased use of health services (2). Although the expansion in the GCC region has occurred at a relatively rapid rate, we may still expect that the disease course, and therefore the size of the (potential) epidemic, can be prevented, reversed, halted, slowed, as it has been in other contexts (e.g. the Diabetes Control and Complications Trial (DCCT) and The UK Prospective Diabetes Study (UKPDS) (3).

However, due to the increasing evidence that diabetes care is sub-optimal on international level in terms of the standards attained, the degree of variability and the level of accountability of health professionals; improving and measuring quality of health care are becoming important issues world-wide. These are now in national agendas of health systems in several countries such as USA and UK (4-5). Little is known about the quality of diabetes control in the GCC; therefore a structured and systematic approach is needed to assess the quality of clinical care among those subjects.

Review question

A systematic literature search was carried out to identify information relevant to the following review questions:

3. How good is current control of type 2 diabetes in the GCC region, based on glycaemic-, blood pressure- and lipid- control indicators?

Inclusion criteria

Types of studies

Studies that used designs from the used list of acceptable methods including: randomized controlled trial, observational study (cross sectional, quasi-experimental and interventional).

Types of participants

Type 2 diabetic patients at all ages, sexes and ethnicities were included, resident and expatriate populations, urban and rural, of all socioeconomic and educational backgrounds in the GCC.

Types of outcome measures

Primary outcomes

(1) Blood glucose control:

Clinical Outcome measure

- Glucose level measurement (HbA1c , FBG, postprandial glucose level and random glucose measurements)

Process measure

- Frequency of glucose level documentation annually

(2) Blood pressure control:

Clinical Outcome measure

- Systolic and diastolic blood pressure levels measurements

Process measure

- Frequency of blood pressure level documentation annually

(3) Blood lipid control :

Clinical Outcome measure

- Lipid levels measurement (HDL, LDL, triglycerides and cholesterol)

Process measure

- Frequency of blood lipid level documentation annually

Exclusion criteria

- Studies that used qualitative methods such as focus group and based on opinions
- Studies where population is mainly pregnant women with type 2 diabetes, or people with other types of diabetes

Study selection

Study collection will be conducted in two stages: (1) an initial screening of the title/abstract against inclusion criteria to identify any relevant paper will be carried out by one reviewer (L.A) ; (2) screening of the full paper that identified to be relevant from the first stage, and it will be carried out by 2 reviewers (L.A and A.M). If disagreement regarding any study eligibility appears, it would be resolved through discussion and asking for the opinion of the third reviewer (A. M).

No limitations on publication type, publication status, study design or language of publication were imposed.

Data extraction/quality assessment

The data captured for each study included data relating to, (1) methods (study design, recruitment, measurement tools, analysis); (2) participant characteristics (3) setting, and (4) outcomes (those observed, their definitions, results of analysis, length of follow-up). Study quality was assessed using a checklist adapted from the Centre for Reviews and Dissemination guidelines (6). Data extraction was performed, in duplication, by two reviewers.

Data synthesis

Data synthesis included summarising the results of the data extraction process, considering the strength of evidence relating to each of our questions, and examination of results inconsistent with our formed proposals. Synthesis was limited by the numbers of studies, particularly in consideration of the identified quasi-experimental studies (see 'Results'), and thus for this set of data, description and discussion suffices.

References

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Appendix 14: Research questions using PICOS-' Quality of T2DM management in the GCC: a systematic review'.

(1) **Research question:** How good is current control of people with type 2 diabetes in the GCC regions, based on glycaemic, blood pressure- and lipid- control indicators?

i) **The question as a testable hypothesis:** in people with type 2 diabetes in the GCC **(P)**, do the indicated levels of blood glucose, pressure and lipids control **(I)** results in good diabetes management **(O)?**

Patient/Population AND	Intervention AND	Outcomes
People with type 2 diabetes mellitus in the **GCC**	Level of **blood glucose, pressure and lipids** Control	Diabetes **management**
Alternative Words		
Type 2 diabetes mellitus: Diabetes mellitus, Non-insulin dependent diabetes mellitus, T 2 DM, Diabetes type 2, Type 2 diabetes, diabetics **GCC:** Qatar, United Arab Emirates UAE, Kingdom of Saudi Arabia KSA, Kingdom of Bahrain, Sultanate of Oman, Kuwait	**Blood glucose:** high blood glucose, hyperglycaemia, hyperglycemia, HbA1c, glyclated haemoglobin levels , Fasting blood glucose levels, FBG, Postprandial blood glucose level **Blood pressure:** High blood pressure, diastolic/ Systolic blood pressure, hypertension, BP, HTN ,hypertensan **Blood lipid:** High blood lipid, hyprcholesterolaemia, hypercholesterol, hyperlipidemia, hyperlipidemaemia, hyperlipidemic, hypertriglycerdemia	**Management:** control, reduction, improvement, enhancement

(2) **Research question:** Have implemented strategies (including public health/ preventive strategies) improved management of type 2 diabetes in the GCC countries?

ii) **The question as a testable hypothesis:** in people with type 2 diabetes in the GCC **(P),** do the implemented strategies (public health/ preventive) **(I),** Improve management of type 2 diabetes **(O)?**

Patient/Population	AND	Intervention	AND	Outcomes
People with type 2 diabetes mellitus in the **GCC**		Implemented strategies (public health/ preventive)		**Management** of type 2 diabetes
		Alternative Words		
Type 2 diabetes mellitus: Diabetes mellitus, Non-insulin dependent diabetes mellitus, T 2 DM, DM/,Diabetes type 2, Type 2 diabetes, diabetics **GCC:** Qatar, United Arab Emirates UAE, Kingdom of Saudi Arabia KSA, Kingdom of Bahrain, Sultanate of Oman, Kuwait		National diabetes programmes, national guidelines, prevention programmes, public health programmes, diabetes management programmes		**Management:** control, reduction, enhancement, improvement

Appendix 15: Search strategy- 'Quality of T2DM management in the GCC: a systematic review'

Search strategy to identify studies from electronic databases

The followed steps for the search strategy included: (1) formatting a well defined review question to maintain the transparency for the review process; (2) revising the review question using PICOS elements (Population, Intervention, Comparators, Outcomes, Study design) (appendix 1); (3) defining the inc/exclusion criteria for the study; (4) producing a list of synonyms abbreviations and spelling variants; (5) combining the PICOS elements using Boolean logic (AND, OR); (6) devising a search strategy using both indexing terms and free text; (6) reviewing the search strategy; (7) pilot the search strategy on one database EMBASE; (8) review the search strategy with another colleague (w. I); (9) repeat the search strategy and finalize it.

Describing electronic database searches

The Medline and Embase were searched separately on 15/07/2009 and the search was repeated on 03/07/2010 (via Dialog and Ovid, respectively; 1950 to July week 1, and 1947 to 2010 July) using the following search strategy:

<u>**Type 2 diabetes**</u>

(22) exp diabetes mellitus, non-insulin-dependent/

(23) exp insulin resistance/

(24) impaired glucose toleranc$.tw.

(25) glucose intoleranc$.tw.

(26) insulin$ resistanc$.tw.

(27) (MODY or NIDDM).tw.

(28) ((typ$ 2 or typ$ II) adj diabet$).tw.

(29) ((keto?resist$ or non?keto$) adj diabet$).tw.

(30) ((adult$ or matur$ or late or slow or stabl$) adj diabet$).tw.

(31) (insulin$ defic$ adj relativ$).tw.

(32) pluri?metabolic$ syndrom$.tw.

(33) 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11

(34) exp diabetes insipidus/

(35) diabet$ insipidus.tw.

(36) 13 or 14

(37) 15 OR 12

Blood glucose

(38) Exp blood glucose/

(39) Blood glucose$.tw.

(40) Exp hyperglycemia/

(41) 17 or 18 or 19

Blood pressure

(21) exp hypertension/

(22) hyperten$.ti.

(23) blood pressure$.tw.

(24) (blood adj pressure).ti.

(25) 21 or 22 or 23 or 24

Blood lipid

(26) exp cholesterol/

(27) exp hyperlipidemia/

(28) cholesterol$.tw.

(29) lipid$.tw.

(30) hyperlipid$.tw.

(31) 26 or 27 or 28 or 29 or 30

The states of The Co-operation Council for the Arab States of the Gulf (GCC)

(32) United Arab Emirate.tw.

(33) Qatar

(34) Kuwait

(35) Sultanate of Omn.mp. or Oman.tw. [mp=title, original title, abstract, name of substance word, subject heading word, unique identifier]

(36) Kingdom of Bahrain.mp. or Bahrain.tw. [mp=title, original title, abstract, name of substance word, subject heading word, unique identifier]

(37) Kingdom of Saudi Arabia.mp. or Saudi.tw. [mp=title, original title, abstract, name of substance word, subject heading word, unique identifier]

(38) ((Saudi or emirates or Kuwait or Oman or Bahrain or Qatar) adj5 (middle east* or Arab*)).mp. [mp=title, original title, abstract, name of substance word, subject heading word, unique identifier]

Type 2 diabetes and blood glucose and the GCC

(39) 16 and 20 and 32

(40) 16 and 20 and 33

(41) 16 and 20 and 34

(42) 16 and 20 and 35

(43) 16 and 20 and 35

(44) 16 and 20 and 36

(45) 16 and 20 and 37

(46) 16 and 20 and 38

<u>Type 2 diabetes and blood pressure and the GCC</u>

(47) 16 and 25 and 32

(48) 16 and 25 and 33

(49) 16 and 25 and 34

(50) 16 and 25 and 35

(51) 16 and 25 and 36

(52) 16 and 25 and 37

(53) 16 and 25 and 38

<u>Type 2 diabetes and blood lipid and the GCC</u>

(54) 16 and 31 and 32

(55) 16 and 31 and 33

(56) 16 and 31 and 34

(57) 16 and 31 and 35

(58) 16 and 31 and 36

(59) 16 and 31 and 37

(60) 16 and 31 and 38

Describing journal hand searches

3 International Journal of Diabetes and Metabolism searched for the period 1993 to 2009

4 Saudi Medical Journal for the period 2000 to 2010

Describing the methods used to search relevant internet sources

3 The Qatar Diabetes Association website (http://www.qda.org.qa/output/page4.asp) was searched using the on-site search engine. The section of the website labelled guidelines and instructions was scanned in detail.

4 The Oman Diabetes Association website (http://omandiabetes.org/static/index.html) was searched using the on-site search engine. The section of the website labelled publications was scanned in detail.

5 The Kuwait Diabetes Society website (http://www.kds-kw.net/) was searched using the on-site search engine. The section of the website labelled news was searched in detail.

6 The International Diabetes Federation (2009) IDF (http://www.diabetesatlas.org/) was searched using the on-site search engine. The section of the website labelled Diabetes Atlas 4th ed. was searched in detail.

7 The World Health Organisation (2009) WHO (http://www.WHO.int/mediacentre/factsheets/fs312/en/) was searched using on-site search engine. The section of the website labelled Fact sheet N 312 Diabetes was searched in detail.

8 The UAE National Diabetes Committee (2009) (http:// api.ning.com) was searched using on-site search engine. The section of the website labelled National Diabetes Guidelines: United Arab Emirates 2009 was searched in detail.

Describing other searches included

- The reference lists of included studies in the review were scanned for relevant studies.

Dr. Mohsen S. Eledrisi from Saudi Arabia was contacted for further information.

Appendix 16: Study quality assessment- 'Quality of T2DM management in the GCC: a systematic review'.

Ref/dates of study	Quality assessment checklist (1)
Famuyiwa et al / 1988 -	1-Y, 2-Y, 3-Y, 4-N, 5-Unclear, 6-N, 7-NA
Al-Shammari et al / 1993 - 1994	1-N, 2-N, 3- Unclear, 4- N, 5-N, 6-Y, 7-NA
Khorsheed et al / 1998 - 2000	1-N, 2-Incomplete, 3- Y, 4- Not well described, 5- Unclear, 6-N, 7-NA
Akbar/ 1999 - 2001	1-Y, 2-Y, 3-Y, 4-Y, 5-N, 6-N, 7-NA
Al-Turki / 2000 - 2001	1-Y, 2-Unclear, 3- Y, 4-N, 5-Unclear, 6-N, 7- NA
Al-Ghamdi / 2002 - 2003	1-N, 2- Y, 3-Y, N, 4- Unclear, 5- N, 6- N, 7-NA
Al-Hussein / 2003-2004	1-Y, 2-incomplete, 3- Y, 4- Y, 5- Unclear, 6- N, 7-NA
Afandi et al / 2005	1-Y, 2-Y, 3-Y, 4- Unclear, 5- Unclear, 6- N, 7- NA
Qari / 2005	1-Y, 2-Y, 3- Y, 4- Y, 5- Partially, 6-N, 7-NA
Kharal et al / 2005- 2006	1-Y, 2-Y, 3-Y, 4-Y, 5-Y, 6-partially, 7-NA
Saadi et al/2005 - 2006	1-Y, 2-Y, 3-Y, 4-Y, 5-N, 6- Y, 7-NA
Al-Shaikh / Not reported	1-Y, 2-Partially , 3- Unclear, 4-Unclear, 5-N, 6- N, 7-NA
Al-Kaabi et al / 2006	1-Y, 2-Y, 3- Y, 4- Y, 5-Unclear, 6 –Partially, 7-NA
Al-Elq / 2006	1-Y, 2-Y, 3-Y, 4-Y, 5- Unclear, 6-Y, 7-NA
Eledrisi et al / Not reported	1-Y, 2-Y, 3-Y, 4- Y, 5-Unclear, 6-N, 7- NA
Sequeira et al / 2001	1-N, 2-Y, 3-Y, 4-Y, 5-N, 6-Partially, 7- NA
Al-Khaja et al/ 2001	1-Y, 2-Y, 3-Y, 4-Y, 5-N, 6-N, 7-NA
Al-Khaja et al/ Not reported	1-Y, 2-Y, 3-Y, 4-Y, 5-N, 6-N, 7-NA
Al-Shehri/ 2003 – 2004	1-Y, 2-Y, 3-Y, 4-Y, 5-N, 6-N, 7-NA
El-shafie et al / 2006 - 2007	1-Y, 2- Y, 3-Y, 4-Y, 5- N, 6- N, 7-NA
Akbar et al/ 2000 - 2001	1-Y, 2-Y, 3-Y, 4-Y, 5- N, 6-N, 7-NA
Reed et al 2001	1-Y, 2-Y, 3- Y, 4- Y, 5- Unclear, 6-Y, 7- NA
Andrews/ 1998 - 2000	1-Y, 2-N, 3- Unclear, 4-Y, 5-Unclear, 6-N, 7-NA
Udezue et al/ 1998-2002	1-Y, 2- Partially stated, not entirely appropriate , 3- not entirely appropriate, 4-Unclear, 5-N, 6- N, 7-NA
Al-Adsani et al/ 2001-2003	1-Y, 2, Unclear, 3-Unclear, 4-Y, 5-Unclear, 6-Y, 7-NA
Khattab et al/ 2002 - 2005	1-Y, 2-Y, 3-Y, 4-Y, 5-N, 6-N, 7-NA
Moharram et al/ 2006-2007	1-Y, 2-Y, 3-Y, 4-Y, 5-Y, 6-Y, 7-NA

Quality assessment checklist (1)

Was the aim of the study stated clearly?

Was the methodology stated? And was it appropriate?

Were appropriate methods used for data collection and analysis?

Was the data analysis sufficiently rigours?

Were preventive steps taken to minimize bias?

Were limitations of the study discussed?

In systematic review, was search strategy adequate and appropriate?

Appendix 17: Ethical approval for the quantitative and qualitative studies

UNITED ARAB EMIRATES
UNIVERSITY

جامعة الإمارات العربية المتحدة

Faculty of Medicine & Health Sciences

كلية الطب والعلوم الصحية

19 October, 2009

Prof. Azeem Majeed
Head of Department of Primary Care and Social Medicine
3rd floor, Reynolds Building, Charing Cross Campus
St Dunstan's Road. London W68RP
UK

Dear Dr. Majeed,

Re: Al Ain Medical District Human Research Ethics Committee - Protocol No. 09/50 – Quality of diabetes management in the UAE.

Thank you for submitting your application to the committee.

Your application was reviewed by the committee and found that it is an interesting and important study without any ethical concerns and I am pleased now to provide you ethical approval of your project.

May I reiterate, should there be any ethical concern arising from the study in due course the Committee should be informed.

Annual reports plus a terminal report are necessary and the Committee would appreciate receiving copies of abstracts and publications should they arise.

I wish to take this opportunity to wish you success with this very important study.

With kind regards,

Yours sincerely,

Dr. Fawaz C. Torab,
Chair, Al Ain Medical District Human Research Ethics Committee
/S[3]

هاتف: ٢٠٠٠ ٧٦٧ (٣ ٩٧١+) - فاكس: ٢٠٠١ ٧٦٧ (٣ ٩٧١+) - ص.ب: ١٧٦٦٦ - العين - الإمارات العربية المتحدة
Phone : (+971 3) 767 2000 - Fax: (+971 3) 767 2001, P.O.Box 17666, Al Ain, United Arab Emirates
www.fmhs.uaeu.ac.ae

Appendix 18: Data collection tool

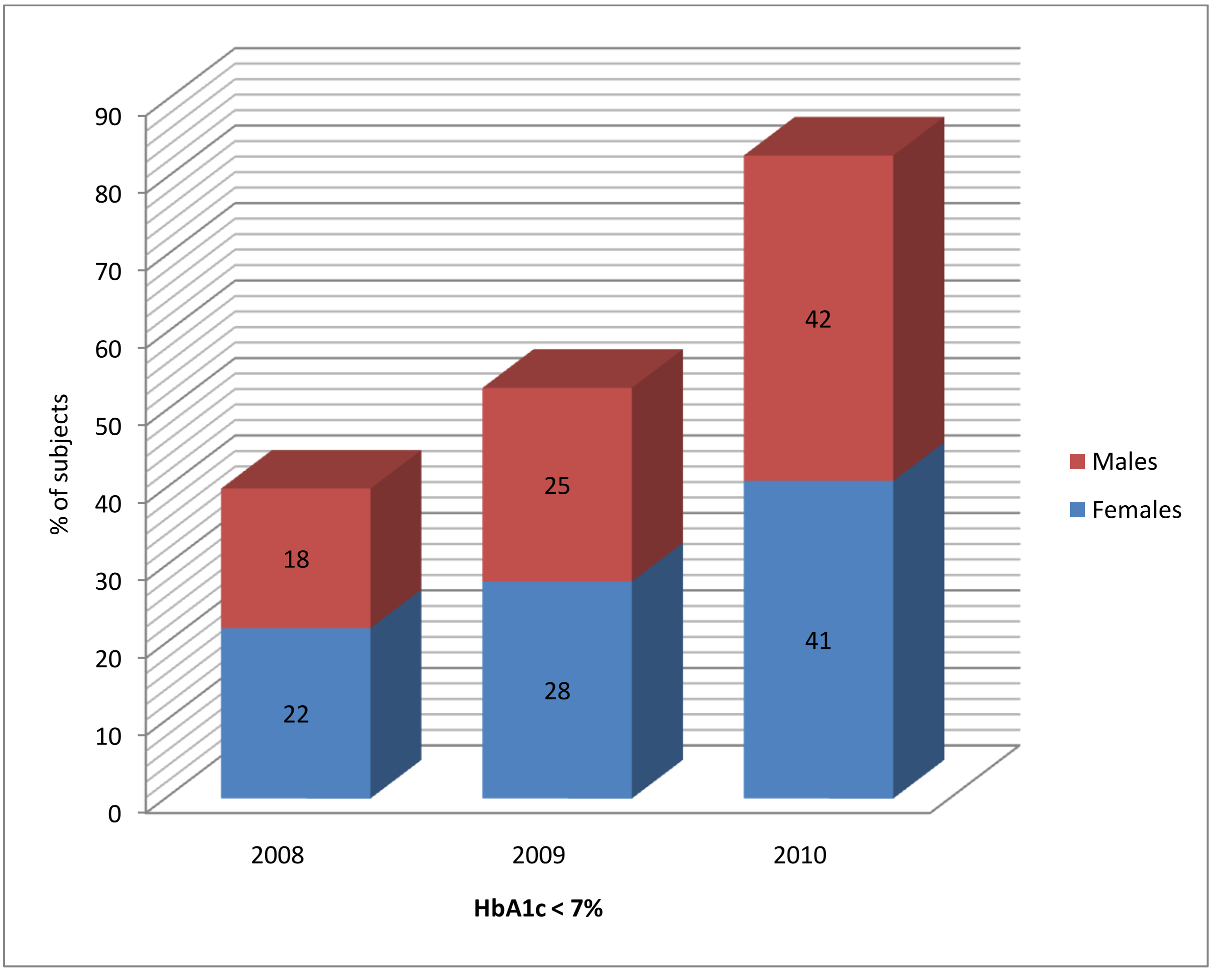
Age:		**Sex: F/M**		
Duration of T2DM:				
Smoking: Y/N		**Physical activity: Y/N**		

Criterion number	Criterion	2008	2009	2010
1	**Blood glucose management**			
	1.1 Has blood glucose been measured within the last year?	Y/ N	Y/ N	Y/ N
	1.2 If yes, how often was HbA1c levels measured?	• Once annually • Twice annually • More than twice annually	• Once annually • Twice annually • More than twice annually	• Once annually • Twice annually • More than twice annually
	1.3 What were the measurements for the HbA1c?	1- 2- 3-	1- 2- 3-	1- 2- 3-
	1.4 Has the person's blood glucose been controlled by lifestyle interventions?	Y/ N	Y/ N	Y/ N
	1.5 Is the patient receiving oral blood lowering therapy?	Y/ N	Y/ N	Y/ N
	1.6 Is the patient on insulin therapy?	Y/ N	Y/ N	Y/ N
2	**Blood pressure management**			
	2.1 Has the person's blood pressure been measured within the last year?	Y/ N	Y/ N	Y/ N
	2.2 If yes, how often was the blood pressure measured?	• Once annually • Twice annually • More than twice annually	• Once annually • Twice annually • More than twice annually	• Once annually • Twice annually • More than twice annually

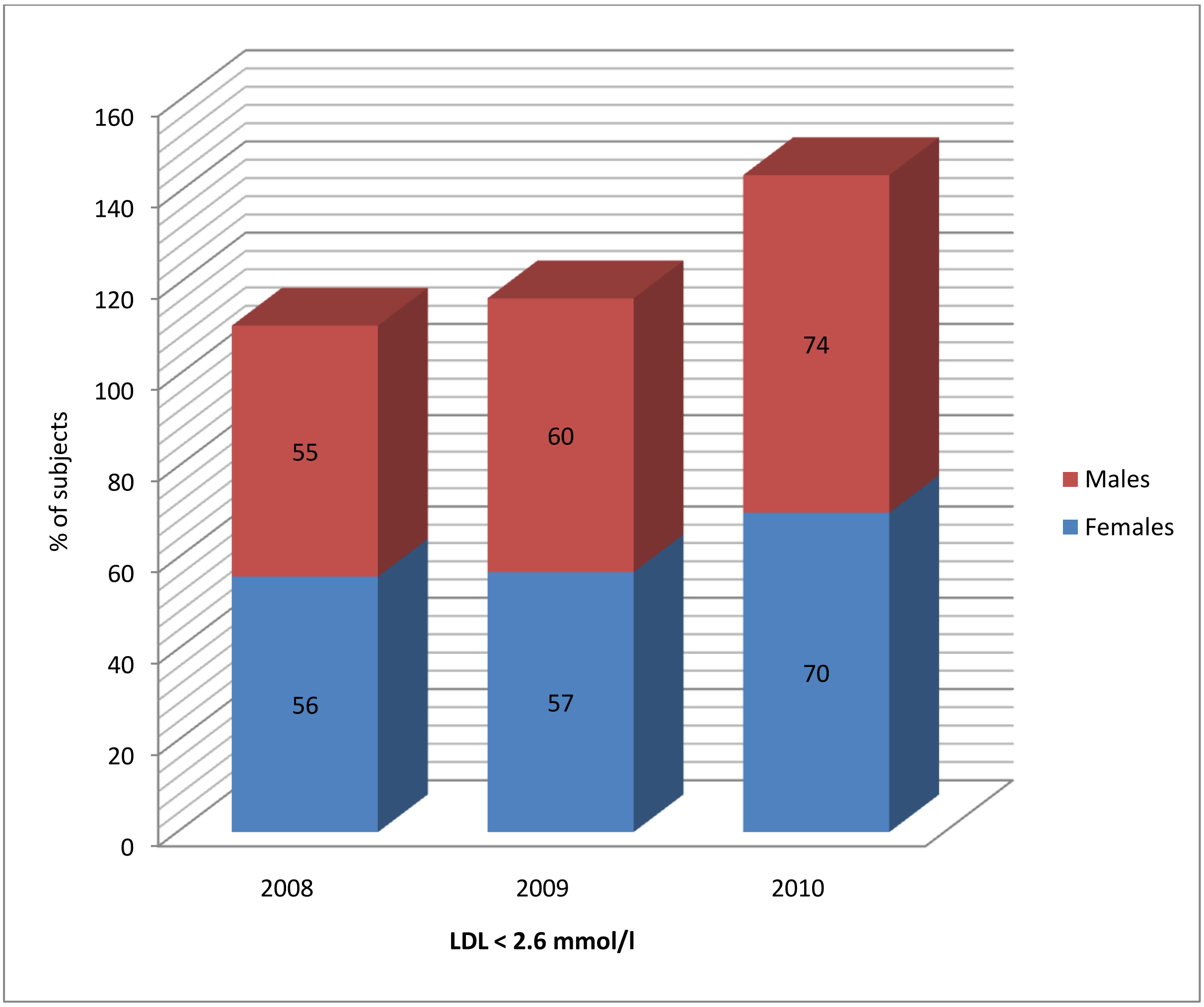
	2.3 What were the measurements for the blood pressure?	1- 2- 3-	1- 2- 3-	1- 2- 3-
	2.4 Is the patient taking any medications to regulate the blood pressure?	Y/N	Y/N	Y/N
	2.5 If yes, was blood pressure control and medication use reviewed?	Y/N	Y/N	Y/N
3	**Blood lipid management**			
	3.1 Has the person's blood lipid been measured within the last year?	Y/N	Y/N	Y/N
	3.2 If yes, how often was the blood lipid measured?	• Once annually • Twice annually • More than twice annually	• Once annually • Twice annually • More than twice annually	• Once annually • Twice annually • More than twice annually
	3.3 What were the measurements for the blood lipids?	1- 2- 3-	1- 2- 3-	1- 2- 3-
	3.4 Is the patient taking any medications to regulate the blood lipids?	Y/N	Y/N	Y/N
4	**Anti-thrombotic therapy**			
	4.1 Is the patient taking any thrombotic drugs?	Y/N	Y/N	Y/N
	Which anti-thrombotic drug the patient is been prescribed? • Aspirin • Plavix	 Y/N Y/N	 Y/N Y/N	 Y/N Y/N
5	**Co-morbidities**			
	5.1 Does the patient suffer from: • coronary heart			

	disease • hypertension • heart failure • atrial fibrillation • renal failure • peripheral vascular disease	Y/N Y/N Y/N Y/N Y/N Y/N		

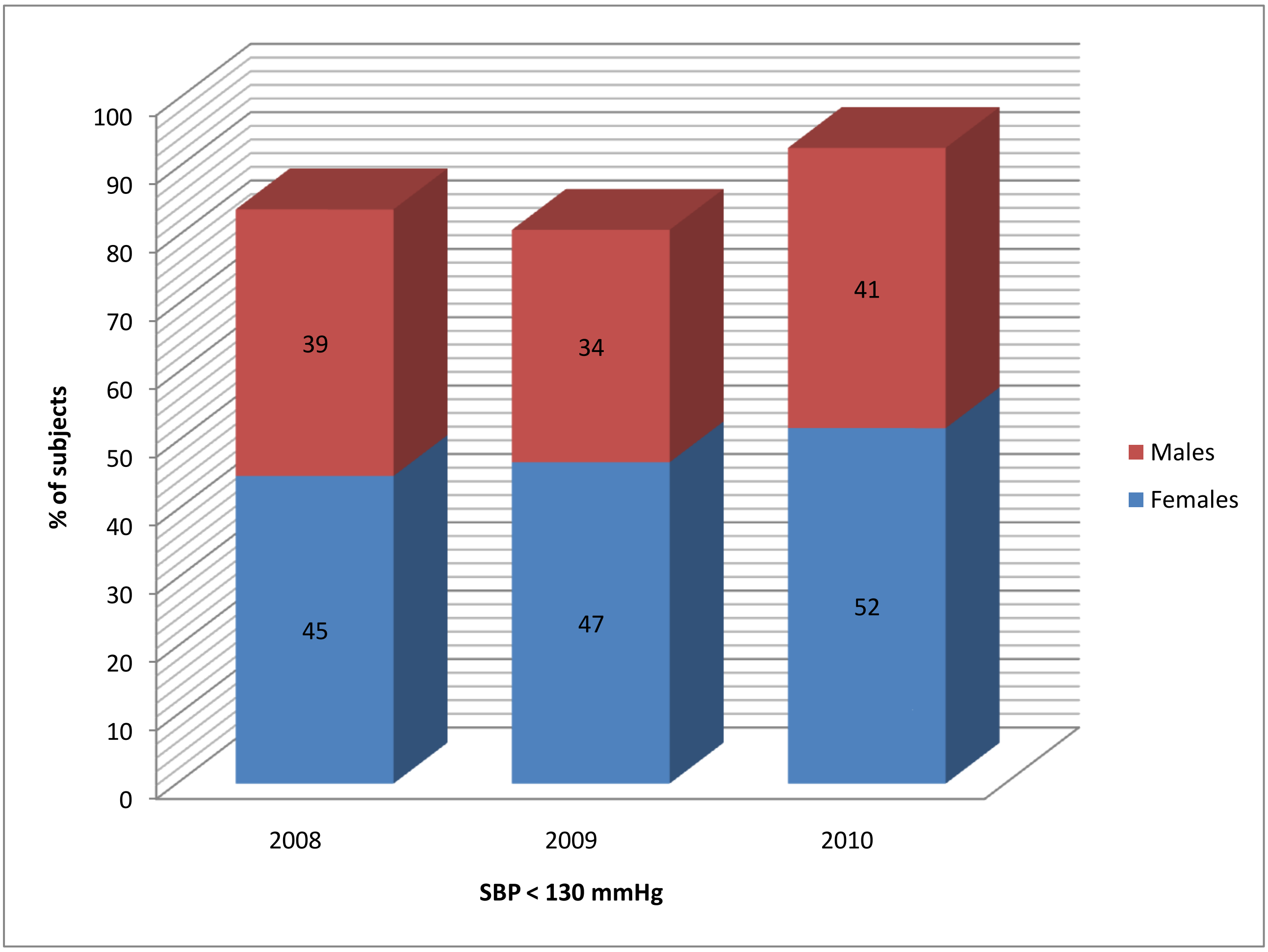
Appendix 19: Proportions of women and men reaching the HbA1c targets: 2008-2010



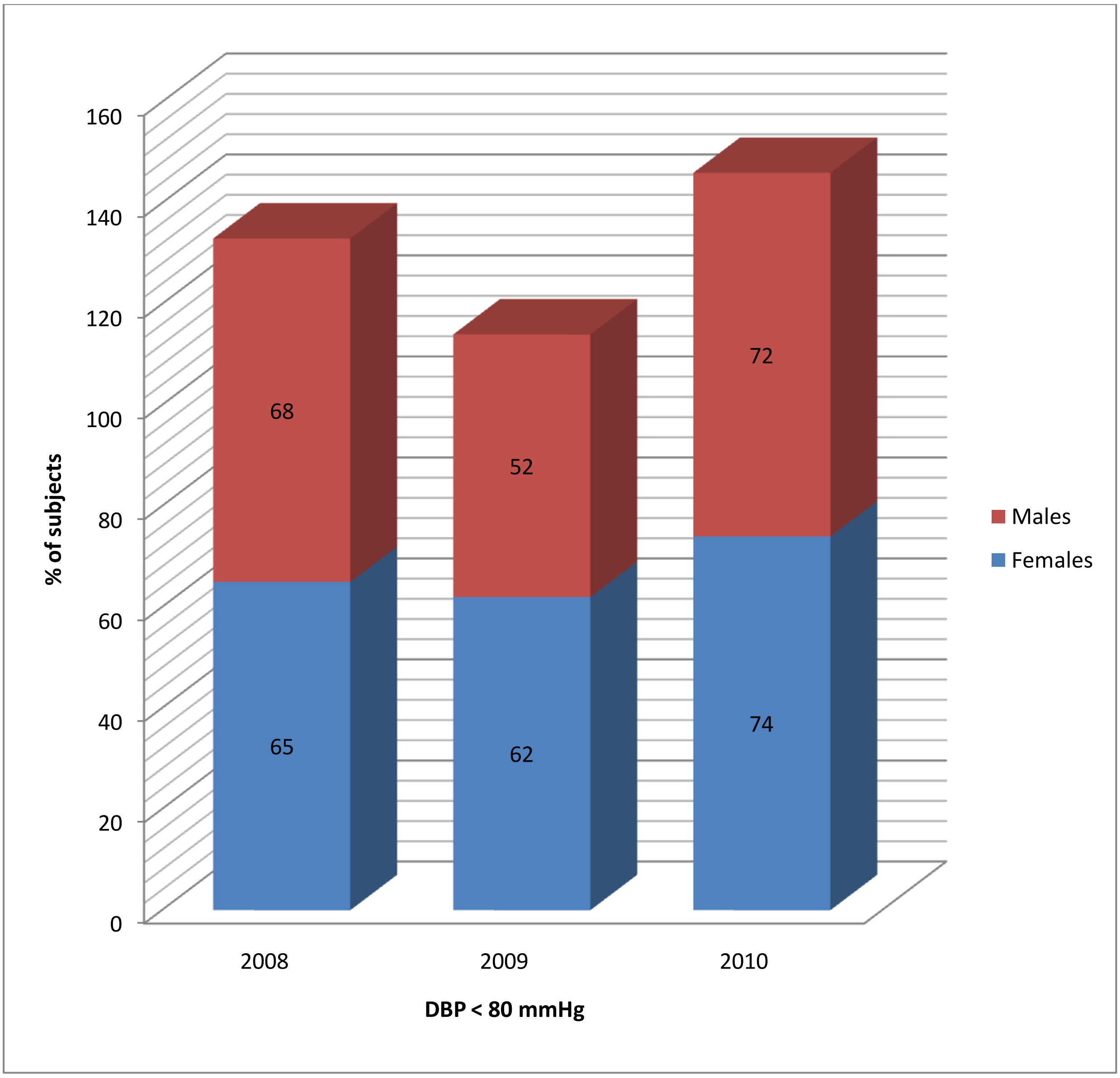
Appendix 20: Proportions of women and men reaching the LDL targets: 2008-2010



Appendix 21: Proportions of women and men reaching the SBP targets: 2008-2010



Appendix 22: Proportions of women and men reaching the DBP targets: 2008-2010



Appendix 23: Cover letter

Dear,

My name is Layla Alhyas. I am a PhD student in the department of and Public health at the Imperial College London and a clinical pharmacist from the UAE Ministry of Health. I am conducting a research study on the factors affecting the quality of type 2 diabetes care at the diabetes centre as part of the requirements of my degree, and I would like to invite you to participate. This study is sponsored by the UAE Ministry of Higher Education and Research.

I am aiming to provide key recommendations to improve the quality of type 2 diabetes management at Tawam Hospital. If you decide to participate you will be asked to meet with me for an interview about type 2 diabetes management at Tawam Hospital. The interview should last about 10 minutes.

Participation is confidential. Study information will be kept in a secure location at the university. Participation is anonymous.

Taking part in the study is your decision. We will be happy to answer any question you have about the study. You may contact me (email: l.alhyas08@imperial.ac.uk) or my supervisor (email: a.majeed@imperial.ac.uk)

Thank you for consideration. If you would like to participate please contact me on the provided email to discuss participating.

With kind regards,

Layla

Appendix 24: Interview guide

Research Topic: factors affecting the quality of type 2 diabetes management at Tawam hospital

Aim:

To identify the factors both facilitators and barriers affecting quality of type 2 diabetes management at the diabetes centre, Tawam hospital based on the perceptions and beliefs of health professionals with focus on factors related to health professionals.

Objectives:

- to identify barriers to improving the quality of diabetes care related to the health care providers' work practices
- to identify facilitators to improving the quality of diabetes care related to the health care providers' work practices
- to develop a frame of knowledge from the perceptions, understanding and experiences of the health care providers regarding the management of people with diabetes to improve quality of diabetes care

Research questions:

- What are the main factors affecting the quality of type 2 diabetes management at the diabetes centre at Tawam hospital?
- What are the main factors related to health care providers that affect the quality of type 2 diabetes management at the diabetes centre at Tawam hospital?
- What are the specific barriers to improving quality of type 2 diabetes care based on the beliefs of health care providers at the diabetes centre at Tawam hospital?
- What are the specific facilitators to improving quality of type 2 diabetes care based on the beliefs of health care providers at the diabetes centre at Tawam hospital?

- What are the suggestions of the health care professionals to improve the quality of care provided to people with diabetes at the diabetes centre at Tawam hospital?

1. Introduction

- Introduce the study, its aims and the researchers
- Brief discussion of ethical issues i.e. confidentiality, anonymity and recording

2. Warm up

- Name
- Job position
- What is your role in managing people with diabetes?
- How long have you been involved in your role?
- What is your view of the management of diabetes in Tawam hospitals' diabetes centre?

3. Factors affecting the quality of managing people with diabetes

We know that all over the world, the care of people with diabetes is variable. Many variables can influence the care provided to people with diabetes. Things that have been looked at in other countries are to do with the patient, the health professionals and the organisation of care.

For you as a care provider at the diabetes centre of Tawam hospital, can you name for me some of the things that you think affect the quality of care you provide to people with diabetes?

What are the things do you think help producing high quality of care to people with type 2 diabetes in the centre?

What are the things do you think prevent producing high quality of care to people with type 2 diabetes in the centre?

4. Motivation of health care providers

How would you describe care providers' motivation in managing people with diabetes?

What things do you think increase your motivation in managing people with diabetes in this centre?

What things do you think decrease your motivation in managing people with diabetes in this centre?

5. Training

Training diabetes care providers to improve the quality of care provided to people with diabetes is important.

How would you describe training diabetes care provider in managing people with diabetes?

PROMPT IF NOT MENTIONED
What about attending conferences?
What about attending academic courses?
What about taking part in workshops?
What about taking part in diabetes related activities?

What sorts of training for health care providers at the diabetes centre do you think is needed and can improve the quality of diabetes management?

PROMPT IF NOT MENTIONED

What about training in communication skills?

What about training in skills needed for behavioural changes?

Why do you think that providing these sorts of training could improve the quality of care provided to people with diabetes at the diabetes centre?

What do you think are the barriers that present at the diabetes centre for training?

What do you think are the facilitators that present at the diabetes centre for training?

6. Team work

The management of people with diabetes is complex and multi-dimensional; therefore working in a team to effectively manage people with diabetes is essential. In Tawam hospital diabetes centre, you wok in a team to manage people with diabetes.

How do you perceive working with others?

Who are involved in the diabetes team that you work in?

What things you find working with this team are rewarding?

What things you find working with this team are problematic?

Who other care providers do you think could be involved in the team?

If any, what are the barriers from involving them?

PROMPT IF NOT MENTIONED
What about lack of diabetes training?
What about lack of resources?
What about cost?

Why do you think their involvement will be useful?

7. Patient- care provider interaction

Effective interaction between care providers and patients is essential and can help achieving the treatment goals.

As a diabetes care provider at the diabetes centre what things do you think affect your interactions with people with diabetes?

What are the barrier you think from producing effective patient-provider interactions at the diabetes centre?

PROMPT IF NOT MENTIONED

What about:

- Language
- Cultural background
- Time with each patient
- Gender
- Age

8. Time with patients

Spending adequate time with patient is important for effective patient-provider interaction

Usually how long do you stay with each patient?

Do you think this time you spend with each patient is adequate?

From your experience at the diabetes centre, what are the things that affect the time you spend with patients?

What are the barriers as you think from spending adequate time with each patient?

9. Care providers preceptions and beliefs

Many care providers rate diabetes as harder to treat than other chronic conditions. What is your perception about this disorder?

What are the reasons behind that?

PROMPT IF NOT MENTIONED

What about:

- Lack of effective drugs
- Complexity of treatment
- Behavioural changes required by the patients
- Inevitability of future complications

Do you think this perception or beliefs affect the quality of care you provide to people with type 2 diabetes?

If yes, how do you think this perceptions or beliefs can affect the quality of care you provide to people with diabetes?

10. Other factors/ recommendations

What are other health care providers' factors in general that were not mentioned and you think they affect the quality of diabetes care at the diabetes centre at Tawam hospital? Do you have any specific recommendations to improve the quality of diabetes care at Tawam hospital?

11. Closing

- Before we finish, I would like to know if there is anything else you would like to say about the topic we have discussed.
- Thank you so much for participating. Your time is much appreciated

Annex 1: Publications and other achievements resulting from this work

Peer-reviewed journal articles

(1) Layla Alhyas, Ailsa McKay, Anjali Balasanthiran and Azeem Majeed. Prevalences of Overweight, obesity, hyperglycaemia, hypertension and dyslipidaemia in the Gulf: systematic review. JRSM short reports. 2011; 2 (7): 55.

(2) Layla Alhyas, Ailsa McKay, Anjali Balasanthiran and Azeem Majeed. Quality of type 2 diabetes management in the Gulf: systematic review. PLoS ONE 2011; 6 (8): 2186.

(3) Layla Alhyas and Ailsa Mckay. Socio-cultural aspects of diabetes care: myths about diabetes in Qassim region, Saudi Arabia. Annals of Alquds Medicine 2010; 6.

(4) Layla Alhyas, Ailsa McKay and Azeem Majeed. Prevalence of type 2 diabetes in the Gulf: systematic review. PLoS ONE. in press.

(5) Layla Alhyas, Chi Yutong and Azeem Majeed. The quality of type 2 diabetes care provided to Emirates patients in a diabetes centre located at a tertiary care setting in Al-Ain, United Arab Emirates: a retrospective cohort study. JRSM short reports. 2012. In press.

(6) Layla Alhyas, Jessica D. Jones, Dalia Dawoud and Azeem Majeed. Factors affecting the motivation of healthcare professionals providing care to Emirates with type 2 diabetes in diabetes centre at a tertiary care in Al-Ain, United Arab Emirates: A qualitative study. JRSM short reports. 2012. In press.

Reviews of Papers:

(1) "Increased length of inpatient stay and poor clinical coding in people with diabetes and with foot disease: a point prevalence study". JRSM short reports, 2011

(2) "Hypertension and type 2 diabetes: a cross sectional study in Morocco". Pan African Medical Journal, 2011.

(3) "Diabetes mellitus in genetically isolated population in Jordan: prevalence, awareness, glycemic control, and associated factors". Journal of diabetes and its complications.

(4) "Long-acting nifedipine for hypertensive patients in the Middle East and Morocco: Observations on efficacy and tolerability of monotherapy or combination therapy". Journal of Integrated Blood Pressure Control.

Professional training/ Workshops

- December/ 2011: Diabetes Epidemiology Training Course- International Diabetes Epidemiology Group, United Arab Emirates
- September /2011: World Health Organization- Health System Development course
- June-July /2010: University of London, London School of Hygiene and Tropical Medicine**-** Intensive Course in Epidemiology and Medical Statistics
- September/ 2011: University of London, London School of Hygiene and Tropical -Advanced Course in Epidemiological Analysis
- November/2010: Social Research Association**-**Designing a Qualitative Study
- November/2010: Social Research Association- **In**-Depth interviewing

Other professional activities:

- 2012: Non-communicable diseases in the low and middle income countries symposium. Imperial college London. Poster presentation "The quality of type 2 diabetes care provided to Emirates patients in a diabetes centre located at a tertiary care setting in Al-Ain, United Arab Emirates: a retrospective cohort study".

- 2011: 12th symposium of International Diabetes Epidemiology Group. Oral presentation "Risk factors for type 2 diabetes in the Gulf: Systematic review2 Sharjah, United Arab Emirates.
- 2011: International Diabetes Federation. Dubai Congress. Poster presentation "Quality of type 2 diabetes management in the Gulf: systemic review". Dubai, United Arab Emirates
- 2011: The society for Academic Primary Care, Annual Scientific Meeting Oral

Presentation “Risk factors for type 2 diabetes in the Gulf: Systematic review”. Cambridge University, UK

- 2010: Imperial College London, department of Primary care and Social Medicine. Oral Presentation “Prevalence of type 2 diabetes in the Gulf: a systematic review”. Imperial College London, UK
- 2010: The Society for Academic Primary Care, Annual Scientific Meeting. Poster Presentation “Quality of type 2 diabetes management in the Gulf: Systematic review” Oxford University, UK
- 2010: Imperial College London, Student Research Symposium. Oral Presentation “Quality of type 2 diabetes management in the Gulf: a systematic review”. Imperial College London, UK.