Background: The prevalence of type 2 diabetes is increasing worldwide, but developing nations will bear a disproportionate share of this burden. Countries in the Middle East and Africa are in a state of transition, where marked disparities of income and access to education and healthcare exist, and where the relatively young populations are being exposed increasingly to processes of urbanisation and adverse changes in diet that are fuelling the diabetes epidemic. Optimising diabetes care in these nations is crucial, to minimise the future burden of complications of diabetes. Methods: We have reviewed the barriers to effective diabetes care with special relevance to countries in this region. Results: The effects of antidiabetic treatments themselves are unlikely to differ importantly in the region compared with elsewhere, but economic inequalities within countries restrict access to newer treatments, in particular. Values relating to family life and religion are important modifiers of the physician–patient interaction. Also, a lack of understanding of diabetes and its treatments by both physicians and patients requires more and better diabetes education, delivered by suitably qualified health educators. Finally, sub-optimal processes for delivery of care have contributed to a lack of proper provision of testing and follow-up of patients in many countries. Conclusion: Important barriers to the delivery of optimal diabetes care exist in the Middle East and Africa.

Introduction
Appropriate management of diabetes, with regular review and adjustment of therapy, is important for the prevention of long-term diabetic complications (1,2). This represents a particular challenge for developing nations, including the Middle East and Africa, which are experiencing higher rates of increase in the prevalence of diabetes than developed countries (3,4). Type 2 diabetes, which accounts for some nine-tenths of all diabetes cases, is a powerful risk factor for cardiovascular disease: unsurprisingly, therefore, the prevalence of cardiovascular risk factors, and of established coronary heart disease, is especially high among countries in the region (5). There is a need for effective interventions to combat these adverse trends. However, developing countries have unique needs and problems that may hinder the adoption of international management guidelines, and not all countries have an authoritative local guideline on which to base their clinical practice.

There are potentially many barriers to the delivery of effective diabetes care, and these may be influenced strongly by regional and cultural factors. The purpose of this review is to consider the barriers to care that are of special relevance to developing countries, such as those in the Middle-East and Africa.

Methods
A PubMed search was conducted to identify publications, using the terms ‘diabetes’, ‘barriers’, ‘compliance’ or ‘adherence’, together with the names of Middle-Eastern or African countries. Additional papers were from reference lists and authors’ reference collections and experience.

Suboptimal glycaemic control and adherence to antidiabetic therapy in Africa and the Middle East
Substantial proportions of people with diabetes in the Middle East and Africa do not maintain adequate
control of glycaemia and the rate of diabetic complications is high (Table 1) (3,6–11). Nevertheless, there is ample evidence that improving protocols for the measurement and management of hyperglycaemia delivers significant benefits in terms of improved blood glucose control (12). In many countries, particularly in Africa, diabetes care must compete for attention and resources with the management of infectious disease. These countries are currently in a state of transition, where non-communicable diseases such as diabetes are expected to add increasingly to the triple scourges of poverty and malnutrition, HIV and tuberculosis (13). The increasing burden of diabetes and its complications will be driven by urbanisation, with a nutritional transition to western, energy-rich diets and increasingly sedentary lifestyles, and by increasing lifespan, as a result of wider access to antiretroviral therapy for HIV (14,15).

Poor therapeutic adherence is also a widespread and important problem in type 2 diabetes (16). Improved adherence improves glycaemia (17,18), reduces the risk of mortality, hospitalisation or cardiovascular events (19,20), and reduces healthcare costs (18). The reasons for non-adherence are many and include side-effects of treatments, complexity of regimens and lack of understanding by patients of the potential prognostic implications of not taking their treatments as directed (21). The approach of individual physicians also influences adherence (22,23). In the developing countries considered here, poor adherence is compounded further by such additional factors as remote and often inaccessible rural locations, illiteracy and poverty/lack of reimbursement of treatment costs (24,25). Recent data indicated that only about half of rural Egyptian patients complied with dietary advice and only one-fifth of insulin-treated patients tested their blood glucose often enough (26). Elsewhere in rural Egypt, only 2% complied ‘always’ with a dietary regimen, while no patient complied with advice on exercise (23). In extreme cases, violent conflict may underlie poor delivery of healthcare, as in Iraq in recent years (27).

Reports of interventions to improve adherence with treatment in Middle eastern/African countries are scarce, although follow-up of patients by telephone or text messaging in Iran was shown to be improve adherence (28). Improving patients’ understanding of their condition facilitates improving their adherence to treatment, and a prospective evaluation of health education in patients with type 2 diabetes or other chronic diseases yielded significant improvements in health-related behaviours in an Arab population (29).

The following sections examine key factors that may limit adherence to therapy in the region.

**Antidiabetic treatments**

In general, the effects of individual treatments in patients from the region appear not to differ from their effects in other populations, although there is a lack of clinical trial data in patients from African or Middle Eastern countries (4). Thus, the same constraints relating to antidiabetic therapy are relevant to Middle Eastern/African patients as for patients in other regions: treatments cause treatment-limiting side-effects for some patients, become ineffective over time and require intensification, and polypharmacy is often necessary for multiple comorbidities (4).

The use of complementary or alternative medicine is common in Africa and the Middle East: for example, a survey in Saudi Arabia found that one-third of patients with type 2 diabetes were using alternative therapies (30). High proportions of patients in other Middle Eastern countries also used complementary

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### Table 1 Overview of sub-optimal glycaemic control and/or high rates of complications of diabetes in Middle Eastern and African countries

| Ref | Country | Key finding |
|-----|---------|-------------|
| (6) | Saudi Arabia | The Diabetes Management Practices Study found that 27% of patients attending a primary care clinic achieved HbA1c < 7%, despite 42% of patients being considered to be well-controlled by their physicians |
| (7) | Alexandria, Egypt | Sixty-nine percent of patients attending a clinic in demonstrated at least one diabetic complication |
| (8) | Cairo district, Egypt | Mean HbA1c was 9.0%; 42% had retinopathy, 21% had albuminuria and 22% had neuropathy |
| (9) | Lebanon | 47% had nephropathy and 60% had neuropathy |
| (10) | UAE | 29% (age-standardised) had diabetes; 54% had retinopathy; 35% had neuropathy; 41% had nephropathy; 11% had peripheral vascular disease; 11% had coronary heart disease |
| (11) | Rural South Africa | About 84% of patients with diabetes had HbA1c levels at least 2% above the normal range, and mean HbA1c was 11.3%; severe obesity was present in 37% and complications were common (40% had retinopathy and 46% had microalbuminuria) |
remedies for their diabetes, often to the exclusion of other treatments, and often without informing their physician (31). Some patients in South Africa feared that their diabetes medications would cause addiction (25). Use of traditional herbal remedies was identified as a significant barrier to the successful initiation of insulin in the primary care setting in South Africa (32). Self-treatment without recourse to a physician was admitted by half of a population of 398 Iranian diabetic patients, especially where cardiovascular comorbidities were present, and was associated again in some cases with use of herbal remedies (33).

**Economic factors**

Broad disparities in income exist between and within countries in the Middle East and Africa, and patients in Tunisia commonly cited financial issues as an important barrier to effective diabetes care (34). Data from the World Health Organisation clearly demonstrate the disparities in healthcare spending between countries in the WHO regions covering Africa or the Middle-East, compared with more developed regions (Figure 1) (35). Figures from the International Diabetes Federation confirm that these disparities apply to diabetes: the USA spent more than $8000 per year on each patient with diabetes in 2011, compared with less than $20 per person with diabetes in the poorest countries (3). Access to healthcare is often limited in developing countries: Figure 2 shows that the numbers of healthcare professionals (especially nurses) available in selected countries from the Middle East and Africa is lower than in developed nations (35). Dialysis and transplantation for end-stage renal disease, a common long-term complication of type 2 diabetes, are beyond the financial reach of most Egyptians, highlighting the importance of prevention of diabetic complications in this setting (36). A study from Jordan published in 2011 evaluated the effect of food insecurity on metabolic parameters in an area of northern Jordan, using a validated instrument (the U.S. food security survey module) (37). Only 22% of the study population of 843 type 2 diabetes patients were rated as ‘food secure’, and higher levels of food insecurity were significantly associated with higher BMI and HbA1c. Rapid economic development of oil states, in particular, is increasing the availability of fast food for urbanised populations (38).

Access to expensive, branded formulations will inevitably be limited in countries where there are large populations living in or near poverty, and where reimbursement for healthcare coverage is sparse (at the time of writing, such products include all DPP4 inhibitors, GLP-1 mimetics and analogue insulins). This reality was acknowledged by the ‘levels of care’ approach of guidelines for the management of diabetes proposed by the International Diabetes Federation, which included practical suggestions for countries with limited healthcare resources (1).

**Demographic, social and cultural factors**

**Gender**

In Saudi Arabia, female gender significantly predicted poorer blood glucose control and greater adiposity, apparently due in part to receipt of fewer sessions of health education (39). Another study from Saudi

![Figure 1](image1.png)

*Figure 1* Healthcare expenditure in regions of the World Health Organisation. Data are for 2006. The Eastern Mediterranean region encompasses Middle-Eastern countries, North African Arab states, plus Somalia; the African region covers all other African countries not included in the above. GDP, gross domestic product. Drawn from data presented by the World Health Organisation (35)
Arabia suggested different mechanisms of elevated cardiovascular risk between men and women: in women, elevated IL-6 and C-reactive protein predicted insulin resistance and hypertension, respectively, while these relationships did not hold for men (40). Health-related quality of life was lower in female vs. male type 2 diabetes patients in Iran (41). Saudi women were less active than men, and had lower knowledge related to disease, compared with men (42). A survey of 75 women in the UAE found that competing demands for their time, a lack of culturally appropriate facilities and sociocultural values that restricted the range of outdoor activities available to them were cited as being important barriers to increasing their physical activity. There may be disparities in provision of care between the genders, as male patients were more likely to be admitted to an Egyptian hospital for type 2 diabetes (43,44) and Egyptian women have been shown to be at greater risk of diabetic complications than their male counterparts (45). Conversely, in Tunisia, women were more likely than men to see their primary care physician for matters related to their diabetes (46). This was ascribed to (for men compared with women) busy lifestyles, lower regard for their health, greater ability to pay for private health coverage and perception of the primary care health centre as a ‘female domain’. Women had a higher burden of morbidity (although this was often seen as of less clinical importance compared with illnesses of men), and women who usually spent most of their time in the home tended to maximise the opportunity for social interaction before and after the clinic visit. Important differences in the process of care were noted (see also below), where less detailed medical notes were retained for women vs. men, and gaps between appointments were longer for women than men (even though the men were less likely to keep them). Men were threefold more likely to receive secondary prevention with antiplatelet agents in a study in Jordan in 2007 (47). Female gender was a significant predictor of sub-optimal rates of attendance for healthcare appointments and treatments in Saudi Arabia (48), and female patients in Iran were more likely to treat themselves without consulting a physician (33).

Complex relationships between gender and health perceptions emerged from a survey of black adolescent girls in South Africa. While the links between obesity and conditions such as hypertension were understood, this was outweighed in most cases by an association of thinness with serious disease, such as HIV or tuberculosis (49). Moreover, overweight was identified with appearing ‘respectable’, and was seen as an advantage for taking part in sporting activity in this context.

Impact of family structures on diet and exercise habits
Diets tend to be energy-rich in the Middle East, with a high intake of sugary foods such as dates and four-fifths of 212 people with diabetes and/or hypertension surveyed in Kuwait stated that the typical local diet inhibited their following the diet suggested by their physician (50). Within this population, following a diet different to that of the rest of the family (in the setting of a large, extended family who attend or host frequent social gatherings) was a particular difficulty for about one-third of the population. The employment of domestic assistants was cited as a...
reason for reduced physical activity by about half of the population. In Arab families, senior family members often expect younger family members to fetch and carry for them thus adding to their sedentary-ness; nevertheless, increasingly sedentary habits among Arab adolescents have been identified as a major future public health issue (51). Conversely, support from family members, especially daughters, has also been shown to be especially important to improving the confidence of patients from a Middle-Eastern country to manage their diabetes (52).

**Tobacco and khat use**

Rates of smoking have increased in countries in North Africa and the Middle East in recent decades, in contrast with western countries, where smoking rates have decreased [reviewed elsewhere (3)]. Chewing khat (or qat), an amphetamine-like stimulant derived from a green plant (*Catha edulis*) native to Africa and the Middle east is also prevalent in the region (53), including among physicians (54), and has been associated with adverse cardiovascular outcomes (55).

**Religious belief**

Religious belief may also impact strongly on healthcare practices. In a study in Iran, religious faith emerged as an important facilitator of improved diabetes care, through such concepts as regarding the onset of diabetes as God’s will, and the body as a gift from God to be cared for (52). A team in Jordan were careful to avoid conflict between international guidelines and cultural mores and religious sensitivities in producing educational materials in Arabic: specifically, material on smoking cessation focussed on the effects of smoking on general health and avoided shortening of life expectancy, as the Quran states that life expectancy is determined by Allah (56). Physicians and patients regarded these materials as helpful and contributing positively to the quality of diabetes care (and of other diseases). Clearly religious belief is often an important determinant of the doctor-patient relationship, and should be considered where appropriate.

Fasting for Ramadan is also a challenge for Muslim people with diabetes, with a risk of deteriorating glycaemic control, and/or hypoglycaemia (57). Strategies to reduce the impact of the Ramadan fast on metabolic control in people with diabetes have been reviewed recently (58).

**Education**

Education may be crucial in improving diabetes care; patients’ knowledge and understanding of fundamental principles of diabetes care vary greatly and misconceptions are prevalent, as shown in a study in Saudi Arabia (Figure 3) (59). Low levels of understanding of diabetes and its complications were found to be associated with diabetic foot disease in a prospective study in Morocco, and lack of knowledge was associated in turn with increasing age, lower educational attainment and low socioeconomic status (60). A diagnosis of diabetes may provoke feelings of shame or embarrassment in the Arab culture (52).

Educational initiatives for patients in the region have proved successful in improving glycaemic control in patients with diabetes, including when these are delivered by members of the healthcare team other than physicians, such as pharmacists (61). Educating patients on the benefits of lifestyle improvements has been shown to improve diet, smoking rates and physical activity in Saudi Arabia (29). Emphasis on seeking to improve patients’ quality of life may be an important way to improve therapeutic adherence (62). Achieving improved knowledge of diabetes is central to improving adherence (see above); for example, a recent study in an Iranian population showed that understanding the chronic nature of diabetes improved adherence (63).

Education of healthcare professionals is also needed. A study in South Africa found a lack of systematic incorporation of diabetes management guidelines in local practice (64). Common reasons for this included scepticism on the part of physicians, disparity between guidelines and existing local practice, and unwillingness to challenge healthcare beliefs of patients (see above). Another study found the relationship between a South African diabetes clinic and its disadvantaged patients to be authoritarian in nature: if the patient failed to collect prescriptions, future prescriptions would be denied (25). Education, access to an internal medicine physician, contact with other patients and information from the media were identified as important sources of information for patients with advanced diabetic eye disease in a cross-sectional study in Egypt conducted between 2008 and 2010; nevertheless, 60% of this population were unaware that diabetes placed their sight at risk until vision-threatening retinopathy had already developed (65). A further study from Egypt found that no interactions between physician and patient could be rated as ‘satisfactory’ (23).

The extent to which a patient is, or is not, confident about their ability to manage their diabetes is an important issue that should be considered individually, with regard to diabetes education. A high ‘locus of control’ (the tendency to exert control over the environment including health issues) is an important contributor to good therapeutic adherence in Iran (66). Similarly, high ‘self-efficacy’ (ability and motivation to carry out key activities important for self-care) made a positive contribution to such
important activities as taking treatment regularly, maintaining blood glucose testing, avoiding periods of excessive food intake and adjusting the diet to manage hypoglycaemia (67).

Overall, successful diabetes education also depends on the presence of a range of supporting factors which typically rely on input from the government, the private sector and the community. An audit of diabetes education in a Saudi primary care clinic, at which 27% of patients received no health education at all, found that these basic structures were not in place to permit effective delivery of education (68). A high priority is increasing the number of diabetes educators (physicians and/or nurses or other healthcare professionals) to counter the lack of knowledge on either side of the health consultation.

**Availability and process of care**

Sub-optimal processes for conducting and recording treatment are commonly associated with poor prognosis of diabetic patients in the Middle East and Africa. Systems and processes for the delivery of

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Figure 3 Health misconceptions among Saudi type 2 diabetes patients. (A) Commonly-held misconceptions relating to diabetes. Misconceptions have been paraphrased for brevity. AD, antidiabetic drugs. (B) Misconception scores relating to gender and age. The misconception score was calculated from the numbers of patients answering ‘yes’ to each health belief (high score was defined as > 30%, based on the median score). Misconception scores did not vary significantly according to educational status or Saudi/non-Saudi origin and these data are not shown here. Drawn from data presented by Al-Saeedi et al. (59)
diabetes care are highly variable between countries. An absence of effective process and recall systems was documented in an Egyptian clinic as recently as 2008 (7). A major centre in the UAE achieved near-universal measurement of HbA1c, blood pressure and lipids (2004–2005); even here, however, recommendations on diet and exercise or smoking, or evidence of a foot examination, were recorded for less than half of patients (areas identified for future improvement by the centre itself) (69).

The presence of specialist diabetes clinics in primary care has been a common feature of western healthcare systems for some time, but is a relatively new phenomenon in a number of countries in the region. The introduction of multifactorial, guideline-driven diabetes care, with intensive education of physicians and nurses, in three primary care clinics in the UAE in 2001 improved adherence to guidelines and satisfaction of patients with their treatment, and there was a trend towards improved control of glycaemia, lipids and blood pressure, relative to control clinics without the intervention (12). While the improvements in cardiometabolic parameters were relatively modest (just failing to achieve statistical significance), the improved guideline-driven control identifies this approach as a promising way forward for Middle-Eastern clinics, as elsewhere. Experience in Saudi Arabia, where the introduction of diabetes care driven by evidence-based flow charts improved HbA1c, BMI, lipids, and indices of diabetic eye, renal and nerve damage, supports this view (70).

A gap between guideline-driven and actual diabetes care practices contributed to poor rates of adequate glycaemic control in Saudi Arabia (6). An initiative to introduce Arabic educational materials in Jordan found that resistance from some physicians was based on an authoritarian model of interaction with patients (with fear of ceding authority or control to patients), and an inaccurate perception that patients would be uninterested in written materials (56).

Conclusions

The prevalence of type 2 diabetes is increasing rapidly in the Middle-east or Africa and the prevalence of cardiovascular disease is already high, and the young populations of these countries, relative to western nations, are increasingly sedentary and obese. While the underlying pathophysiology of type 2 diabetes, and the effects of antidiabetic treatments, are broadly similar among people with type 2 diabetes, distinct aspects of the cultural, demographic and economic environment in this region impact on the overall process of diabetes care in ways that are different from other regions. Recognising these issues will be important in designing more effective strategies for the management of diabetes and preventing the onset of diabetic complications. For example, designing materials to work with cultural and religious belief may improve communication between physicians and patients, and the importance of overcoming barriers to improved lifestyles cannot be overstated. Increasing knowledge of the nature of diabetes and its treatment among patients and physicians, with associated improvements in the delivery of care, would make a major contribution to reducing the burden of morbidity and mortality from diabetes in these countries.

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Author contributions

All authors contributed to the development of this review and provided critical review of its contents.

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