Diabetes Risk, Prevalence and Care

in a Michigan Arab American Community

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Executive Summary

Non-White populations tend to have higher rates of diabetes. However, it is difficult to say if this is true for Arab Americans because they are not routinely tracked as a distinct ethnic category in surveillance of diabetes prevalence. A community survey was conducted to determine the self-reported diabetes prevalence in the Arab American community was similar to the estimate given by a routine statewide surveillance method. Also, measures of diabetes care practices are compared between the Arab American community and the White, non-Arab population in the same Southeast Michigan area.

The questionnaire was administered as a home interview to adults in Southeast Michigan who self-identified as Arab American. The diabetes risk and preventive care questions were crafted to mirror questions in the Michigan Behavior Risk Factor Surveillance System (MiBRFSS) for comparability of estimates during analysis.

Access to Care and Risk Factors: Arab Americans were uninsured three times more often than White, non-Arabs and had lower rates of accessing health care. Standard questions to measure risk factors for diabetes, such as weight and nutrition, seem to be not as well understood in the Arab American community and may indicate a need for culturally adapted questions in this area. High use of tobacco in the Arab American community may present a greater risk for developing diabetes.

Diabetes Prevalence: Starting in 2007, the MiBRFSS began asking Arab ancestry. However, this statewide surveillance method underestimates the self-reported diabetes prevalence in the Arab American population. Routine surveillance methods, like the MiBRFSS, may require specific oversampling design to accurately track health indicators for Arab Americans.

Diabetes Care and Co-morbidities: Self-care and clinical care recommended for people with diabetes appear to be significantly lower in the Arab American population. This was difficult to accurately measure due the high proportion of Arab Americans who answered “Don’t Know” to the care questions, so it is unknown if people were receiving appropriate care but were not aware of care they were receiving. The low reported rate of diabetes education highlights the need for ongoing education for this population. Arab Americans with diabetes were more likely to have co-morbidities – such as high blood pressure, high cholesterol, and heart problems – than White, non-Arabs.

The following recommendations are made to the Michigan Department of Community Health, Diabetes Prevention and Control Program (DPCP) for the purpose of providing guidance in prioritizing future resources and programs to Michigan’s Arab American community:

1. Increase regular diabetes screening efforts targeting Arab Americans to increase the likelihood of diagnosing adults with diabetes as early in the course of disease as possible.
2. Promote diabetes prevention in the Arab American community with culturally appropriate activities and materials.
3. Promote culturally appropriate diabetes self-management education (DSME) in the Arab American community.

Erratum

In the first printing of this report, it was stated that 58.1% of Arab Americans exercised five or more days a week. This was incorrect. The true value is now correctly stated in the table as 9.5% (Table 2, page 6). The accompanying text (page 7) was also altered slightly to reflect this correction.

Introduction

The prevalence of diabetes is highest in non-White populations, as evidenced in national surveillance data.[1] While national surveillance is able to track and compare many racial and ethnic differences for diabetes, Arab Americans are not routinely tracked as part of these efforts. Surveys using federal data standards for race and ethnicity classify people of Arabic/Middle Eastern descent under the White race category.[2] Several independent research studies have been conducted to fill this gap in understanding of ethnic differences. These studies have occurred predominantly in Southeast Michigan – home to the largest concentration of Arab Americans in the United States.[3]

In 2009, the Michigan Diabetes Prevention and Control Program and the Michigan Tobacco Control Program partnered with the Arab Community Center for Economic and Social Services (ACCESS) and the Arab American Chaldean Council (ACC) to conduct a community health survey. The overall goal was to collect data regarding key health concerns in Michigan's Arab American community: tobacco use, secondhand smoke and diabetes. The objectives for the diabetes section of this survey were to:

1) Compare diabetes prevalence estimates from this study to prevalence estimates generated for the Arab American community from a routine statewide surveillance method; and
2) Measure diabetes preventive care practices in the Arab American community and compare this to care measures for a White, non-Arab population in the same geographic area.

Methods

It is estimated that 80% of Michigan's Arab American community resides in the three metro-Detroit counties of Macomb, Oakland and Wayne.[3] Arab Americans share an ancestry from a Middle Eastern or North African nation whose primary language is Arabic. Since Arab is a cultural identity and not a religious one, this also includes Chaldean Americans – or Catholic Arabs from Iraq – although they have a strong identity of their own and have sometimes been reported as distinct groups in previous Arab American health studies. This study treats Chaldean Americans as part of the Arab American identity in the analysis.

Ten cities in Southeast Michigan known to have high concentrations of Arab American residents were targeted for the ACCESS/ACC survey: Dearborn, Dearborn Heights, Detroit, Hamtramck, Oak Park, Southfield, Sterling Heights, Troy, Warren, and West Bloomfield. However, respondents were also recruited from the greater tri-county area (Macomb, Oakland and Wayne). Eligible survey respondents had to self-identify as Arab American, be 18 years or older, reside in the metro-Detroit area, and be physically/mentally capable of answering the questions.

The survey questionnaire was developed by Michigan Tobacco Control Program and Michigan Diabetes Prevention and Control Program staff, and included questions on access to health care, disease risk factors, diabetes preventive care, tobacco/hookah usage, and secondhand smoke. The diabetes risk and preventive care questions were crafted to mirror questions in the Michigan

Behavior Risk Factor Surveillance System (MiBRFSS) for comparability of estimates during the analysis stage. The questionnaire was translated into Arabic and pilot tested before data collection began. Staff at ACCESS and ACC were trained to administer these questionnaires as culturally sensitive interviews in either Arabic or English. Participants were recruited by visiting homes and through other community venues, such as mosques, churches, and other community centers.

A total of 2,025 individuals completed the survey. Roughly half of the survey interviews were completed by ACCESS staff and half by ACC staff. A high number of respondents were born outside the U.S. (83%) and nearly half of them (42%) have lived in the U.S. for 10 years or less. The majority of respondents self-identified as being Lebanese (36%), Iraqi (35%), or Yemeni (17%). Roughly 10% of survey respondents answered an Arabic-translated survey. Twenty-six percent of respondents were high school graduates or equivalent, 24% completed 2-year college or technical training, and 21% completed a 4-year college degree or higher. An estimated 24% of respondent households were at or below the 2009 federal poverty guidelines.

Sample weighting of the ACCESS/ACC survey data was accomplished by treating each targeted city as a stratum in the sampling design. Respondents who did not reside in a targeted city were assigned the mean weight for all targeted cities. Post-stratification weighting was used to adjust for both sex and age using the specific sex/age distribution for people Michigan residents reporting Arab ancestry within the United States Census.[4]

Comparisons are made between the Arab American respondents in this survey and White, non-Arabs in the same geographic area from the MiBRFSS to highlight the differences between the two populations that are grouped together under the same "White" race category. The MiBRFSS is a statewide telephone survey of Michigan residents aged 18 years and older. A question was added to the MiBRFSS in 2007, 2008 and 2009 to specifically capture Arab ancestry of respondents. The MiBRFSS oversampled geographic areas with a high density of African American residents. Many of these areas also overlap areas of high Arab American densities, although the sampling design did not specifically target the Arab American population. *Caution should be used when comparing results from different surveys. The methodologies for the ACCESS/ACC and MiBRFSS surveys are different; therefore, you may not be looking at the same "snapshot" of regional information. Also, telephone-based surveys yield different responses than in-person interviews and by interviewers speaking "their own language."*

Results and Discussion

Access to Care

Access to health care is an important factor in an individual's general health status. In general, people with poorer access to care tend to have worse health outcomes. Disparities in access to care are often seen in non-White racial/ethnic groups, although Arab Americans have not been specifically examined.[5] Cultural norms may affect health care usage. There is a tendency to not acknowledge sickness in Arab cultures (separate from religious views of health). For some segments of the Arab population, there is also a fear or mistrust of doctors. Additionally, as in

other cultures, diabetes carries a social stigma in Arab culture. Linguistic barriers have been cited as a significant barrier to accessing care in the Southeast Michigan Arab community;[6] however, only 7% of respondents in the ACCESS/ACC survey indicated language as a barrier to receiving care.

In the 2009 ACCESS/ACC survey, 31% of Arab Americans reported having no insurance coverage. In addition, Arab American respondents from the 2009 ACCESS/ACC survey were uninsured three times more often than White, non-Arabs within the same geographic area from the MiBRFSS (Table 1). The rate of uninsured from the 2009 ACCESS/ACC survey is similar to that seen in the 2005 Health Assessment Survey conducted by ACC for Arab and Chaldean Americans in the same Southeast Michigan region (34%).[6] Arab Americans also appeared to be delaying routine health exams slightly with a smaller proportion going for a routine checkup every year as compared to White, non-Arabs (64% vs. 72%) (Table 1). This is significantly lower than the 2005 ACC survey findings where 78% of Arab and Chaldean Americans reported seeing a physician in the past year.[6]

Table 1. Health care access among Arab American and White, non-Arab populations in Southeast Michigan (Macomb, Oakland and Wayne Counties).

	Arab American* (n = 2,025)		White, non-Arab† (n = 5,690)	
	%	95%CI	%	95%CI
Do you have any kind of health care coverage?				
Yes	69.0%	66.7, 71.2	90.3%	89.0, 91.5
No	31.0%	28.8, 33.3	9.7%	8.5, 11.0
About how long has it been since you last visited a doctor for a routine checkup?				
Within the past year	64.4%	62.0, 66.7	72.0%	70.4, 73.6
Within the past 2 years	26.3%	24.2, 28.4	14.3%	13.0, 15.6
Within the past 5 years	6.9%	5.6, 8.4	7.5%	6.5, 8.5
5 or more years ago	2.5%	1.9, 3.3	6.3%	5.5, 7.1
Do you have your own family doctor?				
Yes	81.5%	79.7, 83.2	88.9%	87.6, 90.2
No	18.5%	16.8, 20.4	11.1%	9.8, 12.4

* From the 2009 ACCESS/ACC survey.
† From the 2007-2009 MiBRFSS.

While having insurance may help to increase access to health care; higher premiums, deductibles and co-pays may also create a financial burden for families, thus delaying or limiting access to care. In the 2009 ACCESS/ACC survey, cost was the factor most often cited for delaying care (28% of respondents). Cost as a barrier is further supported in statewide MiBRFSS numbers where Arab Americans were twice as likely to report not seeing a doctor when they needed to because of cost (21.7%) compared to White, non-Arabs (10.8%).[7] The good news is that Arab Americans diagnosed with diabetes were significantly more likely to have insurance than the general Arab American population in the 2009 ACCESS/ACC survey (83% vs. 69%). And,

significantly more Arab Americans with diabetes reported seeing a doctor in the last year than the general Arab American population (84% vs. 64%).

Risk Factors for Diabetes

Weight: It is generally accepted that the risk for developing type 2 diabetes is linked to lifestyle factors such as weight, nutrition and physical activity. Arab American respondents from the 2009 ACCESS/ACC survey were less likely to be obese or overweight/obese than White, non-Arabs respondents from the MiBRFSS (Table 2). It should be noted that this is based on self-report and not actual measurement of the respondent. Another study that directly measured height and weight of Arab Americans in the same region reported 34% obesity among participants.[8] Community clinicians have suggested the wording of the height and weight survey questions may not have been well understood by the respondents; anecdotally, they are seeing no reduction in the community's obesity rates.

Table 2. Risk factors for diabetes among Arab American and White, non-Arab populations in Southeast Michigan (Macomb, Oakland and Wayne Counties).

	Arab American* (n = 2,025)		White, non-Arab (n = 5,690)	
	%	95%CI	%	95%CI
Overweight or obese (BMI ≥ 25)				
Yes	59.4%	57.0, 61.7	63.2%†	61.4, 65.0
No	40.6%	38.3, 43.0	36.8%†	35.0, 38.6
Obese (BMI ≥ 30)				
Yes	17.1%	15.3, 19.2	26.2%†	24.7, 27.7
No	82.9%	80.8, 84.7	73.8%†	72.3, 75.3
Eats fruits or vegetables 5 or more times a day				
Yes	10.1%	8.8, 11.7	24.2%†	22.6, 25.9
No	89.9%	88.3, 91.2	75.8%†	74.1, 77.4
Exercises 5 or more days a week				
Yes	9.5%	8.2, 11.0	62.4%†	60.6, 64.3
No	90.5%	89.0, 91.8	37.6%†	35.7, 39.4
Current tobacco use (cigarette, hookah, or other tobacco product)				
Yes	49.2%	46.8, 51.7	22.7%‡	20.0, 25.6
No	50.8%	48.4, 53.2	77.3%‡	74.4, 80.0
Family history of diabetes				
Yes	43.1%	40.6, 45.6	n/a	--
No	56.9%	54.4, 59.4	n/a	--

* From the 2009 ACCESS/ACC survey.
† From the 2007-2009 MiBRFSS.
‡ From the 2007 and 2009 MiBRFSS, excluding 2008 because the question was not run.

Nutrition: Arab Americans appear to have lower than recommended intake of fruits and vegetables (Table 2). However, this may be due to the wording of the survey question not being

appropriate for the respondent population. The question asked how many times a day fruits or vegetables are eaten. It may be that this population eats two or more servings for every time they count one type of fruit or vegetable, thus consuming more than the average American serving. One previous study showed that the Arab American population in Southeast Michigan had high levels of fruit and vegetable consumption.[9] However, this same study also found that high fruit and vegetable intake did not have a protective effect on cholesterol due to the high consumption of fatty foods. Depending on the country of origin, meats and sweets can make up a large part of the Arab diet. Additionally, younger generations of Arab Americans may be more acculturated thus consuming more of the high fat fast foods. Future measurement of nutrition in this community should include questions on consumption of fatty foods in addition to clarifying the amount of fruits and vegetables consumed by breaking down the daily frequency to the number of servings.

Physical Activity: Exercise in the Arab American community appears to be significantly less practiced than in the comparable White, non-Arab community (Table 2). The lower rate of exercise may be in part due to cultural differences in thinking about physical activity. Many immigrants were involved in strenuous physical labor in home countries, and walking was a prominent part of everyday activity.[10] It can take time for them to acculturate to the Western notion of regular physical activity for health and when not associated with work tasks. From a previous study, immigrant Arabic men reported being more physically active than women.[11] This is not surprising given traditional Muslim values for modesty and limited availability of gender-separated exercise facilities, although opportunity has improved in recent years with emergent women-only gyms (e.g. Curves for Women). One community member suggested that Muslim women would be more likely to participate in activities outside the home if efforts are made to include children and other family members.

Tobacco Use: People who smoke are more than twice as likely to develop diabetes as those who have never smoked.[12] Arab Americans have double the current tobacco use rates compared to White, non-Arabs (Table 2). In the 2009 ACCESS/ACC survey, 32% of respondents reported currently smoking cigarettes and 30% currently use the hookah (also known as narghile or water pipe); and there is a large overlap between the use of cigarettes and the hookah. In a comparative study, people of Arab ancestry had lower rates of cigarette smoking (24% vs. 38% white, non-Arab), but higher rates of hookah smoking compared to White, non-Arabs (7% vs. 4%).[13] The hookah is considered a "traditional" way of consuming tobacco in Arab nations, and can be part of social activities. Many people feel that hookah use is safer than smoking cigarettes. However, research has shown that people receive more nicotine from a hookah than they would from a cigarette.[14] Since it is nicotine that impairs the body's use of insulin, Arab Americans using a hookah may be at higher risk of developing diabetes than those who only use cigarettes.

Family History: Roughly 43% of Arab Americans report that diabetes has been diagnosed in an immediate family member (Table 2). A person with a family history of diabetes is 2-4 times more likely to develop diabetes than someone without a family history.[15] It is unknown how self-report of family history may be affected by the social stigma of diabetes. In the 2005 Michigan Diabetes, Arthritis and Osteoporisis survey, 58% of White respondents self-reported having a family history of diabetes.[16] This is a significantly higher number and may include

Arab Americans in the White race category. While family history of type 2 diabetes is one of the strongest risk factors for getting the disease, it only seems to impact people living a Western lifestyle.[17] Therefore, acculturation may be an important interacting factor when using family history for diabetes risk assessment in the Arab American community.

Diabetes Diagnosis

When comparing self-reported diabetes prevalence in the Arab American population, the ACCESS/ACC survey and the MiBRFSS give two very different answers (Table 3). The diabetes prevalence of 8.7% within the 2009 ACCESS/ACC survey is over double the diabetes prevalence of 4.1% found in the MiBRFSS. This suggests that the MiBRFSS underestimates the diabetes prevalence in the Arab American population. This observation is further supported by the 2005 Health Assessment Survey conducted by ACC, which found a self-reported diabetes prevalence of 6.0% among Chaldeans and 7.0% among Arabs.[6]

Table 3. Diagnosed diabetes prevalence of Arab American and White, non-Arab populations in Southeast Michigan (Macomb, Oakland and Wayne Counties).

	Unweighted	Weighted	
	Sample Size	%	95%CI
Arab American population			
2009 ACCESS/ACC survey	2,025	8.7%	7.2, 10.5
2007-2009 MiBRFSS*	253	4.1%	2.5, 6.6
White, non-Arab population			
2007-2009 MiBRFSS	5,691	8.0%	7.3, 8.8

* The Arab-American diagnosed diabetes prevalence estimate for the MiBRFSS is a statewide figure because the sample size in the Southeast Michigan region alone was not sufficient to produce an estimate.

It is not surprising that the MiBRFSS may underestimate this population since the sample size of self-identified Arab Americans in the MiBRFSS is not large (n = 253), especially compared to the ACCESS/ACC survey (n = 2,025) and the 2005 ACC survey (n = 3,132). Tracking health indicators of Arab American populations using routine surveillance methods like the MiBRFSS may require a specific oversampling design to target that population, in addition to the question ascertaining Arab ancestry.

When comparing self-reported diabetes prevalence in the Arab American population to the White, non-Arab population in the same region, the estimates are fairly similar (Table 3). The diabetes prevalence of 8.7% in the 2009 ACCESS/ACC survey is within the confidence limits of the diabetes prevalence of 8.0% for White, non-Arabs within the MiBRFSS. This observation is again supported by the 2005 Health Assessment Survey conducted by ACC where Whites had a diabetes prevalence of 7.0%, similar to the 6.0% among Chaldeans and 7.0% among Arabs.[6]

Given the self-reported results, it appears that diabetes prevalence in the Arab American population is no different than what is seen in the White, non-Arab population. However, self-report is dependent on a person's screening history and awareness of the test results, and these factors may be different between Arab Americans and White, non-Arab populations. Clinical

testing with a fasting blood glucose test is a far more reliable measure of diabetes prevalence in a population. Previously published studies of Arab American households in Southeast Michigan undergoing a fasting blood glucose test report a total diabetes prevalence (both diagnosed and undiagnosed) of 18-33%.[8,18,19] This is compared to a total diabetes prevalence of 11% for Whites.[20] The disparity seen in total diabetes prevalence might be explained by the proportion of total diabetes that was undiagnosed. Arab Americans and Chaldeans who have diabetes are thought to be undiagnosed 50% and 45% of the time respectively, compared to Whites with diabetes who are undiagnosed 38% of the time.[8,19,20]

Diabetes Care

Self-care and clinical care recommended for people with diabetes appear to be significantly lower in the Arab American population than in the White, non-Arab population (Table 4). Of great concern is the fact that Arab Americans were far more likely to report they did not know whether they received proper medical care for their diabetes. These results can be interpreted in on or more ways:

1) Arab Americans with diabetes are receiving less preventive care than White, non-Arabs;
2) Arab Americans have less access to the resources they need to care for their diabetes than White, non-Arabs;
3) Arab Americans with diabetes are less knowledgeable about what constitutes good diabetic care than White, non-Arabs; or
4) Arab Americans with diabetes are less active in managing their own diabetic care and do not track these measures as closely as White, non-Arabs.

Glucose Monitoring: For people with diabetes who are not using insulin, it is often recommended by certified diabetes educators to monitor blood glucose at least once a day. A previous study reported 74% of Arab Americans with diabetes monitored their blood glucose levels daily.[21] But, only slightly more than half (55%) of Arab Americans who have diabetes reported checking their blood glucose one or more times a day in the 2009 ACCESS/ACC survey (Table 4). This is less than the 62% of White, non-Arabs from the MiBRFSS who reported checking their blood glucose levels one or more times a day. It also appears Arab Americans with diabetes are more likely to test their glucose levels less frequently – several times a week or several times a month – compared to White, non-Arabs (Table 4). The cost of regular glucose testing may potentially be leading to less frequent testing. Glucose testing meters can often be found at reduced or no cost; however, patient assistance programs rarely cover the cost of testing strips for low-income individuals. Clinicians at ACCESS also feel that knowledge of the need for daily testing is low among Arab Americans with diabetes and the lower frequency of testing could be compounded by the overall lack of obvious symptoms accompanying the earlier stages of diabetes, and a cultural sense of denial regarding diagnosis.

The American Diabetes Association recommends monitoring blood glucose three or more times a day for people with diabetes who are using insulin.[22] While the 2009 ACCESS/ACC survey did not specifically ask about insulin use, insulin use has been reported at 26-27% for Arab Americans (including those on combination therapy of oral agents and insulin).[21,23] Clearly, the

reported 9% of Arab Americans with diabetes monitoring glucose three or more times a day falls short of this recommendation for care (Table 4).

Table 4. Diabetes care practice among Arab American and White, non-Arab populations with diabetes in Southeast Michigan (Macomb, Oakland and Wayne Counties).

	Arab American* (n = 135)		White, non-Arab† (n = 638)	
	%	95%CI	%	95%CI
About how often do you check your blood sugar?				
★ 3 or more times a day	8.7%	4.3, 16.8	18.0%	14.0, 22.8
★ Twice a day	13.0%	7.5, 21.5	18.3%	14.3, 23.1
★ Once a day	33.6%	25.0, 43.5	25.9%	21.2, 31.1
1 or more times a week	30.4%	22.2, 40.2	16.6%	13.1, 20.7
1 or more times a month	10.5%	6.1, 17.4	4.3%	2.5, 7.4
1 or more times a year	1.8%	0.6, 5.5	1.2%	0.5, 2.8
Never	2.0%	0.6, 6.1	13.8%	10.3, 18.2
Don't Know	n/a	--	2.0%	0.8, 5.3
About how many times in the past 12 months has a doctor, nurse or other health care provider checked you for A1C?				
1 time	10.7%	6.6, 16.9	14.0%	10.5, 18.5
★ 2 or more times	27.2%	18.9, 37.5	67.2%	61.8, 72.1
Never	4.9%	2.2, 10.5	5.9%	3.7, 9.0
Don't Know/Never heard of test	57.1%	47.1, 66.6	13.0%	10.0, 16.7
When was the last time you had an eye exam in which the pupils were dilated?				
★ Within the past year	65.0%	55.7, 73.2	70.0%	64.6, 74.8
Within the past 2 years	8.1%	4.5, 14.3	15.8%	12.1, 20.4
2 or more years ago	8.2%	4.6, 14.0	11.2%	8.0, 15.3
Never	n/a	--	1.9%	0.9, 4.0
Don't know	18.8%	12.9, 26.5	1.1%	0.4, 2.9
About how many times in the past 12 months has a health professional checked your feet for sores or irritations?				
★ 1 or more times	55.4%	45.5, 64.9	69.2%	63.7, 74.2
Never	11.5%	7.2, 18.0	29.9%	25.0, 35.4
Don't Know	33.1%	24.6, 43.0	0.9%	0.4, 1.9
Have you ever taken a course or class on how to manage your diabetes yourself?				
★ Yes	15.9%	10.4, 23.7	49.5%	43.9, 55.0
No	74.3%	63.6, 82.7	50.4%	44.8, 56.0
Don't know	9.7%	3.9, 22.1	0.1%	0.0, 0.8

* From the 2009 ACCESS/ACC survey.
† From the 2007-2009 MiBRFSS.
★ Denotes the answer that fits within the American Diabetes Association Clinical Practice Recommendations.
n/a Answer option was not included on the 2009 ACCESS/ACC survey.

Clinical Exams: Recommended clinical exams for people with diabetes includes annual receipt of two Hemoglobin A1C tests, a dilated eye exam, and a foot exam by a professional.[22] Arab Americans reported similar rates of eye exams as White, non Arabs – at 65% and 70% respectively (Table 4). This is also similar to a previous study where 67% of Arab Americans received a dilated eye exam.[21] However, rates of A1C testing and professional foot exams appear to be lower for Arab Americans, although this is confounded by the high number of Arab Americans who answered "don't know" to these questions (57% and 33% respectively). No other research could be located to compare these indicators against.

Diabetes Education: The proportion of Arab Americans with diabetes who report ever taking a class to manage their diabetes is extremely low (Table 4). The 16% found in the 2009 ACCESS/ACC survey is far lower than the 50% for White, non-Arabs in the MiBRFSS in the same geographic region – and far lower than the 66% previously reported for an Arab American population in Dearborn, Michigan using 2000-2001 data.[21] The difference between the 2009 ACCESS/ACC survey results and the previous study is likely not due to differences in geographic boundaries of the studies. This finding did not change when the weighted frequencies for Dearborn-only residents were calculated. One potential explanation for the decrease in diabetes education rates may be the 2006 closure of the Oakwood Hospital Diabetes Program in Dearborn, which reported educating 10-15 Arab Americans a year at time of closure. Overall, the low reported rate of diabetes education highlights the need for ongoing education for this population.

Diabetes Co-morbidities

Co-morbid conditions appear to be a greater problem in the Arab American community than for other communities. The 2005 ACC Health Assessment Survey found that Arabs and Chaldeans were more likely to have three or more chronic conditions compared to Whites and Blacks.[6] In the 2009 ACCESS/ACC survey, Arab Americans with diabetes were more likely to have high blood pressure, high cholesterol, and heart problems than White, non-Arabs from the MiBRFSS (Table 5). There is no clear difference for chronic kidney disease between Arab Americans and White, non-Arabs. It is possible that some of the higher rates of co-morbidities seen in Arab Americans are due to diabetes being diagnosed at later stages than the White, non-Arab cohort; which gives the disease more time to do more damage.

High blood pressure and high cholesterol are not only co-morbid conditions that people with diabetes need to control, but also risk factors that can lead to the development of diabetes. When comparing results from the 2009 ACCESS/ACC survey to that of a similar study completed in the past, a higher rate of hypertension was reported for the general Arab American population in the previous study (44% versus 23%).[24] Also, higher rates of hypercholesterolemia and heart disease were reported in past studies than in the ACCESS/ACC survey: hypercholesterolemia was reported at 47% and 38-40% versus 30%, and heart disease was reported at 8% versus 6%. This could either indicate an improvement in preventive practices and care over time, or changes properly diagnosing this population.

Table 5. Comorbidities among Arab American and White, non-Arab populations with diabetes in Southeast Michigan (Macomb, Oakland and Wayne Counties).

	Arab American* (n = 135)		White, non-Arab (n = 638)	
	%	95%CI	%	95%CI
Have you ever been told you have high blood pressure?				
Yes	73.0%	63.7, 80.7	63.5%†	57.3, 69.2
No	27.0%	19.3, 36.3	36.5%†	30.8, 42.7
Have you ever been told you have high blood cholesterol?				
Yes	74.0%	63.6, 82.1	62.6%†	56.5, 68.3
No	26.0%	17.9, 36.2	37.4%†	31.7, 43.5
Have you ever been told you have had a heart attack?				
Yes	25.0%	16.8, 35.6	17.3%‡	14.1, 21.1
No	75.0%	64.4, 83.2	82.7%‡	78.9, 85.9
Have you ever been told you have kidney disease or low kidney function?				
Yes	12.6%	6.8, 22.2	11.5%§	6.3, 20.2
No	87.4%	77.8, 93.2	88.5%§	79.8, 93.7

* From the 2009 ACCESS/ACC survey.
† From the 2007 and 2009 MiBRFSS, excluding 2008 because the question was not run.
‡ From the 2007-2009 MiBRFSS.
§ From the 2009 MiBRFSS, the only year this question has been run.

Recommendations

The following recommendations are made to the Michigan Department of Community Health, Diabetes Prevention and Control Program (DPCP) for the purpose of providing guidance in prioritizing future resources and programs to Michigan's Arab American community.

> ***Recommendation #1:***
> Increase regular diabetes screening efforts targeting Arab Americans to increase the likelihood of diagnosing adults with diabetes as early in the course of disease as possible.

While self-reported diabetes prevalence does not appear to show any difference between Arab Americans and White, non-Arabs; research using the fasting blood glucose test in the Southeast Michigan region suggests there are more Arab Americans with diabetes overall (diagnosed and undiagnosed). Many more Arab Americans appear to be unaware of their condition as compared to Whites, which potentially places this population at substantially greater risk for developing long-term complications of diabetes such as heart disease, stroke, kidney disease, blindness and amputations. Earlier diagnosis can help delay the onset of these serious complications.

Currently, ACCESS and ACC conduct diabetes screening for clients visiting their clinics. Both centers organize health fairs with free screening services in the community, and publicizes other free screenings and clinics in the area. It is worth noting that the American Diabetes Association does not recommend glucose screenings outside of clinics because most people will not be

fasting for accurate glucose measurement. Although a number of free diabetes screening services are offered in the Arab American community, community awareness of these services may be low. A previous survey reported 64% of respondents were unaware of free and available health services at the local health departments and community clinics.[24] Low awareness of services may continue due to the high numbers of refugees entering the community every year, who generally lack consistent and comprehensive health information and health insurance. ACCESS and ACC are continually challenged to market their services, and learn from experience and community feedback to improve their approaches. Both agencies are very adept at making connections with mosques, churches, and other local organizations in order to better reach out to communities.

The Michigan Diabetes Prevention and Control Program can help ACCESS and ACC in their efforts to promote diabetes screening using the low-cost paper risk assessment tool to help people determine if they are at risk of developing diabetes, and refer them to a medical professional for further testing if they are found to be at risk. The referral to follow up with a medical professional for proper diagnosis of the disease is an important ethical consideration in any screening activity. The paper risk assessment tool has been used successfully in other Michigan communities, and can be available at health fairs even when glucose screening services are not. It also has the added potential of improving community outreach and increasing public awareness.

It is suggested to distribute the one-page American Diabetes Association Risk Assessment "*Could You Have Diabetes and Not Know It?,*" or an adaptation thereof, to area mosques and churches (Appendix A). Clerics, priests, or lay health educators could receive a brief training about diabetes and the paper risk assessment tool. They could then lecture their congregation about the importance of screening, diagnosis, and treatment; or make these assessments available through a newsletter or information rack. The purpose would be for informational purposes only and no one would be required to complete the assessment. The assessment would first act as an outreach tool, giving ACCESS and ACC the opportunity to meet with faith-based institutions and make them aware of health fairs and other center activities. The assessment could also act as a community teaching tool, allowing people to learn what the risks for diabetes are and whether they may be at-risk themselves. The assessment could be available in both Arabic and English, and would act as a pre-screening tool directing people to follow-up with ACCESS, ACC, or their health care provider if their risk is high.

Recommendation #2:
Promote diabetes prevention in the Arab American community with culturally appropriate activities and materials.

Screening for diabetes will also identify people with prediabetes, which is reported to affect 23% of Arab American adults.[8] It is important to implement programs to refer individuals screened with prediabetes to reduce their risk of developing type 2 diabetes. The Diabetes Prevention Program (DPP) was a landmark clinical study assessing the effectiveness of lifestyle changes and medication in reducing diabetes risk in an ethnically and culturally diverse population. Lifestyle intervention alone was more effective than drug therapy alone and resulted in a 58% reduction in

the development of diabetes at 3 years and 34% reduction at 10 years.[25,26] The goals of lifestyle intervention include modest weight loss (5-7% of body weight) and moderate physical activity (150 minutes a week). A priority of the Michigan Diabetes Prevention and Control Program is to mobilize community resources to promote DPP-like programs to reduce the number of people who develop diabetes.

In 2009, the ACCESS Community Health & Research Center participated in a trial study to implement a culturally-modified version of the DPP specifically for the Arab American population. The 12-session program, entitled *LIFESTYLE*, enrolled 71 people from the community who were determined to be at risk of developing diabetes. *LIFESTYLE* differed from the DPP in that it also taught people to self-monitor daily caloric and fat intake. Cultural modifications included a family focus that encouraged people to bring family members to classes, offered gender-segregated classes depending on country of origin, and availability of bilingual materials. At the end of the study, 78% of participants were doing 150 minutes of physical activity a week. Additionally, 44% of participants had lost 7% or more of their body weight, and 59% had lost 5% or more.[27] There was an 86% retention rate in this study and the significant socio-demographic factor associated with these outcomes was the level of family support. Anecdotally, since this study ended, the principal investigator reports many in the Dearborn Arab American community have expressed interest in using this program again.

The Michigan Diabetes Prevention and Control Program should work to re-establish the *LIFESTYLE* program in the ACCESS-served community, and encourage area partners to offer free trial memberships at area gyms. The *LIFESTYLE* researchers report that the Fairlane Club and Ford Community and Performing Arts Center are already well used by the Arab American community. Other community fitness centers, such as Curves for Women and Fitness USA, offer gender-separated workout facilities for women. Nutrition learning resources are also available in the Dearborn community with monthly Arab cooking classes recently established at the Islamic Center of America. ACC staff are also interested in establishing a *LIFESTYLE* program in Hamtramck. The DPCP should work with ACC to identify and train health educators as well as identify area nutrition and physical activity resources.

Recommendation #3:
Promote culturally appropriate diabetes self-management education (DSME) in the Arab American community.

Diabetes self-management education (DSME) is an evidence-based program that provides information and teaches skills to help people with diabetes with their daily care. It is a critical element of care for all people with diabetes and is necessary in order to improve patient outcomes.[28] About 60% more people with diabetes statewide report doing self-care activities (blood glucose monitoring or feet checking) when they attended DSME. In addition, about 50% more people with diabetes report receiving a recommended clinical exam (two Hemoglobin A1C tests or a dilated eye exam or a foot exam by a professional) when they have had DSME.[29] Furthermore, research has found that DSME reduces hospitalization and lowers A1C values; both are indicators that diabetes is better controlled.[30,31,32] For these reasons, the Michigan Diabetes Prevention and Control Program has determined that the most effective way to improve

both self-care and clinical care indicators is to promote diabetes education.

Currently, ACCESS and ACC deliver some level of diabetes education through clinic nurses and volunteer nutritionists/dietitians. However, neither agency has a Certified Diabetes Educator (CDE) on staff. Additionally, ACCESS promotes the *Diabetes Review & Healthy Steps Program* from the American Diabetes Association and Great Lakes Medical Supply. This program consisted of 18 free education classes (in 2009) within various community locations across the region led by a CDE. The Dearborn site is one of the most well attended sites for these programs, indicating both need and interest in the most concentrated Arab American community.[33]

To improve access to a diabetes educator, the Michigan Diabetes Prevention and Control Program should connect ACCESS and ACC community health clinics to area hospital-based DSME programs certified by the State. There are multiple State-certified sites that have Arabic translators available, such as William Beaumont Hospitals, St. John's Providence Health System and Henry Ford Health System. Efforts can be made to help the diabetes educators establish classes either in the ACCESS and ACC community health clinics or other community gathering site. Segregated classes may need to be held for Muslim men and women. Additionally, certified diabetes educators can work with volunteer health educators on ACCESS and ACC staff in a peer-to-peer mentorship to increase their staff's capacity to deliver diabetes education on-site.

There is also a need to improve access to gestational diabetes education classes in the Arab American community. Gestational diabetes grew from 1.7% in 1998 to 4.6% in 2008 in Arab American mothers.[34] It is especially important for Arab American women of childbearing age to know their diabetes status and the impact of diabetes on birth outcomes. Previous research found foreign-born Arab American women with diabetes are twice as likely to have a preterm birth as compared to foreign-born women without diabetes.[35] Diabetes was not a predictor of preterm birth in U.S.-born Arab American women.

One aspect of cultural sensitivity to be addressed in diabetes education is to encourage all Muslims with diabetes to receive a pre-Ramadan consultation with a doctor or diabetes educator to discuss glycemic control during fasting. Chaldeans also observe fasting during Baoutha and possibly Lent, and should receive similar consultation prior to fasting. The American Diabetes Association published recommendations for the management of diabetes during Ramadan (Appendix B). The DPCP should work with ACCESS and ACC to create shorter guideline reference sheets for fasting (in Arabic and English), and distribute these to area health care providers who see large numbers of patients with Arab ethnicity.

Finally, DPCP should provide clinics with updated patient assistance program information. These programs can often help with medications, such as metformin. However, free or low-cost test strips for glucometers are often only available if the patient has Medicare or another type of insurance. DPCP staff could provide assistance enrolling qualified patients into Medicaid to increase those eligible for patient assistance programs.

Limitations

While much of the 2009 ACCESS/ACC survey was conducted as a probability sample, parts of the survey were conducted as a convenience sample. Therefore, analysis of the entire sample was considered as a convenience sample. The biases of undercoverage and self-selection associated with a convenience sample limits generalization of the results. This issue highlights the importance of the investigators properly training interviewers to not only conduct the questionnaire, but to understand the need to follow standardized selection procedures for respondents.

Another limitation with this survey is the heterogeneity of the Arab American Community in Southeast Michigan, as the community is ethnically diverse. Roughly 35% of respondents were Iraqi, 35% were Lebanese, 17% were Yemeni, and the remainder represented ancestries of 13 other Middle Eastern and North African nations. The International Diabetes Federation has estimated diabetes prevalence in these various countries and it ranges from 2.5% in Yemen to 14.4% in Bahrain.[36] Another issue is immigration status, or length of time the respondent has lived in the United States. Roughly 83% of respondents were immigrants to the U.S. Previous research found Arab Americans that are less acculturated tend to have higher risk of diabetes.[11] Of those respondents who are immigrants, 42% have been in the U.S. for 10 years or less and 60% have been in the U.S. for 15 years or less.

Finally, the generalization of these results may be limited by the region of study. A majority of Arab American diabetes studies have been conducted in Southeast Michigan. Researchers at the University of Michigan have pointed out that Arab Americans in Southeast Michigan tend to be less affluent on average than Arab Americans nationally.[37] Another unique characteristic of the region is its high concentration of Arab Americans. Prior research shows that ethnic minorities living in areas with high concentrations of their own ethnic group have more social support which might have a protective effect, and the results reported for this study population may be different from what would be found in a population that had a lower concentration of Arab Americans.[37]

Despite these limitations, this study adds to the growing knowledge of diabetes care issues in the Arab American community. Furthermore, it highlights the continuing need to conduct specific research in this community since observed health outcomes can be very different than what is observed in the White race category of traditional surveillance techniques.

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Could You Have Diabetes and Not Know It?

Take the Test. Know your Score.

There are 18.2 million Americans with diabetes – and nearly one-third of them (or 5.2 million people) don't know it! Take this test to see if you are at risk for having diabetes. Diabetes is more common in African Americans, Latinos, American Indian and Alaskan Native, Asian Americans, and Pacific Islanders. If you are a member of one of these ethnic groups, you need to pay special attention to this test.

To find out if you are at risk, write in the points next to each statement that is true for you. If a statement is *not* true, write a zero. Then add all the points to get your total score.

1.	My weight is equal to or above that listed in the chart.	**Yes**	**5**	____
2.	I am under 65 years of age **and** I get little or no exercise during a usual day.	**Yes**	**5**	____
3.	I am between 45 and 64 years of age.	**Yes**	**5**	____
4.	I am 65 years old or older.	**Yes**	**9**	____
5.	I am a woman who has had a baby weighing more than nine pounds at birth.	**Yes**	**1**	____
6.	I have a sister or brother with diabetes.	**Yes**	**1**	____
7.	I have a parent with diabetes.	**Yes**	**1**	____
			TOTAL	

Scoring 3-9 points

You are probably at low risk for having diabetes now. But don't just forget about it – especially if you are a Hispanic/Latino, African American, American Indian and Alaskan Native, Asian American, and Pacific Islander. You may be at higher risk in the future.

Scoring 10 or more points

You are at a greater risk for having diabetes. Only your health care provider can determine if you have diabetes. At your next office visit, find out for sure.

American Diabetes Association®

At-Risk Weight Chart

Body Mass Index

Height	*Weight*
In feet and inches without shoes	*In pounds without clothing*
4' 10"	**129**
4' 11"	**133**
5' 0"	**138**
5' 1"	**143**
5' 2"	**147**
5' 3"	**152**
5' 4"	**157**
5' 5"	**162**
5' 6"	**167**
5' 7"	**172**
5' 8"	**177**
5' 9"	**182**
5' 10"	**188**
5' 11"	**193**
6' 0"	**199**
6' 1"	**204**
6' 2"	**210**
6' 3"	**216**
6' 4"	**221**

If you weigh the same or more than the amount listed for your height, you may be at risk for diabetes.

Diabetes Facts You Should Know

Diabetes is a serious disease that can lead to blindness, heart disease, strokes, kidney failure, and amputations. It kills almost 210,000 people each year.

Some people with diabetes have symptoms and some do not.
If you have any of the following symptoms, contact your doctor:

- **Extreme thirst**
- **Frequent urination**
- **Unexplained weight loss**

For more information on diabetes, call **1-800-Diabetes (342-2383)** or visit **www.diabetes.org.**

The information contained in the American Diabetes Association (ADA) web site and this risk test is not a substitute for medical advice or treatment, and the ADA recommends consultation with your doctor and health care professional.

هل يمكن أن تكون مصابا بمرض السكري من دون أن تعرف ذلك؟

بادر إلى فحص نفسك، لتعلم النتيجة

هناك أكثر من 18.2 مليون أمريكي مصاب بمرض السكري – وثلثهم تقريبا (أي 5.2 مليون شخص) لا يعرف ذلك!! قم بإجراء الفحص كي تعرف إذا كنت معرضا للإصابة بالسكري. إن السكري مرض أكثر شيوعا بين الأمريكيين من أصل افريقي، والهسبان/اللاتينو، والهنود الحمر، والسكان الأصليين في ألاسكا، والأمريكيين من أصل آسيوي، وسكان جزر المحيط الهادي. إذا كنت تنتمي إلى إحدى هذه الجماعات الإثنية، عليك أن توجه اهتماما خاصا إلى هذا الفحص.

إذا أردت أن تعرف ما إذا كنت معرضا للخطر بصورة خاصة، سجل النقاط بمحاذاة كل جملة أدناه تنطبق عليك. إذا كانت الجملة غير صحيحة، سجل صفرا. ثم احسب مجموع النقاط.

• وزني يعادل الوزن الوارد في القائمة أو يزيد عليه.	**نعم**	**5**	____
• عمري أقل من 65 سنة **و** لا أمارس التمارين الرياضية في اليوم العادي، أو أمارسها قليلا جدا	**نعم**	**5**	____
• عمري بين 45 و 64 سنة	**نعم**	**5**	____
• عمري 65 سنة أو أكثر	**نعم**	**9**	____
• أنا امرأة أنجبت طفلا وزنه أكثر من 4.5 كيلوغراما (9 باوند) عند الولادة	**نعم**	**1**	____
• أحد إخواني أو أخواتي مصاب بالسكري	**نعم**	**1**	____
• أحد والديّ مصاب بالسكري	**نعم**	**1**	____
		المجموع	

إذا كان مجموع الأرقام 3 – 9 نقاط
أنت ربما معرض لدرجة قليلة من خطر الإصابة بالسكري الآن. ولكن لا تتجاهل الموضوع – خاصة إذا كنت هسبانيا/لاتينو، أو أمريكيا من أصل افريقي، أو من الهنود الحمر، أو من السكان الأصليين في ألاسكا، أو الأمريكيين من أصل آسيوي، أو من سكان جزر المحيط الهادي.

إذا كان مجموع النقاط 10 أو أكثر
أنت معرض لدرجة أكبر من خطر الإصابة بالسكري. طبيبك فقط هو الذي يمكنه تحديد ما إذا كنت مصابا بالسكري. تحقق من ذلك في زيارتك القادمة إلى عيادته.

American Diabetes Association®

جدول الوزن لخطر الإصابة بالسكري
مؤشر كتلة الجسم

الوزن	الطول
رطل (باوند) من دون ملابس	**قدم/بوصة من دون حذاء**
129	**4’ 10”**
133	**4’ 11”**
138	**5’ 0”**
143	**5’ 1”**
147	**5’ 2”**
152	**5’ 3”**
157	**5’ 4”**
162	**5’ 5”**
167	**5’ 6”**
172	**5’ 7”**
177	**5’ 8”**
182	**5’ 9”**
188	**5’ 10”**
193	**5’ 11”**
199	**6’ 0”**
204	**6’ 1”**
210	**6’ 2”**
216	**6’ 3”**
221	**6’ 4”**

إذا كان وزنك يعادل أو يزيد على الرقم المسجل بمحاذاة طولك، قد تكون معرضا لخطر الإصابة بالسكري.

حقائق يجب أن تعرفها عن السكري

السكري مرض خطير يمكن أن يقود إلى فقدان البصر، وأمراض القلب، والجلطة الدماغية، وفشل الكلى، وبتر الأطراف.
يقتل السكري نحو 210.000 شخص كل سنة.

بعض المصابين بمرض السكري تبدو عليهم أعراض المرض، وبعضهم لا تبدو عليه هذه الأعراض.
إذا كان لديك أي من الأعراض التالية، اتصل بطبيبك:

- **العطش الشديد**
- **كثرة التبول**
- **خسارة في الوزن من دون سبب معروف**

لمزيد من المعلومات عن السكري، اتصل بالرقم (342-2383) 1-800-Diabetes أو قم بزيارة الموقع ا لشبكي (الإنترنت) www.diabetes.org
إن المعلومات ا لمتوفرة على الموقع الشبكي لرابطة السكري الأمريكية (ADA) وهذا الاختبار لنسبة التعرض للخطر ليست بديلا للمشورة الطبية أو العلاج الطبي، وتنصح رابطة السكري الأمريكية باستشارة طبيبك أو المتخصص في رعايتك الصحية.

(ARABIC 2005)

Recommendations for Management of Diabetes During Ramadan

Update 2010

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Since our last publication about diabetes and fasting during Ramadan (1), we have received many inquires and comments concerning important issues that were not discussed in the previous document, including the voluntary 1- to 2-day fasts per week that many Muslims practice throughout the year, as well as the effect of prolonged fasting (more than 18 h a day) in regions far from the equator during Ramadan when it occurs in summer—a phenomenon expected to affect millions worldwide for the next 10–15 years. Since 2005, there have been substantial additions to the literature, including two studies examining the effect of structured education and support for safe fasting, both of which had promising results (2,3). In addition, new medications, such as the incretin-based therapies, have been introduced with less risk for hypoglycemia.

According to a 2009 demographic study, Islam has 1.57 billion adherents, making up 23% of the world population of 6.8 billion, and is growing by ~3% per year (4). Fasting during Ramadan, a holy month of Islam, is a duty for all healthy adult Muslims. The high global prevalence of type 2 diabetes—6.6% among adults age 20–79 years (5)—coupled with the results of the population-based Epidemiology of Diabetes and Ramadan 1422/2001 (EPIDIAR) study, which demonstrated among 12,243 people with diabetes from 13 Islamic countries that ~43% of patients with type 1 diabetes and ~79% of patients with type 2 diabetes fast during Ramadan (6), lead to the estimate that worldwide more than 50 million people with diabetes fast during Ramadan.

Ramadan is a lunar-based month, and its duration varies between 29 and 30 days. Muslims who fast during Ramadan must abstain from eating, drinking, use of oral medications, and smoking from predawn to after sunset; however, there are no restrictions on food or fluid intake between sunset and dawn. Most people consume two meals per day during this month, one after sunset and the other before dawn.

Fasting is not meant to create excessive hardship on the Muslim individual according to religious tenets. Nevertheless, many patients with diabetes insist on fasting during Ramadan, thereby creating a medical challenge for themselves and their health care providers. It is increasingly important that medical professionals be aware of potential risks associated with fasting during Ramadan and with approaches to mitigate those risks. These issues are rapidly becoming global issues, not only in Indonesia, Pakistan, and the Middle East, but also in North America, Europe, and Oceania.

Although recommendations for management of diabetes in patients who elect to fast during Ramadan were proposed in 1995 at a conference in Casablanca (7), our previous document was prompted by the EPIDIAR study (6). The purpose of this review is to evaluate new data that has emerged since the publication of the 2005 article and to refine our recommendations.

In this revised document, we continue to avoid use of the terms "indications" or "contraindications" for fasting because fasting is a spiritual issue for which patients make their own decision after receiving appropriate advice from religious teachings and from health care providers. However, we emphasize that fasting, especially among patients with type 1 diabetes with poor glycemic control, is associated with multiple risks.

SUMMARY OF MAJOR CHANGES AND UPDATES — The current report:

- Addresses the voluntary 1- to 2-day fasts per week that many Muslims practice throughout the year
- Discusses the effect of prolonged fasting (more than 18 h a day) in regions far from the equator during Ramadan when it occurs in summer (a phenomenon expected to affect millions of people world-wide for the next 10–15 years)
- Reviews additional and novel literature, including studies examining the effect of structured education and support for safe fasting
- Provides additional information including the clinical use of new medica-

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tions with an emphasis on those with lesser risk for hypoglycemia, such as incretin-based therapies
- Addresses safety information and the use and limitations of existing medications such as thiazolidinediones
- Addresses the growing global scope of the challenge of diabetes and fasting during Ramadan—more than 50 million people with diabetes will fast during Ramadan in 2010

PATHOPHYSIOLOGY OF FASTING

— Insulin secretion, which promotes the storage of glucose in liver and muscle as glycogen, is stimulated by feeding in healthy individuals. During fasting, circulating glucose levels tend to fall, leading to decreased secretion of insulin. Concurrently, levels of glucagon and catecholamines rise, stimulating the breakdown of glycogen, and at the same time gluconeogenesis is augmented (8). As fasting becomes protracted for more than several hours, glycogen stores become depleted, and the low levels of circulating insulin allow increased fatty acid release from adipocytes. Oxidation of fatty acids generates ketones that can be used as fuel by skeletal and cardiac muscle, liver, kidney, and adipose tissue, thus sparing glucose for continued utilization by brain and erythrocytes.

The transition from the fed state through brief fasting and into prolonged starvation is mediated by a series of complex metabolic, hormonal, and glucoregulatory mechanisms. Felig (9) conveniently divided the transition from a fed to a fasted state into three stages:

1) the postabsorptive phase, 6–24 h after beginning fasting
2) the gluconeogenic phase, from 2–10 days of fasting
3) the protein conservation phase, beyond 10 days of fasting.

Although most religious fasts seldom exceed 24 h, the variability of the duration of every phase may lead to different physiological responses to fasting. This variability may explain the feasibility of prolonged fast even in subjects with type 1 diabetes in some studies (11). After an overnight fast, the average rate of glucose utilization by a healthy human is ~7 g per hour. By extrapolation, the 70–80 g of glycogen present in the liver can provide glucose to the brain and peripheral tissues for about 12 h (10).

In individuals without diabetes, the processes described above are regulated by a delicate balance between circulating levels of insulin and counterregulatory hormones that help maintain glucose concentrations in the physiological range. In patients with diabetes, however, glucose homeostasis is perturbed by the underlying pathophysiology and often by pharmacological agents designed to enhance or supplement insulin secretion. In patients with type 1 diabetes, glucagon secretion may fail to increase appropriately in response to hypoglycemia. Epinephrine secretion is also defective in some patients with type 1 diabetes because of a combination of autonomic neuropathy and defects associated with recurrent hypoglycemia (8). In patients with severe insulin deficiency, a prolonged fast in the absence of adequate insulin can lead to excessive glycogen breakdown and increased gluconeogenesis and ketogenesis, leading to hyperglycemia and ketoacidosis. Patients with type 2 diabetes may suffer similar perturbations in response to a prolonged fast; however, ketoacidosis is uncommon, and the severity of hyperglycemia depends on the extent of insulin resistance and/or deficiency.

In a recent study, normal volunteers were subjected to intermittent 20-h fasts every 2nd day for 15 days while maintaining body weight. Plasma free fatty acid and β-hydroxybutyrate concentrations increased after 20 h of fasting, confirming that the subjects were fasting. Insulin-mediated whole-body glucose rates increased and insulin-induced inhibition of lipolysis in adipose tissue was more prominent after than before the intervention. After the 20-h fasting periods, plasma adiponectin was increased compared with the basal levels before and after the intervention. This experiment was the first to show in humans that intermittent fasting increases insulin-mediated glucose uptake rates, compatible with the thrifty gene concept (12). Limited human data suggests higher HDL cholesterol and lower triacylglycerol concentrations but no effect on blood pressure from fasting. In terms of cancer risk, there is no human evidence to date of the effects of fasting. However, animal studies found decreases in lymphoma incidence, longer survival after tumor inoculation, and lower rates of proliferation of several cell types (13).

Table 1—*Major risks associated with fasting in patients with diabetes*

Hypoglycemia
Hyperglycemia
Diabetic ketoacidosis
Dehydration and thrombosis

RISKS ASSOCIATED WITH FASTING IN PATIENTS WITH DIABETES

— Fasting during Ramadan has been uniformly discouraged by the medical profession for patients with diabetes. In keeping with this, a large epidemiological study conducted in 13 Islamic countries on 12,243 diabetic individuals who fasted during Ramadan showed a high rate of acute complications (6). However, a few studies on this topic using relatively small groups of patients suggest that complication rates may not be significantly increased (14–18). Some of the major potential complications associated with fasting in patients with diabetes are outlined in Table 1.

Hypoglycemia

Decreased food intake is a well-known risk factor for the development of hypoglycemia (19). It has been estimated that hypoglycemia accounts for 2–4% of mortality in patients with type 1 diabetes (20). There are no reliable estimates concerning the contribution of hypoglycemia to mortality in type 2 diabetes; however, it is felt that hypoglycemia is an infrequent cause of death in this group of patients. Rates of hypoglycemia are several-fold lower in patients with type 2 compared with type 1 diabetes (6), and rates are even lower in patients with type 2 diabetes treated with oral agents (21).

The effect of fasting during Ramadan on rates of hypoglycemia in patients with diabetes is not known with certainty. The largest dataset is the recent EPIDIAR study (6), which showed that fasting during Ramadan increased the risk of severe hypoglycemia (defined as hospitalization due to hypoglycemia) some 4.7-fold in patients with type 1 diabetes (from 3 to 14 events · 100 people^{-1} · month^{-1}) and 7.5-fold in patients with type 2 diabetes (from 0.4 to 3 events · 100 people^{-1} · month^{-1}). The incidence of severe hypoglycemia was probably underestimated in this study because events requiring assistance from a third party without the need for hospitalization were not included. Although the average A1C in these patients at the beginning of Ramadan was not given, it is unlikely that the patients in this

study had good glycemic control. Severe hypoglycemia was more frequent in patients in whom the dosage of oral hypoglycemic agents or insulin were changed and in those who reported a significant change in their lifestyle (6).

Hyperglycemia

Long-term morbidity and mortality studies in people with diabetes, such as the Diabetes Control and Complications Trial (DCCT) and the UK Prospective Diabetes Study (UKPDS), demonstrated the link among hyperglycemia, microvascular complications, and possibly macrovascular complications (19,22). However, there is no information linking repeated yearly episodes of short-term hyperglycemia (e.g., 4-week duration) and diabetes-related complications. Control of glycemia in patients with diabetes who fasted during Ramadan has been reported to deteriorate, improve, or show no change (21–25). The extensive EPIDIAR study showed a fivefold increase in the incidence of severe hyperglycemia (requiring hospitalization) during Ramadan in patients with type 2 diabetes (from 1 to 5 events · 100 people^{-1} · month^{-1}) and an approximate threefold increase in the incidence of severe hyperglycemia with or without ketoacidosis in patients with type 1 diabetes (from 5 to 17 events · 100 people^{-1} · month^{-1}) (6). Hyperglycemia may have been due to excessive reduction in dosages of medications to prevent hypoglycemia. Patients who reported an increase in food and/or sugar intake had significantly higher rates of severe hyperglycemia (6).

Diabetic ketoacidosis

Patients with diabetes, especially those with type 1 diabetes, who fast during Ramadan, are at increased risk for development of diabetic ketoacidosis, particularly if their diabetes is poorly controlled before Ramadan (6). In addition, the risk for diabetic ketoacidosis may be further increased due to excessive reduction of insulin dosages based on the assumption that food intake is reduced during the month.

Dehydration and thrombosis

Limitation of fluid intake during the fast, especially if prolonged, is a cause of dehydration. The dehydration may become severe as a result of excessive perspiration in hot and humid climates and among individuals who perform hard physical labor. In addition, hyperglycemia produces an osmotic diuresis, further contributing to volume and electrolyte depletion. Orthostatic hypotension may develop, especially in patients with preexisting autonomic neuropathy. Syncope, falls, injuries, and bone fractures may result from hypovolemia and the associated hypotension. In addition, contraction of the intravascular space can further exacerbate the hypercoagulable state that is well demonstrated in diabetes (23). Increased blood viscosity secondary to dehydration may enhance the risk of thrombosis and stroke (24). A report from Saudi Arabia suggested an increased incidence of retinal vein occlusion in patients who fasted during Ramadan (25). However, hospitalizations due to coronary events or stroke were not increased during Ramadan (26). There are no data concerning the effect of fasting on mortality in patients with or without diabetes.

MANAGEMENT — It is worth reemphasizing that fasting for patients with diabetes represents an important personal decision that should be made in light of guidelines for religious exemptions and after careful consideration of the associated risks in consultation with health care providers. Most often, the medical recommendation will be to not undertake fasting. However, patients who insist on fasting need to be aware of the associated risks of the fasting experience and techniques to decrease this risk. Patients may be at higher or lower risk for fasting-related complications depending on the number and extent of their risk factors. Conditions associated with "very high," "high," "moderate," and "low" risk for adverse events in patients with type 1 or type 2 diabetes who decide to fast during Ramadan are listed in Table 2.

Table 2— *Categories of risk in patients with type 1 or type 2 diabetes who fast during Ramadan*

Very high risk
Severe hypoglycemia within the 3 months prior to Ramadan
A history of recurrent hypoglycemia
Hypoglycemia unawareness
Sustained poor glycemic control
Ketoacidosis within the 3 months prior to Ramadan
Type 1 diabetes
Acute illness
Hyperosmolar hyperglycemic coma within the previous 3 months
Performing intense physical labor
Pregnancy
Chronic dialysis
High risk
Moderate hyperglycemia (average blood glucose 150–300 mg/dl or A1C 7.5–9.0%)
Renal insufficiency
Advanced macrovascular complications
Living alone and treated with insulin or sulfonylureas
Patients with comorbid conditions that present additional risk factors
Old age with ill health
Treatment with drugs that may affect mentation
Moderate risk
Well-controlled diabetes treated with short-acting insulin secretagogues
Low risk
Well-controlled diabetes treated with lifestyle therapy, metformin, acarbose, thiazolidinediones, and/or incretin-based therapies in otherwise healthy patients

Note: This classification is based largely on expert opinion and not on scientific data derived from clinical studies.

General considerations

Several important issues deserve special attention.

Individualization. Perhaps the most crucial issue is the realization that care must be highly individualized and that the management plan will differ for each specific patient.

Frequent monitoring of glycemia. It is essential that patients have the means to monitor their blood glucose levels multiple times daily. This is especially critical in patients with type 1 diabetes and in patients with type 2 diabetes who require insulin.

Nutrition. During Ramadan there is a major change in the dietary pattern compared with other times of the year. Most health problems are likely to arise from inappropriate diet or as a consequence of over-eating and insufficient sleep. Therefore, the diet during Ramadan for people with diabetes should not differ significantly from a healthy and balanced diet. The nutritional advice should be tailored to their special needs and medical problems. It should aim at maintaining a constant body mass. In most studies, 50–60% of individuals who fast maintain their body weight during the month, while 20–25% either gain or lose weight (6). The common practice of ingesting large amounts of foods rich in carbohydrates and fats, especially at the sunset

meal, should be avoided. Because of the delay in digestion and absorption, ingestion of foods containing "complex" carbohydrates (slow digesting foods) may be advisable at the predawn meal, which should be eaten as late as possible before the start of the daily fast. It is also recommended that fluid intake be increased during nonfasting hours.

Exercise. Normal levels of physical activity may be maintained. However, excessive physical activity may lead to a higher risk of hypoglycemia and should be avoided, particularly during the few hours before the sunset meal. Quite commonly, multiple prayers are performed after the sunset meal; this generally involves repeated cycles of rising, kneeling, and bowing and should be considered a part of the daily exercise program. In some patients with poorly controlled type 1 diabetes, exercise may lead to severe hyperglycemia.

Breaking the fast. All patients should understand that they must always and immediately end their fast if hypoglycemia (blood glucose of <60 mg/dl [3.3 mmol/l]) occurs because their blood glucose may drop further if they delay treatment. The fast should also be broken if blood glucose reaches <70 mg/dl (3.9 mmol/l) in the first few hours after the start of the fast, especially if insulin, sulfonylurea drugs, or meglitinide are taken at predawn. Finally, the fast should be broken if blood glucose exceeds 300 mg/dl (16.7 mmol/l). Patients should avoid fasting on "sick days."

Pre-Ramadan medical assessment

All patients with diabetes who wish to fast during Ramadan should prepare by undergoing a medical assessment and engaging in a structured education program to undertake the fast as safely as possible. This assessment should take place 1–2 months before Ramadan. Specific attention should be devoted to patients' overall well-being and to the control of their glycemia, blood pressure, and lipids. Appropriate blood studies should be ordered and evaluated. Specific medical advice must be provided to individual patients concerning the potential risks they must accept if they decide to fast. During this assessment, necessary changes in diet or medication regimen should be made so that the patient initiates fasting while on a stable and effective program. This assessment should also extend to those who do not wish to fast because they often are exposed to the risk of hypo- and hyperglycemia during Ramadan as a reflection of social habits encountered during the month.

Ramadan-focused structured diabetes education

The role of structured education for patients is well established in the management of diabetes. This should be extended to Ramadan-focused diabetes education. Many Muslims with diabetes are very passionate about fasting during Ramadan. This passion is a golden opportunity to empower people with diabetes for better management of their diabetes, not only during Ramadan but also throughout the year. However, many health care professionals find that they are unable to give the appropriate medical advice due to lack of knowledge about the optimum management of diabetes while fasting. Indeed, often people with diabetes feel that there is lack of harmony between the medical and the religious advice they receive. Hence, a Ramadan-focused diabetes educational program should ideally include three components:

1) An awareness campaign aimed at people with diabetes, health care professionals, the religious and community leaders as well as the general public
2) Ramadan-focused structured education for health care professionals
3) Ramadan-focused structured education for people with diabetes.

Raising the general awareness of Ramadan and diabetes should strengthen the harmony between medical and religious advice. This is of particular importance in non-Muslim countries where poor communication and understanding between these communities is commonplace. Greater understanding regarding the religious context and perspective regarding Ramadan and the act of fasting, as well as the potential risks and the medical options to achieve a safer outcome for those who wish to fast, is critical for all parties.

Health care professionals should be trained to deliver a structured patient education program that includes a better understanding of fasting and diabetes, individual risk quantification, and options to achieve safer fasting. This includes the importance of glucose monitoring during fasting and nonfasting hours, when to stop the fast, meal planning to avoid hypoglycemia and dehydration during prolonged fasting hours, and the appropriate meal choices to avoid postprandial hyperglycemia. The educational program should include advice on the timing and intensity of physical activity during fasting. Certainly, it is important that use of diabetes-related medications and their potential risk during fasting are also discussed.

A well-trained health care professional should be able to deliver all these components to people with diabetes either individually or in a group session at diabetes centers, primary health care centers, local mosques, and/or community centers. The ability to deliver this educational program in a simple, structured method and in the patients' own language is a distinct advantage, especially in multilingual communities. Certainly, many of the components of the program will help empower people with diabetes to take better care of themselves throughout the year.

An example of such an educational program, which involves increasing awareness and training for health care professionals and the local community about diabetes and Ramadan through a structured education program, was conducted in 2007 in the U.K. for a group of 111 people with type 2 diabetes (2). Though the group excluded people treated with insulin, secretagogues were used in over 90% of the people. Individualized medication dose adjustments were suggested to all patients. At the end of Ramadan, when compared with a control group comprising those who did not participate in the Ramadan-focused diabetes education, those who received such education exhibited a nearly 50% reduction in hypoglycemic event rates despite fasting, whereas those in the control group had experienced a fourfold increase in the rate of hypoglycemic events from baseline during fasting. It is important to note that this occurred while glycemic control was maintained at the same level for 12 months (2). Furthermore, the group that received structured education lost a small amount of weight compared to weight gain in the control group (27).

Management of patients with type 1 diabetes

Fasting at Ramadan carries a very high risk for people with type 1 diabetes. This risk is particularly exacerbated in poorly controlled patients and those with limited access to medical care, hypoglycemic unawareness, unstable glycemic control, or recurrent hospitalizations. In addition, the risk is also very high in patients who

are unwilling or unable to monitor their blood glucose levels several times daily. It is currently recommended that treatment regimens aimed at intensive glycemia management be used in patients with diabetes. The DCCT and its follow up, the Epidemiology for Diabetes Interventions and Complications (EDIC) study, demonstrated that intensive glycemia management is protective against microvascular and perhaps macrovascular complications and that the benefits are long lasting (19,28). Glycemic control at near-normal levels requires use of multiple daily insulin injections (three or more) or use of continuous subcutaneous insulin infusion through pump therapy. Close monitoring and frequent insulin dose adjustments in this setting are essential to achieve optimal glycemic control and avoid hypo- or hyperglycemia in patients with type 1 diabetes.

Some patients with type 1 diabetes prefer to fast at Ramadan, and most of them change their insulin regimens immediately before, during, and a few days after this month. However, very few studies have documented the safety and/or efficacy of different insulin regimens in type 1 diabetic patients who fast during the month of Ramadan. The current understanding is that the basal-bolus regimen is the preferred protocol of management. It is thought to be safer, with fewer episodes of hyper- and hypoglycemia. A frequently used option is once- or twice-daily injections of intermediate or long-acting insulin along with premeal rapid-acting insulin. It is unlikely that other regimens, including one or two injections of intermediate-, long-acting, or premixed insulin, would provide adequate insulin therapy. A recent small study with insulin glargine suggests the relative safety and efficacy of this agent in 15 relatively well-controlled patients with type 1 diabetes who fasted for 18 h and experienced a minimal decline in mean plasma glucose from 125 to 93 mg/dl with only two episodes of mild hypoglycemia (29). Another study in patients with type 1 diabetes using insulin glulisine, lispro, or aspart instead of regular insulin in combination with intermediate-acting insulin injected twice a day led to improvement in postprandial glycemia and was associated with fewer hypoglycemic events (30). Clinical studies with other types of insulin in multiple daily injection regimens during fasting are limited.

Continuous subcutaneous insulin infusion (pump) management is an appealing alternative strategy, but at a substantially greater expense. Compared with those who did not fast during Ramadan, patients with type 1 diabetes on insulin pump therapy who fasted showed a slight improvement in A1C (3).

Management of patients with type 2 diabetes

Diet-controlled patients. In patients with type 2 diabetes who are well controlled with lifestyle therapy alone, the risk associated with fasting is quite low. However, there is still a potential risk for occurrence of postprandial hyperglycemia after the predawn and sunset meals if patients overindulge in eating. Distributing calories over two to three smaller meals during the nonfasting interval may help prevent excessive postprandial hyperglycemia. Physical activity may be modified in its intensity and timing, e.g., ~2 h after the sunset meal.

Patients treated with oral agents. The choice of oral agents should be individualized. In general, agents that act by increasing insulin sensitivity are associated with a significantly lower risk of hypoglycemia than compounds that act by increasing insulin secretion.

Metformin. Patients treated with metformin alone may safely fast because the possibility of severe hypoglycemia is minimal. However, perhaps the timing of the doses should be modified to provide two-thirds of the total daily dose with the sunset meal and the other third before the predawn meal.

Glitazones. The thiazolidinedione or glitazone agents (pioglitazone and rosiglitazone) are not independently associated with hypoglycemia, though they can amplify the hypoglycemic effects of sulfonylureas, glinides, and insulin. However, they are associated with weight gain and anecdotally can be associated with increased appetite. The longstanding concerns regarding cardiovascular safety, caused by the increased frequency of heart failure, continue despite greater understanding that the mechanism of this adverse effect seems to be related to renal tubular sodium and water reabsorption and not to an intrinsic affect on cardiac contractility. More recently, apprehension has emerged regarding reports of increased frequency of macular edema and of bone fractures, particularly in postmenopausal women. The recent controversy regarding the cardiovascular safety of rosiglitazone seems to have been largely mitigated by the Rosiglitazone Evaluated for Cardiovascular Outcomes and Regulation of Glycaemia in Diabetes (RECORD) study, which failed to demonstrate either harm or benefit. Nevertheless, most perceive a relative advantage of pioglitazone compared with rosiglitazone vis-à-vis lipid effects. A practical issue of significant importance with respect to the utility of glitazones in periods of fasting such as Ramadan is that these agents require 2–4 weeks to exert substantial antihyperglycemic effects. Therefore, these agents cannot be quickly substituted for agents associated with hypoglycemia during periods of fasting (31).

Sulfonylureas. It has been suggested that this group of drugs is unsuitable for use during fasting because of the inherent risk of hypoglycemia. However, severe or fatal hypoglycemia is a relatively rare complication of sulfonylurea use. Nevertheless, their use should be individualized with caution. Use of chlorpropamide is relatively contraindicated during Ramadan because of the possibility of prolonged and unpredictable hypoglycemia. Similarly, it has been suggested that glyburide or glibenclamide may be associated with a higher risk of hypoglycemia than other second-generation sulfonylureas, specifically gliclazide, glimepiride, and glipizide (32,33). Finally, it should be noted that the sulfonylureas glyburide (glibenclamide) and gliclazide MR have played a central role in the long-term outcome studies UKPDS and ADVANCE (Action in Diabetes and Vascular Disease: Preterax and Diamicron MR Controlled Evaluation), both of which demonstrated microvascular benefits and at least trends toward improvements in cardiovascular disease without evidence of excess mortality (34). Additional studies on the use of sulfonylureas in patients who fast during Ramadan are needed before strong recommendations on their utility can be made. Nevertheless, because of their worldwide use and relatively low cost, these agents may be used in Ramadan, though with caution.

Short-acting insulin secretagogues. Members of this group (repaglinide and nateglinide) are useful because of their short duration of action. They could be taken twice daily before the sunset and predawn meals. One study in patients with type 2 diabetes who fasted showed that use of repaglinide was associated with less hypoglycemia compared with glibenclamide (35). Nateglinide has the shortest duration of action and therefore

the lowest risk of severe fasting hypoglycemia among the secretagogues.

Incretin-based therapy. Therapies that affect the incretin system include glucagon-like peptide-1 receptor agonists (GLP-1ras) exenatide and liraglutide and dipeptidylpeptidase-4 inhibitors (DPP-4is) alogliptin, saxagliptin, sitagliptin, and vildagliptin. These classes of agents are not independently associated with hypoglycemia, though they can increase the hypoglycemic effects of sulfonylureas, glinides, and insulin. Exenatide in particular can be dosed before meals to minimize appetite and promote weight loss. With its short half-life of 2 h, it is not associated with a substantial effect on fasting glucose. Liraglutide is dosed once a day, independent of meals, and is more effective in controlling fasting glycemia. Both require titration to effective doses over a period of 2–4 weeks and are associated with mild to moderate nausea in almost half of those exposed on at least one occasion, particularly as therapy is initiated. DPP-4is are among the best tolerated drugs for the treatment of diabetes. They are moderately less effective in A1C lowering than GLP-1ras and, importantly vis-à-vis treatment during Ramadan, do not require titration. Many have touted their potential role as a substitute for sulfonylureas. However, there are no specific studies of these agents during periods of fasting with respect to either tolerability or efficacy (36).

α-Glucosidase inhibitors. Acarbose, miglitol, and voglibose slow the absorption of carbohydrates when taken with the first bite of a meal. Because they are not associated with an independent risk of hypoglycemia, particularly in the fasting state, they may be particularly useful during Ramadan. However, they are only modestly effective and exert little or no effect on fasting glucose, and therefore are usually used in combination with other agents to control fasting glucose. α-Glucosidase inhibitors are associated with frequent mild to moderate gastrointestinal effects, particularly flatulence. Using modest doses and slowly initiating therapy are reported to minimize the frequency of these adverse effects (37).

Patients treated with insulin. Problems facing patients with type 2 diabetes who administer insulin are similar to those with type 1 diabetes, except that the incidence of hypoglycemia is less. Again, the aim is to maintain necessary levels of basal insulin to prevent fasting hyperglycemia. An effective strategy would be judicious use of intermediate- or long-acting insulin preparations plus a short-acting insulin administered before meals. Although hypoglycemia tends to be less frequent, it is still a risk, especially in patients who have required insulin therapy for a number of years or in whom insulin deficiency predominates in the pathophysiology. Very elderly patients with type 2 diabetes may be at especially high risk.

Using one injection of a long-acting or intermediate-acting insulin can provide adequate coverage in some patients as long as the dosage is appropriately individualized; however, most patients will require rapid- or short-acting insulin administered in combination with the basal insulin at meals, particularly at the evening meal, which typically contains a larger caloric load. There is some evidence suggesting that use of a rapid-acting insulin analog instead of regular human insulin before meals in patients with type 2 diabetes who fast during Ramadan is associated with less hypoglycemia and smaller postprandial glucose excursions (38,39). In a recent study, the use of premixed lispro with neutral protamine lispro in a 50:50 ratio for the evening meal and regular human insulin with NPH in a 30:70 ratio at the early morning meal during Ramadan compared with regular human insulin at 30:70 twice daily was associated with moderate improvement in glycemic control and hypoglycemia (40).

Insulin pumps. An insulin pump provides continuous insulin delivery over 24 h with basal infusion rates programmed and individualized for each patient. Patients self-administer boluses of insulin with meals or at times of hyperglycemia, often with mathematical support from the pump. The reliance on exclusively rapid-acting or short-acting insulin allows for flexibility over an extremely wide range of insulin doses with great precision. However, frequent glucose monitoring is required because failure of the pump or the infusion site can result in severe deterioration in control over a few hours. Theoretically, the combined risks of hypoglycemia from prolonged daytime fasting and hyperglycemia from excessive nighttime eating can be better managed by an insulin pump–based regimen than by multiple insulin dose–injection therapy. Hypoglycemia can be aborted, reduced, prevented, and even more readily treated in pump-treated patients by timely downward adjustments or even stopping insulin delivery from the pump. Such an advantage is not available to those treated with a conventional insulin injection in which insulin continues to be released from the site of injection throughout its predetermined duration of action. Any excess insulin action can only be counteracted by intake of carbohydrates.

Fasting at Ramadan may be successfully accomplished in people with type 1 diabetes if they are fully educated and facile with the use of the insulin pump and are otherwise metabolically stable and free from any acute illnesses. Prior to Ramadan, they should receive adequate training and education, particularly with respect to self-management and insulin dose adjustment. They should adjust their infusion rates carefully according to results of frequent home blood glucose monitoring. Most will need to reduce their basal infusion rate while increasing the bolus doses to cover the predawn and sunset meals.

Diabetic medication adjustment during Ramadan

Illustrative examples and recommendations for adjusting therapy during Ramadan in patients with type 2 diabetes are shown in Table 3.

Pregnancy and fasting during Ramadan

Pregnancy is a state of increased insulin resistance and insulin secretion and of reduced hepatic insulin extraction. Fasting glucose concentrations are lower and postprandial glucose and insulin levels are substantially higher in healthy pregnant women than in healthy women who are not pregnant. Elevated blood glucose and A1C levels in pregnancy are associated with increased risk for major congenital malformations. Fasting during pregnancy would be expected to carry a high risk of morbidity and mortality to the fetus and mother, although controversy exists (41). While pregnant Muslim women are exempt from fasting during Ramadan, some with known diabetes (type 1, type 2, or gestational) insist on fasting. These women constitute a high-risk group, and their management requires intensive care (42).

In general, women with pregestational or gestational diabetes are at very high risk and may be strongly advised not to fast during Ramadan. However, if they insist on fasting, special attention should be given to their care. Pre-Ramadan eval-

Table 3—*Recommended changes to treatment regimen in patients with type 2 diabetes who fast during Ramadan*

Before Ramadan	During Ramadan
Patients on diet and exercise control	Consider modifying the time and intensity of physical activity; ensure adequate fluid intake
Patients on oral hypoglycemic agents	Ensure adequate fluid intake
Biguanide, metformin 500 mg, three times daily	Metformin, 1,000 mg at the sunset meal, 500 mg at the predawn meal
TZDs, AGIs, or incretin-based therapies	No change needed
Sulfonylureas once a day	Dose should be given before the sunset meal; adjust the dose based on the glycemic control and the risk of hypoglycemia
Sulfonylureas twice a day	Use half the usual morning dose at the predawn meal and the usual dose at sunset meal
Patients on insulin	Ensure adequate fluid intake
Premixed or intermediate-acting insulin twice daily	Consider changing to long-acting or intermediate insulin in the evening and short or rapid-acting insulin with meals; take usual dose at sunset meal and half usual dose at predawn meal

AGI, α-glucosidase inhibitor; TZD, thiazolidinedione. Note: The recommendations given in this table are for illustrative purposes and are largely based on expert clinical opinion and not on scientific data derived from clinical studies. The recommendations must be adjusted for each specific patient. Adapted from Akbani et al. (43).

uation of their medical condition is essential. This includes preconception care with emphasis on achieving near-normal blood glucose and A1C values, counseling about maternal and fetal complications associated with poor glycemic control, and education focused on self-management skills. Ideally, patients should be managed in high-risk clinics staffed by an obstetrician, diabetologists, a nutritionist, and diabetes nurse educators. The management of pregnant patients during Ramadan is based on an appropriate diet and intensive insulin therapy. The issues discussed above concerning the management of type 1 and type 2 diabetes also apply to this group, with the exception that more frequent monitoring and insulin dose adjustment is necessary.

Management of hypertension and dyslipidemia

Dehydration, volume depletion, and a tendency toward hypotension may occur with fasting during Ramadan, especially if the fast is prolonged and is associated with excessive perspiration. Hence, the dosage and/or the type of antihypertensive medications may need to be adjusted to prevent hypotension. Diuretics may not be appropriate during Ramadan for some patients. It is a common practice that the intake of foods rich in carbohydrates and saturated fats is increased during Ramadan. Appropriate counseling should be given to avoid this practice, and agents that were previously prescribed for the management of elevated cholesterol and triglycerides should be continued.

CONCLUSIONS — Fasting during Ramadan for patients with diabetes carries a risk of an assortment of complications. In general, patients with type 1 diabetes are at very high risk of life-threatening complications. Patients with type 1 diabetes who have a history of recurrent hypoglycemia or hypoglycemia unawareness or who are poorly controlled are at very high risk for developing severe hypoglycemia. On the other hand, an excessive reduction in the insulin dosage in these patients (to prevent hypoglycemia) may place them at risk for hyperglycemia and diabetic ketoacidosis. Hypo- and hyperglycemia may also occur in patients with type 2 diabetes, but is generally less frequent and has less severe consequences than in patients with type 1 diabetes. A patient's decision to fast should be made after ample discussion with a health care provider concerning the risks involved. Patients who insist on fasting should undergo pre-Ramadan assessment and receive appropriate education and instructions related to physical activity, meal planning, glucose monitoring, and dosage and timing of medications.

Newer pharmacological agents have lesser hypoglycemic potential and may have specific advantages during Ramadan. Similarly, insulin pump therapy may provide greater safety in the Ramadan setting. There are a few studies of these newer techniques in the Ramadan setting with encouraging results, but in general this challenging therapeutic situation has not been adequately addressed in clinical trials.

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