Canadian Collaboration for Immigrant and Refugee Health (CCIRH)
Full Text

GUIDELINES FOR IMMIGRANT HEALTH

Appendix 14: Type 2 diabetes mellitus: evidence review for newly arriving immigrants and refugees

Arunmozhi Dominic MD, Kevin Pottie MD MClSc, Dominique Elien Massenat MD, Elizabeth Harvey RN, Jianwei Zhong PhD, Stewart B. Harris MD MPH; for the Canadian Collaboration for Immigrant and Refugee Health

Department of Medicine (Dominic), University of Western Ontario; Departments of Family Medicine and Epidemiology and Community Medicine, Centre for Global Health, Institute of Population Health and C.T. Lamont Primary Health Care Research Centre, Élisabeth Bruyère Research Institute (Pottie), University of Ottawa; Community Medicine (Massenat), University of Ottawa; (Harvey), University of Western Ontario; C.T. Lamont Primary Health Care Research Centre, Élisabeth Bruyère Research Institute (Zhong); Centre for Studies in Family Medicine, Department of Family Medicine, Schulich School of Medicine and Dentistry (Harris), University of Western Ontario.

ABSTRACT

Background: The worldwide prevalence of type 2 diabetes mellitus is expected to double in the next two decades. Certain ethnicities are known to have higher prevalence of type 2 diabetes and may be at increased risk for diabetes complications. We conducted an evidence review to determine the burden of type 2 diabetes within immigrant populations; to evaluate the effectiveness of early detection and treatment; and to identify clinical considerations for prevention and treatment in primary care.

Methods: We systematically assessed evidence on type 2 diabetes screening and treatment for newly-arriving immigrant and refugee adults: benefits and harms, applicability, clinical considerations and implementation issues were considered. The quality of the evidence was assessed using the GRADE approach.

Results: South Asian, Latin American, and African immigrant ethnicities are at risk for diabetes at a younger age and face a two-to-four fold higher prevalence of type 2 diabetes compared to Canadian-born Caucasians. Age and obesity, especially when measured by waist circumference, are good predictors of risk of diabetes. Screening and treating pre-diabetes with lifestyle interventions can delay the onset of diabetes. Early detection and treatment of diabetes can reduce the risk of micro- and macro- vascular diabetes-related complications; lowering high blood pressure can reduce overall mortality. Culturally- appropriate diabetes education and lifestyle interventions are more effective at controlling sugars than standard approaches.

Interpretation: Immigrant and refugee adults from certain ethnicities are vulnerable to type 2 diabetes and its complications. This review highlights the importance of age, ethnicity, and abdominal obesity in predicting diabetes and the role for culturally appropriate lifestyle interventions and appropriate blood pressure control to reduce related cardiovascular complications.

Competing interests: None declared.

Contributors: All of the authors contributed to the conception and refinements of the study design and the analysis and interpretation of the data. Arunmozhi Dominic drafted the initial manuscript, and all of the other authors provided critical revisions. All of the authors approved the final manuscript submitted for publication.

Acknowledgements: We would like to thank Ayesha Ratnayake, Ricardo Batista and Roo Deinstadt for their editing and formatting support. Additionally, we would like to acknowledge Jennifer Creer for providing helpful feedback on earlier drafts of this manuscript, Lynn Dunikowski for providing expert librarian support and Sarah McDermott for contributing to the literature review.

Funding: The authors acknowledge the funding support of the Canadian Institutes of Health Research Institute of Health Services and Policy Research, the Champlain Local Health Integration Network, and the Calgary Refugee Program. The Public Health Agency of Canada (PHAC) contributed funding for the development and publication of reviews of the scientific evidence on select topics related to PHAC programs of work. The conclusions and recommendations made in the guidelines were independently developed by the Canadian Collaboration for Immigrant and Refugee Health. The views expressed in this report are the views of the authors and do not necessarily reflect those of PHAC and other funders.

Box 1: Recommendations on type 2 diabetes mellitus from the Canadian Collaboration for Immigrant and Refugee Health

Screen immigrants and refugees >35 years of age from ethnic groups at high risk for type 2 diabetes (South Asian, Latin American and African) with fasting blood glucose.

Basis of recommendation

- **Balance of benefits and harms:** Detecting impaired fasting glucose and treating with diet and exercise can delay the onset of diabetes (NNT 5, CI 4 to 6). Treating diabetes patients with intensive blood pressure interventions can decrease mortality (NNT 38, CI 23 to 203), and tight glucose control can decrease myocardial infarctions (NNT 131, CI 87 to 298). Certain ethnicities face a two-to-four fold higher prevalence of type 2 diabetes with earlier onset compared to Caucasians. Minimal harms are reported for lifestyle interventions and side effects of antihyperglycemic agents.
- **Quality of evidence:** Moderate
- **Values and preferences:** The Committee attributed more value to delaying the onset of diabetes than to the current uncertainty of impact on mortality for lifestyle interventions. The Committee attributed value to the potential to decrease morbidity and mortality with treatment of hypertension and hyperglycaemia in high-risk ethnic populations than to concern of harms due to treatments.

The cases

Omar, a non-English/ Arabic speaking 45-year-old engineer from Sudan who has been in Hamilton for the past 10 months as a landed immigrant, presents for routine exam. He has gained weight over the winter months and, after learning he has a high-risk waist circumference, he consents to a fasting glucose.

Yolanda, a non-English/Spanish-speaking 35-year-old woman from Colombia spent two years as a refugee before coming to Canada for permanent resettlement. Shortly after arrival, her family physician notes her fasting glucose is 6.5 mmol/L.

How would you manage these patients?

Introduction

The World Health Organization estimates there are 171 million persons with diabetes around the world (2.8% prevalence, including all age groups); this number is expected to double by 2030.[1,2] Type 2 diabetes is recognized five-to-12 years after hyperglycaemia develops.[3] Diabetes screening efficiency improves when targeted at undiagnosed and high-risk populations.[4]

More than two million Canadians have diabetes mellitus and, by the end of this decade, this number is expected to be three million.[1] South Asian, Latin American, and African ethnicities have a two-to-four-times greater risk for developing type 2 diabetes than the Caucasian population.[5,6] Up to fifty percent of Canada's recent immigrants come from South Asia, Latin America and the Caribbean.[6] We conducted an evidence review to estimate the diabetes burden for immigrant and refugee populations in Canada; to evaluate the effectiveness of diabetes screening with prevention and treatment; and to identify barriers and facilitators to diabetes prevention and treatment in primary care.

Methods

We used the 14-step-methods approach developed by the Canadian Collaboration for Immigrant and Refugee Health (CCIRH).[7] We constructed a Clinician Summary Table to highlight populations of interest, including the epidemiology, clinical considerations, and potential key clinical actions (Appendix 2). We then constructed a logic model to define the clinical preventive actions, outcomes, and key clinical questions.

Search strategy for systematic reviews and guidelines

We designed a search strategy with a librarian scientist to identify relevant systematic reviews and guidelines from electronic databases (MEDLINE, CINAHL, Embase and Cochrane Database of Systematic Reviews) and websites including the National Guideline Clearinghouse (http://www.guideline.gov/), Public Health Agency of Canada (http://www.phac-aspc.gc.ca), United States Preventive Services Task Force (http://www.ahrq.gov/clinic/USpstfix.htm), Canadian Task Forces on Preventive Health Care (http://www.ctfphc.org/), and the World Health Organization (WHO) (http://www.who.int/en/). The search focused on articles published from January 1 1995- January 1 2009. Two reviewers screened eligible systematic reviews for relevance to our key questions. We appraised eligible systematic reviews using the National Institutes for Health and Clinical Evidence (NICE) critical appraisal tool to assess systematicity, transparency, quality of methods and relevance, and appraised relevant guidelines using the AGREE Instrument. We chose a reference systematic review for each clinically important outcome.

We conducted a second literature search from January 1, 2009- July 14, 2010 to assess whether the reference

systematic reviews needed to be updated or supplemented with recent studies. Studies were included if the study design was a randomized controlled trial, controlled clinical trial, or cohort study utilizing a placebo or no treatment comparison that was relevant to key questions. Using the same databases, we conducted a third literature search from December 1, 1998- January 1, 2009 to identify studies on type 2 diabetes mellitus focusing on immigrant and refugee populations: 1) baseline risk or prevalence; 2) risk of clinically important outcomes; 3) genetic and cultural factors (e.g., preferences, values, knowledge) and potential; and 4) compliance variation.

Synthesis of evidence and values

We synthesized the evidence from systematic reviews and pertinent cohort and clinical trials using the GRADE summary of findings tables that assess both relative and absolute effects of interventions. We also appraised evidence quality for each outcome using the GRADE quality assessment tool that assesses study limitations, directness, precision, consistency, and publication bias across all studies (Box 2). In the clinical considerations data synthesis, we reported implementation issues. Finally, we identified gaps in the research.

Results

The first literature search, focusing on reviews and guidelines, yielded 630 articles. None discussed screening effectiveness in immigrants and refugees and related prevention of cardiovascular complications. There were two systematic reviews and a meta-analysis focusing on the genetic risk factors predisposing high-risk ethnic groups to diabetes.[8-10] Additionally, there was a systematic review[11] and a meta-analysis[12] on the disparities in type 2 diabetes treatment between high-risk ethnic groups and the general Caucasian population. Finally, there were two systematic reviews on culturally-appropriate treatment of type 2 diabetes in high-risk populations.[13,14]

Since no population-specific screening guidelines were found for immigrant populations, we enlarged the search for systematic reviews to include screening and type 2 diabetes treatment in the general population. This search yielded 905 reviews. We selected the US Preventive Services Task Force article on screening effectiveness for type 2 diabetes in the general population as the most recent, relevant, high quality systematic review.[4] We also selected a review on the case and disease management of adults with diabetes.[15] The updated search, building on the Canadian Diabetes Association's 2008 Clinical Practice Guidelines[16] and the United States Task Force's systematic review[4] on type 2 diabetes prevention and management for screening and treatment effectiveness, yielded an additional 21 articles; two were particularly relevant.[17,18] We also identified a meta-analysis of randomised controlled trials[19] that studied the impact of tight gylycemic controls on morbidity and mortality. Additionally, the Canadian Diabetes Association guidelines addressed high-risk population screening issues.[16] (Appendix 1)

The literature search for articles relevant to immigrants and refugees yielded 2020 articles; 220 addressed the prevalence, burden of disease, disease risk, or barriers to care for immigrants and refugees. A recent Cochrane systematic review on culturally- appropriate health education for type 2 diabetes in ethnic minorities was central to our clinical considerations.[17]

What is the burden of type 2 diabetes in immigrant and refugee populations?

Diabetes prevalence is increasing worldwide, most notably in South Asia, Sub-Saharan Africa, and Latin America, regions that are major contributors to international migration. India has the largest prevalence, estimated to be 31 million in 2000.[2] Contributory factors cited for increased type 2 diabetes prevalence include genetic susceptibility;[9,10] increasing sedentary lifestyle;[20] changing food habits;[21] increasing levels of adult and childhood obesity; low health literacy; and low socio-economic status. A shift to a "westernized" lifestyle is a contributing factor in the increase of type 2 diabetes in developing countries.[22,23]

Type 2 diabetes is a complex genetic disease comprised of many metabolic disorders, with a common phenotype of glucose intolerance.[24] Some genetic variants are specific to various ethnicities[24] and several studies have identified genetic risk factors in South Asian,[25,26] Hispanic,[27] and African ethnicities.[28] In Canada, approximately 50% of new immigrants[29] are South Asian, Latin American, and African and face a two-to-four fold higher type 2 diabetes prevalence than Caucasians[30-32] and experience younger age onset.[33] A recent linked-database prevalence study in Ontario[6] confirmed these disparities: South Asian (Odds Ratio: men 4.01 (CI), women 3.22 (CI)), Latin American (Odds Ratio: men 2.18, women 2.40 women) and Sub-Saharan Africa (Odds Ratio: men 2.31. women 1.83). Diabetes-related mortality has also been reported as higher among Latin Americans in the USA[34] and South Asians in the United Kingdom than whites.[34]

Age is also an important risk factor for diabetes; and the average age at diagnosis is decreasing; for example,

from 52.0 to 46.0 years in the US (P <.05)[33] and most dramatically in Black, Asian and Hispanic populations. In India, there is a significantly higher type 2 diabetes \prevalence in age groups 35-to-44 years (8.5 to 11.5% p = 0.05).[35]

Overweight or obesity are other important risk factors for diabetes.[36] Central adiposity results in a higher degree of insulin resistance and hence confers a higher risk for diabetes and premature coronary artery disease.[37] A recent study conducted among a high-risk population of Jamaica found that the sensitivity and specificity of waist circumference in predicting type 2 diabetes is 71% and 79% in men and 65% and 60% in women, respectively[38] suggesting waist circumference can be a useful alternative to Body Mass Index. The recent Canadian Diabetes Association guidelines include a chapter on using ethnic-specific Body Mass Index and waist circumference cutoffs to screen high-risk ethnic groups.[16] The International Diabetes Federation has recommended using ethno-specific waist circumference as a cut-off parameter for screening these high-risk populations (Table 1).[39,40]

Table 1: Country/ethnic-specific values for waist circumference

Country/ethnic group	Waist circumference† (as measure of central obesity)	
Europids*	Male	≥ 94 cms
	Female	≥ 80cms
South Asians ‡	Male	≥ 90cms
	Female	≥ 80cms
Chinese	Male	≥ 90cms
	Female	≥ 80cms
Japanese§	Male	≥ 85cms
	Female	≥ 90cms
Ethnic South and Central Americans	Use South Asian recommendations until more specific data are available	
Sub-Saharan Africans	Use European data until more specific data are available	
Eastern Mediterranean and Middle East	Use European data until more specific data are available for (Arab) populations	

These are pragmatic cut-points and better data are required to link them to risk. Ethnicity should be the basis for classification, not the country of residence.
*In the USA the Adult Treatment Panel III values (102 cm male; 88 cm female) are likely to continue to be used for clinical purposes.
†In future epidemiological studies of populations of Europid origin, prevalence should be given using both European and North American cut-points to allow better comparisons.
‡Based on a Chinese, Malay and Asian-Indian population.
§Subsequent data analyses suggest that that Asian values (male 90 cm; female 80 cm) should be used for Japanese populations until more data are available.

Newly-arriving immigrants and refugees to Canada may also be at increased risk for diabetes due to migration stress[39] and cultural and linguistic limitations barring diabetic education and health services.[13,14,17,41] These barriers contribute to delayed diagnosis in immigrant populations groups and increased risk for obesity and impaired glucose tolerance.

Does diabetes screening decrease its incidence and/or related cardiovascular complications?

Screening tests

Fasting plasma glucose (FPG) is considered the most appropriate diabetes screening test.[18,42] FPG and the 75-g oral glucose tolerance test (OGTT) are both suitable tests for diabetes; however, the FPG test is preferred in clinical settings because it is easier, faster to perform, more reproducible, more convenient and acceptable, and less expensive.[43-45] A recent systematic review also concluded that HbA1C and FPG are equally effective screening tools, but HbA1c is more costly than FPG.[44]

A fasting plasma glucose level of 7.0 mmol/L has a moderate sensitivity (40%– 87%), but good specificity (96%–99%), to predict a plasma glucose level of 11.1 mmol/L in two-hour OGTT.[46-49] Lowering the fasting plasma glucose threshold to 6.1 mmol/L improves the test's sensitivity (66%– 95%), at the cost of specificity (90%–96%).[50]

Relative benefits and harms of treatment

In consultation with the Canadian Committee for Immigrant and Refugee Health methods group, we chose decreased diabetes incidence and reduced morbidity and mortality from cardiovascular complications as desirable effects; socioeconomic harms from labelling and medication side effects are relevant undesirable effects. We synthesized effectiveness estimates to summarize relative effects for each of these outcomes using the Summary of Findings table format developed by the Cochrane Collaboration.[51]

The United States Task Force meta-analysis (2008) on lifestyle interventions in pre-diabetes[52] showed a significant decrease in diabetes onset: RR 0.48 (0.4 to 0.58). This meta-analysis included five moderate-to-high-quality randomized controlled trials and demonstrated consistently positive effects. Using the GRADE approach we rated the quality of this evidence as high. Researchers need to study the long-term morbidity and mortality effects of delaying diabetes onset, which is the main limitation for this evidence (see Table 2).

Table 2: Summary of Findings: Lifestyle modifications for prevention of Type 2 diabetes

Patient or population: patients at high risk to Type 2 diabetes, with impaired fasting glucose
Settings: outpatient/ community health clinics
Intervention: Lifestyle modifications for person with impaired fasting glucose
Source: Harris R, Donahue K, Rathore SS, Frame P, Woolf SH, Lohr KN. Screening adults for type 2 diabetes: a review of the evidence for the U.S. Preventive Services Task Force. *Ann Intern Med* 2003;138(3):215-29.

Outcomes	Absolute effect		Relative effect (95% CI)	No of Participants (studies)	Quality of the evidence (GRADE)	Comments
	Risk for control group	Difference with lifestyle modifications (95% CI)				
Decrease incidence in Type 2 Diabetes FPG, OGTT (follow-up: mean 3.8 years)	**Medium risk population**		**RR 0.48** (0.4 to 0.58)	5275 (5)	**high**[1,2,3]	**NNT 5** (4 to 6)
	471 per 1000	**245 less per 1000** (57 less to 28 less per 1000)				

*The basis for the **assumed risk** (e.g. the median control group risk across studies) is provided in footnotes. The **corresponding risk** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).
CI: Confidence interval; RR: Risk ratio;

GRADE Working Group grades of evidence
High quality: Further research is very unlikely to change our confidence in the estimate of effect.
Moderate quality: Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
Low quality: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
Very low quality: We are very uncertain about the estimate.

[1] Test for heterogeneity: Q = 6.104; P = 0.192
[2] These studies applied to our population group (i.e. >35yrs, Canadian, Ethnic groups)
[3] There were sufficient participants in all studies and most events recorded were minimal in intervention compared to control group.

Additionally, we identified a Cochrane systematic review[17] with 11 randomized controlled trials that showed that culturally-appropriate health education was effective in reducing blood sugars and increasing diabetes knowledge in ethnic minority groups, at least short term.

None of these trials reported significant adverse effects from lifestyle interventions; evidence was insufficient to comment on the negative theoretical impact of labelling.

Diabetes is associated with a two fold increase in risk of cardiovascular complications and the United States Task Force systematic review (2008)[52] identified blood pressure as the most important cardiovascular risk factor. The United States Task Force (2003)[18] identified a large well conducted trials[53] and a meta analysis[53] that showed aggressive blood pressure control in diabetes reduces cardiovascular morbidity and mortality. These trials reported minor adverse drug reactions such as cough with some antihyptertensives and no harms related to socioeconomic implications of diagnosis and treatment (see Table 3).

A recent meta-analysis[19] selected five prospective randomized controlled trials evaluating the effect of intensive glucose control on cardiovascular outcomes and death. This study showed a small but significant decrease in myocardial infarctions in the treatment group, which had an Hgb A1C of 0.9% lower than the control group, but no effect on events of stroke or mortality (see Table 4).

Populations and individuals who would benefit the most from screening have undiagnosed, longstanding disease; intensive lifestyle and/ or hypertension interventions would have the greatest absolute effect.[52] Screening for diabetes is most efficient when targeted to populations with risk factors;[54-59] for example, in the Diabetes Prevention Program,[60] key factors included age, high-risk ethnicity, and obesity. Waugh et al., (2007)[61] in an economic modelling study, concluded risk-factor targeted screening would be cost-effective.

Clinical considerations

Does screening for Type 2 diabetes occur during the migration process?

All immigrants and refugees coming to Canada undergo the Citizenship and Immigration Canada Immigration Medical Examination, which includes screening for a history of diabetes and a urinalysis for glucose and

Table 3: Summary of Findings: Should intensive antihypertensive treatment be used in patients with Type 2 Diabetes to prevent cardiovascular disease?

Patient or population: patients with patients with type 2 diabetes and hypertension
Settings: hospital outpatient / community health clinics
Intervention: intensive blood pressure control
Comparison: moderate blood pressure control
Source: Turnbull F, Neal B, Algert C et al. Effects of different blood pressure-lowering regimens on major cardiovascular events in individuals with and without diabetes mellitus: results of prospectively designed overviews of randomized trials. *Arch Intern Med* 2005;165(12):1410-9.

Outcomes	Absolute effect		Relative effect (95% CI)	No of Participants (studies)	Quality of the evidence (GRADE)	Comments
	Risk for moderate blood pressure control group	Difference with intensive blood pressure control (95% CI)				
Decrease incidence of stroke definitions from the International Classification of Disease, Ninth Revision (ICD-9) Follow-up: mean 166.9 years	**Study population**		**RR 0.64** (0.46 to 0.89)	3599 (27 studies)	**moderate**[1,2]	**NNT 61** (41 to 198)
	46 per 1000	**17 less per 1000** (4 less to 24 less per 1000)				
Decrease in cardiovascular events definitions from the International Classification of Disease, Ninth Revision (ICD-9) Follow-up: mean 166.9 years	**Study population**		**RR 0.75** (0.61 to 0.94)	3599 (27 studies)	**moderate**[1,2]	**NNT 29** (19 to 120)
	140 per 1000	**35 less per 1000** (50 less to 97 less per 1000)				
Decrease cardiovascular death definitions from the International Classification of Disease, Ninth Revision (ICD-9) Follow-up: mean 166.9 years	**Study population**		**RR 0.67** (0.40 to 1.12)	3599 (27 studies)	**low**[1,2,3]	**NNT 48** (not stat.sig.)
	64 per 1000	**21 less per 1000** (5 less to 51 less per 1000)				
Decrease total mortality definitions from the International Classification of Disease, Ninth Revision (ICD-9) Follow-up: mean 166.9 years	**Study population**		**RR 0.73** (0.56 to 0.95)	3599 (27 studies)	**moderate**[1,2]	**NNT 38** (23 to 203)
	99 per 1000	**27 less per 1000** (28 less to 67 less per 1000)				

*The basis for the **assumed risk** (e.g. the median control group risk across studies) is provided in footnotes. The **corresponding risk** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).
CI: Confidence interval; **RR:** Risk ratio;

GRADE Working Group grades of evidence
High quality: Further research is very unlikely to change our confidence in the estimate of effect.
Moderate quality: Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
Low quality: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
Very low quality: We are very uncertain about the estimate.

[1] The heterogeneity is not indicated in these studies involving diabetic patients but only includes the heterogeneity value for overall studies including diabetics and non diabetics.
[2] The population of interest would include the age group starting from 35years of age whereas the mean age of participants in these studies were 59.6 to 60ars of age. Additionally, most participants with diabetes might have been diagnosed for many years and are symptomatic. However our clinical action would involve screening patients who are asymptomatic.
[3] Wide confidence interval including null effect.

protein. Fasting blood glucose and other related tests are done only on select individuals.

What are potential implementation issues?

Approximately fifty percent of newly arriving immigrants to Canada are from ethnicities at high risk for type 2 diabetes. Cultural differences can also contribute. For

DOI 10.1503/cmaj.090313.

Table 4: Summary of Finding: intensive blood glucose control to decrease cardiovascular

Patient or population: patients with diabetes type II
Settings: hospital outpatient and primary care clinics
Intervention: intensive blood glucose control for patients with Type 2 Diabetes

Source: Ray KK, Seshasai SR, Wijesuriya S et al. Effect of intensive control of glucose on cardiovascular outcomes and death in patients with diabetes mellitus: a meta-analysis of randomised controlled trials. *Lancet* 2009;373(9677):1765-72.

Outcomes	Absolute effect		Relative effect (95% CI)	No of Participants (studies)	Quality of the evidence (GRADE)	Comments
	Risk for control group	Difference with intensive blood glucose control (95% CI)				
Non fatal MI	**48 per 1000**	**8 less per 1000** (28 less to 37 less per 1000)	**RR 0.84** (0.76 to 0.93)	33040 (5 studies)	**high**	**NNT 131** (87 to 298)
Stroke events	**34 per 1000**	**2 less per 1000** (26 less to 34 less per 1000)	**RR 0.93** (0.82 to 1.06)	33040 (5 studies)	**high**	**NNT 421** (not stat.sig.)
All cause mortality	**84 per 1000**	**2 more per 1000** (72 more to 96 more per 1000)	**RR 1.02** (0.88 to 1.17)	33040 (5 studies)	**high**	**NNT 596** (not stat. sig.)
Psychological effects of screening - not measured	See comment	See comment	Not estimable	-	See comment	USPTF (Norris 2008): Data on psychological effects of screening for type 2 diabetes, none of data suggested significant adverse effects at up to 1 year fu

*The basis for the **assumed risk** (e.g. the median control group risk across studies) is provided in footnotes. The **corresponding risk** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).
CI: Confidence interval; **RR:** Risk ratio;

GRADE Working Group grades of evidence
High quality: Further research is very unlikely to change our confidence in the estimate of effect.
Moderate quality: Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
Low quality: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
Very low quality: We are very uncertain about the estimate.

example, Muslims observe the religious tradition of fasting during Ramadan. This period not only has special implications for dietary recommendations,[62] but also practitioners need to appreciate the cultural importance of participating in fasting and subsequent community celebrations. Another example of cultural variation is the perception among certain Africans that weight gain and obesity are signs of good health. Additionally, Canada's northern climate often means a significant lifestyle and physical activity shift.[29] Some immigrants may also have gone through "transit migration" before they arrive in Canada: indeterminate residence of migrants, legal or illegal, in a receiving country, that may or may not develop into further emigration.[63] Financial insecurity, challenges finding employment, retraining, and re-establishing support networks once in Canada may contributes to migration stress. Migration stress may impact both risk factors for diabetes and ability to adhere to clinical recommendations related to type 2 diabetes and related complications.

Lifestyle interventions including counselling for dietary modifications, weight reduction, and increased exercise are central to diabetes management. A recent Cochrane systematic review[64] found diet and lifestyle reduced weight and incidence of diabetes, but was more effective in younger populations. Others have found that diabetes-related education is less effective in situations of low socioeconomic and cultural factors.[63,65,66] Socio-economic and cultural and communication barriers can impair access to good quality diabetes care and education. Consequently, new immigrants are less likely to use or know about diabetes preventive services.[67] The

approach to managing diabetes is multidisciplinary, including involvement of primary care practitioners, specialists and self-management programs. Surveys and qualitative studies from various ethnic groups have shown gender preferences and wishes that practitioners could adapt dietary and exercise advice to fit with a particular community.[14,66,68]

A recent Cochrane systematic review[17] synthesized evidence from 11 randomized controlled trials studying the effect of culturally-appropriate health education for type 2 diabetes, including health education delivery and considering the cultural background of the individual or group at whom the intervention was directed. Their results showed improved glycaemic control (HgA1C), knowledge scores, and an improvement in the intervention groups at three months and six months compared to standard approaches. Other outcomes, such as lipid levels and blood pressure, showed no significant difference from control groups. The authors concluded that, at least short term, culturally-appropriate diabetes health education improved sugar levels and knowledge. Another systematic review,[69] looking at diabetic care in socially disadvantaged populations, reports that interventions can improve and include culturally-tailored care, focusing on individuals in assessment and feedback and incorporating treatment algorithms.

Language and cultural barriers remain key issues in care delivery.[13,14,41] In addition, certain groups are not only less likely to present for preventive care but are also less knowledgeable about diabetes prevention. The inability to deliver culturally-appropriate care can lead to increased health care costs in the treatment of diabetes and its complications. Again, it is challenging for the health care system to provide socio-economically and culturally applicable screening, prevention and management strategies to a population that varies widely in economic, educational, social and cultural backgrounds.

Recommendations of other groups

The United States Task Force for Preventive Services recommends screening in all asymptomatic hypertensive populations2 and suggests population-targeted screening for those with hypertension, advanced age, and obesity. The Canadian Diabetes Association[16] recommends diabetes screening in all adults over 40; earlier testing should be considered in people with additional risk factors. Ethnic-specific waist circumference cut-off points should be used for risk stratification. The American Diabetic Association recommends screening for pre-diabetes mellitus and T2DM in adults who are overweight or obese (Body Mass Index ≥25kg/m^2) and who have one additional risk factor (e.g. physical inactivity, first degree relative with diabetes, members of high risk ethnic populations, hypertension). In those without risk factors, screening should begin at age 45.[16] The Canadian Task Force (2003)[70] states there is fair evidence to recommend screening adults with hypertension for T2DM to prevent cardiovascular events and death and good evidence to recommend lifestyle interventions for overweight individuals (Body Mass Index >25kg/m^2, or >22kg/m^2 if of Asian descent) with impaired glucose tolerance to reduce diabetes progression. The International Diabetes Federation Guidelines (2005)[39] do not recommend universal screening for undiagnosed diabetes, but suggest detection programmes should target high-risk people identified by assessment of risk factors; lifestyle modifications can be effective in controlling many adverse risk factors. Our recommendations focus on improving the precision of screening for high risk ethnic populations.

The cases revisited

Omar has 2 confirmed Fasting Plasma Glucose level of ≥7.0mmol/L, consistent with a diagnosis of type 2 diabetes mellitus. The approach to his treatment should include both lifestyle interventions (culturally-appropriate diet and physical activity) and the use of anti-hyperglycemic agents preferably starting with metformin, if additional assistance is needed for glycaemic control. In addition, ensuring Omar maintains a blood pressure of less than 130/80 and has his lipids controlled (LDL < 2.0 mmol/L) is important to prevent long-term cardiovascular complications. In working with Omar, consideration should also be given to the financial and time burden that these measures may entail, particularly over the long-term, given that diabetes is a chronic disease.

Yolanda first needs a 75g Oral Glucose Tolerance test to confirm a diagnosis of pre-diabetes. If she has only impaired glucose tolerance, a multi-disciplinary team approach that provides support and education and is sensitive to the dietary and lifestyle changes that are culturally and financially feasible would be the first choice in her management.

Conclusion and research needs

Newly-arriving immigrants and refugees from high risk ethnic groups are susceptible to type 2 diabetes. Obesity, stress, and lifestyle changes related to migration, lack of information concerning prevention, language and cultural barriers impairing access to chronic disease care may

contribute to earlier diabetes onset and increased complications (diabetic retinopathy, kidney disease, and cardiovascular diseases). In Canada's universal health care system, primary care practitioners play a central role in diabetes screening and providing education for high-risk groups. Culturally and financially-appropriate education is effective in reducing blood sugars and increasing knowledge. More research will be needed to evaluate long-term implications of waist circumference screening and diabetes prevention programs, including the relative effects of very intense blood pressure control. Additional research is also needed to better understand the role of stress and migration in diabetes development among high-risk immigrant populations.

Key points

- Persons from South Asian, Middle Eastern, Latin American, and African origin develop hyperglycaemia at a younger age and face a two-to-four- fold higher prevalence of type 2 diabetes compared to Caucasians. Approximately half of Canada's recent immigrants (2001-2006) are from these ethnic groups.
- Persons with hypertension and hypercholesterolemia are at high risk for complications from diabetes and have the most to benefit from treatment of obesity, high cholesterol, hypertension and hyperglycaemia. Impaired access to appropriate health care can lead to higher risk for diabetes complications for immigrant populations.
- Culturally-appropriate diabetes education and lifestyle interventions are more effective at controlling sugars than standard approaches.

Box 2: Grading of Recommendations Assessment, Development and Evaluation Working Group grades of evidence (www.gradeworkinggroup.org)

High quality: Further research is very unlikely to change our confidence in the estimate of effect.
Moderate quality: Further research is likely to have an important impact on our confidence in the estimate of effect and could change the estimate.
Low quality: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
Very low quality: We are very uncertain about the estimate.

REFERENCES

1. Canadian Diabetes Association. Diabetes Report 2005. *Canadian Diabetes Association* 2009;Available at: URL: http://www.diabetes.ca/files/diabetesreport2005/CDA-diabetesreport-2005-en.pdf. AccessedOctober 27, 2009.
2. Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of diabetes - Estimates for the year 2000 and projections for 2030. *Diabetes Care* 2004;27(5):1047-53.
3. Muggeo M. Accelerated complications in Type 2 diabetes mellitus: the need for greater awareness and earlier detection. *Diabet Med* 1998;15(Suppl 4):S60-S62.
4. US Preventive Services Task Force. Screening for Type 2 Diabetes Mellitus in Adults: U.S. Preventive Services Task Force Recommendation Statement. *Annals of Internal Medicine* 2008;148(11):846-54.
5. Carter JS, Pugh JA, Monterrosa A. Non-insulin-dependent diabetes mellitus in minorities in the United States. *Annals of Internal Medicine* 1996;125(3):221-32.
6. Creatore MI, Moineddin R, Booth G, Manuel D, DesMueles M, McDermott S, et al. Age- and sex-related prevalence of diabetes mellitus among immigrants to Ontario, Canada. CMAJ 2010; 182: 781-789
7. Tugwell P, Pottie K, Welch V, et al. Evaluation of evidence based literature and formulation of recommendations for Clinical Preventative Guidelines for Immigrants and Refugees in Canada. CMAJ 2010 DOI:10.1503/cmaj.090289.
8. Cauchi S, ElAchhab Y, Choquet H et al. TCF7L2 is reproducibly associated with type 2 diabetes in various ethnic groups: a global meta-analysis. *J Mol Med* 2007;85(7):777-82.
9. Kunz R, Bork JP, Fritsche L, Ringel J, Sharma AM. Association between the angiotensin-converting enzyme- insertion/deletion polymorphism and diabetic nephropathy: a methodologic appraisal and systematic review. *J Am Soc Nephrol* 1998;9(9):1653-63.
10. Ludovico O, Pellegrini F, Di Paola R et al. Heterogeneous effect of peroxisome proliferator-activated receptor gamma2 Ala12 variant on type 2 diabetes risk. *Obesity* 2007;15(5):1076-81.
11. Peek ME, Cargill A, Huang ES. Diabetes health disparities: A systematic review of health care interventions. *Med Care Res Rev* 2007;64(5_suppl):101S-156.
12. Kirk JK, D'Agostino RB Jr, Bell RA et al. Disparities in HbA1c levels between African-American and Non-Hispanic white adults with diabetes. *Diabetes Care* 2006;29(9):2130-6.
13. Caban A, Walker EA. A systematic review of research on culturally relevant issues for Hispanics with diabetes. *Diabetes Educ* 2006;32(4):584-95.
14. Whittemore R. Culturally competent interventions for Hispanic adults with type 2 diabetes: a systematic review. *J Transcult Nurs* 2007;18(2):157-66.
15. Norris SL, Nichols PJ, Caspersen CJ et al. The effectiveness of disease and case management for people with diabetes: A systematic review. *Am J Prev Med* 2002;22(4):15-38.
16. Canadian Diabetes Association Clinical Practice Guidelines Expert Committee. Canadian Diabetes Association 2008 clinical practice guidelines for the prevention and management of diabetes in Canada. *Can J Diabetes* 2008;32(suppl 1):S1-S201.
17. Hawthorne K, Robles Y, Cannings-John R, Edwards AGK. Culturally appropriate health education for type 2 diabetes mellitus in ethnic minority groups. *Cochrane Database of Systematic Reviews* 2008;3(Art. No.: CD006424.).

18. US Preventive Services Task Force. Screening for Type 2 Diabetes Mellitus in Adults: Recommendations and Rationale. *Ann Intern Med* 2003;138(3):212-4.

19. Ray KK, Seshasai SR, Wijesuriya S et al. Effect of intensive control of glucose on cardiovascular outcomes and death in patients with diabetes mellitus: a meta-analysis of randomised controlled trials. *Lancet* 2009;373(9677):1765-72.

20. Fischbacher CM, Hunt S, Alexander L. How physically active are South Asians in the United Kingdom? A literature review. *J Public Health* 2004;26(3):250-8.

21. Kandula NR, ez-Roux AV, Chan C et al. Association of acculturation levels and prevalence of diabetes in the Multi-Ethnic Study of Atherosclerosis (MESA). *Diabetes Care* 2008;31(8):1621.

22. Uppaluri MD. Heart disease and its related risk factors in Asian Indians. *Ethnicity & Disease* 2002;12(1):45-53.

23. Freeman H, Cox RD. Type-2 diabetes: a cocktail of genetic discovery. *Hum Mol Genet* 2006;15(Spec 2):R202-R209.

24. Abate N, Chandalia M, Satija P et al. ENPP1/PC-1 K121Q polymorphism and genetic susceptibility to type 2 diabetes. *Diabetes* 2005;54(4):1207-13.

25. Das SK. Genetic Epidemiology of Adult Onset Type 2 Diabetes in Asian Indian Population: Past, Present and Future. *Int J Hum Genet* 2006;6(1):1-13.

26. Radha V, Vimaleswaran KS, Babu HN et al. Role of genetic polymorphism peroxisome proliferator-activated receptor-gamma2 Pro12Ala on ethnic susceptibility to diabetes in South-Asian and Caucasian subjects: Evidence for heterogeneity. *Diabetes Care* 2006;29(5):1046-51.

27. Palmer ND, Lehtinen AB, Langefeld CD et al. Association of TCF7L2 Gene Polymorphisms with Reduced Acute Insulin Response in Hispanic Americans. *J Clin Endocrinol Metab* 2008;93(1):304-9.

28. Sale MM, Smith SG, Mychaleckyj JC et al. Variants of the transcription factor 7-like 2 (TCF7L2) gene are associated with type 2 diabetes in an African-American population enriched for nephropathy. *Diabetes* 2007;56(10):2638-42.

29. Statistics Canada. Census snapshot-Immigration in Canada: A portrait of the foreign-born population, 2006 Census. *Statistics Canada* 2009;Available at: URL: http://www.statcan.gc.ca/pub/11-008-x/2008001/article/10556-eng.pdf. AccessedMay 1, 2009.

30. Davis TM, Cull CA, Holman RR. Relationship between ethnicity and glycemic control, lipid profiles, and blood pressure during the first 9 years of type 2 diabetes: U.K. Prospective Diabetes Study (UKPDS 55). *Diabetes Care* 2001;24(7):1167-74.

31. Raleigh VS. Diabetes and hypertension in Britain's ethnic minorities: implications for the future of renal services. *BMJ* 1997;314(7075):209-13.

32. Chaturvedi N, Jarrett J, Morrish N, Keen H, Fuller JH. Differences in mortality and morbidity in African Caribbean and European people with non-insulin dependent diabetes mellitus: results of 20 year follow up of a London cohort of a multinational study. *BMJ* 1996;313(7061):848-52.

33. Koopman RJ, Mainous AG, III, Diaz VA, Geesey ME. Changes in age at diagnosis of type 2 diabetes mellitus in the United States, 1988 to 2000. *Ann Fam Med* 2005;3(1):60-3.

34. McBean AM, Li S, Gilbertson DT, Collins AJ. Differences in Diabetes Prevalence, Incidence, and Mortality Among the Elderly of Four Racial/Ethnic Groups: Whites, Blacks, Hispanics, and Asians. *Diabetes Care* 2004;27(10):2317-24.

35. Ramachandran A, Snehalatha C, Latha E, Vijay V, Viswanathan M. Rising prevalence of NIDDM in an urban population in India. *Diabetologia* 1997;40(2):232-7.

36. Wang Y, Rimm EB, Stampfer MJ, Willett WC, Hu FB. Comparison of abdominal adiposity and overall obesity in predicting risk of type 2 diabetes among men. *Am J Clin Nutr* 2005;81(3):555-63.

37. Vazquez G, Duval S, Jacobs DR, Jr., Silventoinen K. Comparison of body mass index, waist circumference, and waist/hip ratio in predicting incident diabetes: a meta-analysis. *Epidemiol Rev* 2007;29:115-28.

38. Sargeant LA, Bennett FI, Forrester TE, Cooper RS, Wilks RJ. Predicting incident diabetes in Jamaica: the role of anthropometry. *Obes Res* 2002;10(8):792-8.

39. International Diabetes Federation. Clinical Guidelines Taskforce: Global Guideline for Type 2 Diabetes. *International Diabetes Federation* 2005;Available at: URL: http://www.idf.org/webdata/docs/IDF%20GGT2D.pdf.

40. Alberti K, Zimmet P, Shaw J. Metabolic syndrome a new world-wide definition. A Consensus Statement from the International Diabetes Federation. *Diabetic Medicine* 2006;23(5):469-80.

41. Campos C. Narrowing the cultural divide in diabetes mellitus care: A focus on improving cultural competency to better serve hispanic/latino populations. *Insulin* 2006;1(2):70-6.

42. American Diabetes Association. Screening for Diabetes. *Diabetes Care* 2002;25(suppl 1):s21-s24.

43. Anand SS, Razak F, Vuksan V et al. Diagnostic strategies to detect glucose intolerance in a multiethnic population. *Diabetes Care* 2003;26(2):290-6.

44. Bennett CM, Guo M, Dharmage SC. HbA(1c) as a screening tool for detection of Type 2 diabetes: a systematic review. *Diabet Med* 2007;24(4):333-43.

45. Schousboe K, Henriksen JE, Kyvik KO, Sorensen TI, Hyltoft PP. Reproducibility of S-insulin and B-glucose responses in two identical oral glucose tolerance tests. *Scand J Clin Lab Invest* 2002;62(8):623-30.

46. Blunt BA, Barrett-Connor E, Wingard DL. Evaluation of fasting plasma glucose as screening test for NIDDM in older adults. Rancho Bernardo Study. *Diabetes Care* 1991;14(11):989-93.

47. Chang CJ, Wu JS, Lu FH, Lee HL, Yang YC, Wen MJ. Fasting plasma glucose in screening for diabetes in the Taiwanese population. *Diabetes Care* 1998;21(11):1856-60.

48. Lee CH, Fook-Chong S. Evaluation of fasting plasma glucose as a screening test for diabetes mellitus in Singaporean adults. *Diabet Med* 1997;14(2):119-22.

49. Wiener K. Fasting plasma glucose as a screening test for diabetes mellitus. *Diabet Med* 1997;14(8):711-2.

50. Engelgau MM, Narayan KM, Herman WH. Screening for type 2 diabetes. *Diabetes Care* 2000;23(10):1563-80.

51. Glasziou P, Osman AD, Higgins J. Summary of Findings Tables within Cochrane Reviews: Draft Specification for RevMan 5.0. In: Oxman AD, Glasziou P, Higgins J, editors. *Obtaining a consensus on the content and methods of a Summary of Findings table for Cochrane Reviews Report to the Cochrane Collaboration Steering Group*. Cochrane Collaboration; 2005.

52. Norris SL, Kansagara D, Bougatsos C, Fu R. Screening adults for type 2 diabetes: a review of the evidence for the U.S. Preventive Services Task Force. *Ann Intern Med* 2008;148(11):855-68.

53. Harris R, Donahue K, Rathore SS, Frame P, Woolf SH, Lohr KN. Screening adults for type 2 diabetes: a review of the evidence for the U.S. Preventive Services Task Force. *Ann Intern Med* 2003;138(3):215-29.

54. Turnbull F, Neal B, Algert C et al. Effects of different blood pressure-lowering regimens on major cardiovascular events in individuals with and without diabetes mellitus: results of prospectively designed overviews of randomized trials. *Arch Intern Med* 2005;165(12):1410-9.

55. Greaves CJ, Stead JW, Hattersley AT, Ewings P, Brown P, Evans PH. A simple pragmatic system for detecting new cases of type 2 diabetes and impaired fasting glycaemia in primary care. *Fam Pract* 2004;21(1):57-62.

56. Lindstrom J, Louheranta A, Mannelin M et al. The Finnish Diabetes Prevention Study (DPS): Lifestyle intervention and 3-year results on diet and physical activity. *Diabetes Care* 2003;26(12):3230-6.

57. Lorenzo C, Okoloise M, Williams K, Stern MP, Haffner SM. The metabolic syndrome as predictor of type 2 diabetes: the San Antonio heart study. *Diabetes Care* 2003;26(11):3153-9.

58. Schmidt MI, Duncan BB, Bang H et al. Identifying individuals at high risk for diabetes: The Atherosclerosis Risk in Communities study. *Diabetes Care* 2005;28(8):2013-8.

59. Stern MP, Williams K, Haffner SM. Identification of persons at high risk for type 2 diabetes mellitus: do we need the oral glucose tolerance test? *Ann Intern Med* 2002;136(8):575-81.

60. Diabetes Prevention Program Research Group. Diabetes Prevention Program. *National Diabetes Information Clearinghouse (NDIC)* 2005;Available at: URL: http://diabetes.niddk.nih.gov/dm/pubs/preventionprogram/.

61. Waugh N, Scotland G, McNamee P et al. Screening for type 2 diabetes: literature review and economic modelling. *Health Technol Assess* 2007;11(17):iii-xi, 1.

62. Miro PMF, Goday A, Cano JF. Treatment of diabetes mellitus during Ramadan. *Med Clin (Barc)* 2007;129:303-8.

63. Greenhalgh T, Helman C, Chowdhury AM. Health beliefs and folk models of diabetes in British Bangladeshis: a qualitative study. *BMJ* 1998;316(7136):978-83.

64. Orozco LJ, Buchleitner AM, Gimenez-Perez G, Roque IF, Richter B, Mauricio D. Exercise or exercise and diet for preventing type 2 diabetes mellitus. *Cochrane Database Syst Rev* 2008;(3):No.CD003054.

65. Baradaran HR, Knill-Jones RP, Wallia S, Rodgers A. A controlled trial of the effectiveness of a diabetes education programme in a multi-ethnic community in Glasgow [ISRCTN28317455]. *BMC Public Health* 2006;6:134.

66. Fagerli RA, Lien ME, Wandel M. Experience of dietary advice among Pakistani-born persons with type 2 diabetes in Oslo. *Appetite* 2005;45(3):295-304.

67. Rhodes P, Nocon A, Wright J. Access to diabetes services: the experiences of Bangladeshi people in Bradford, UK. *Ethnicity and Health* 2003;8(3):171-88.

68. Molokhia M, Oakeshott P. Ethnic minorities have specific needs with regard to cardiovascular risk. *BMJ* 2000;321(7253):112.

69. Glazier RH, Bajcar J, Kennie NR, Willson K. A systematic review of interventions to improve diabetes care in socially disadvantaged populations. *Diabetes Care* 2006;29(7):1675-88.

70. American Diabetes Association. Standards of medical care in diabetes. *Diabetes Care* 2010;33(Supplement 1 S11-S61).

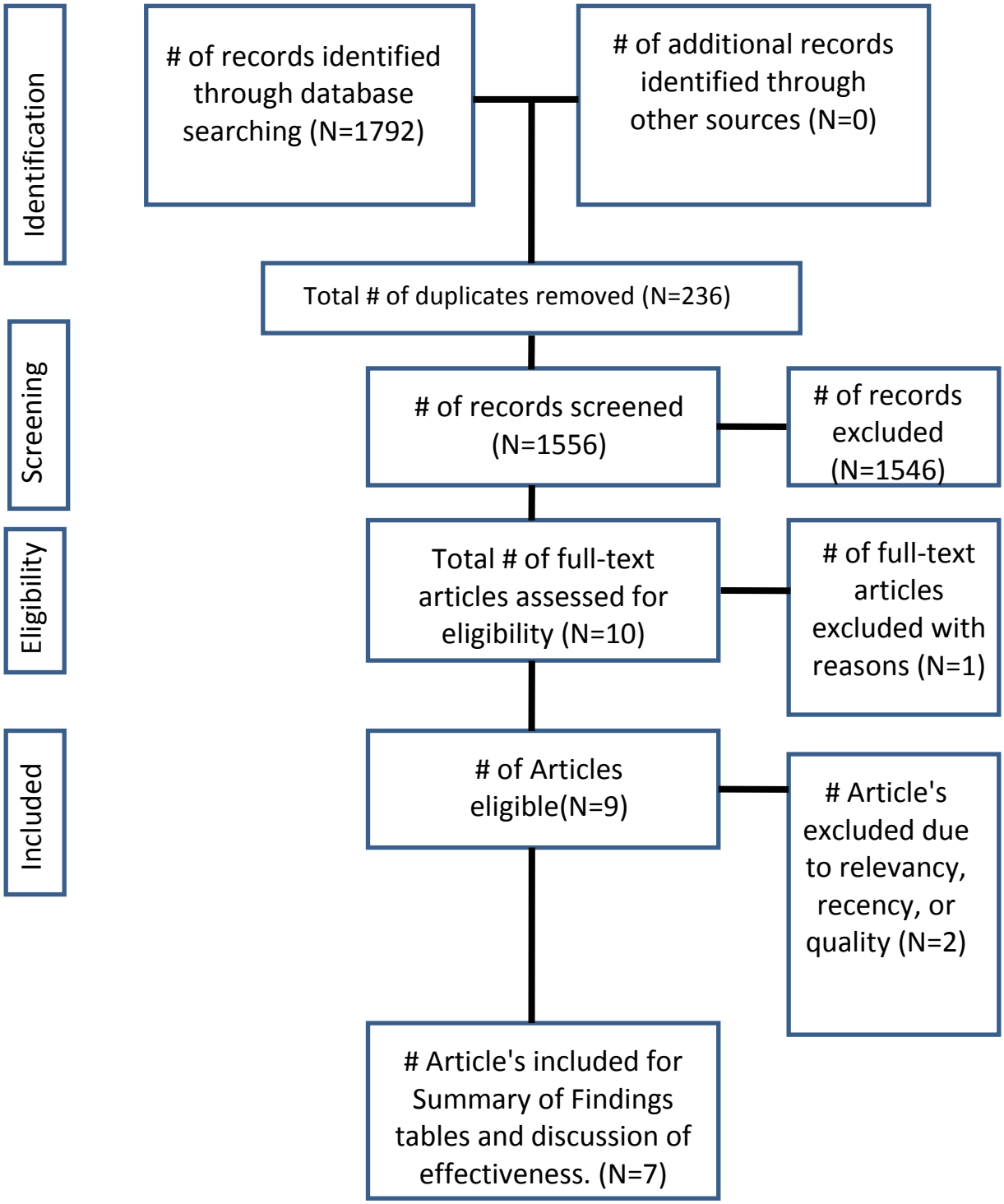
Correspondence to: Arunmozhi Dominic, Resident Physician, Department of Medicine, University Hospital, Rm A-ALL 134, 339 Windermere Road, London, Ontario N6A 5A5 Department of Medicine, University of Western Ontario.

Clinical preventive guidelines for newly arrived immigrants and refugees

This document provides the review details for the CMAJ CCIRH Type 2 Diabetes Mellitus paper. The series was developed by the Canadian Collaboration for Immigrant and Refugee Health and published at www.cmaj.ca.

Appendix 1: Figure 1

Figure 1: Final Search and Selection Flow Sheet



Appendix 2: Type 2 Diabetes Mellitus Evidence Based Clinician Summary Table

Screen immigrants and refugees >35 years of age from ethnic groups at high risk for type 2 diabetes (South Asian, Latin American and African) with fasting blood glucose.

Prevalence: Persons from South Asian, Latin American, and African origin are at high risk for type 2 diabetes (>7% prevalence for adults >20 years of age). Greater than 50% percent of Canada's recent immigrants are from high- risk ethnic groups, and these individuals develop hyperglycaemia at a younger age and face two-to-four fold higher prevalence diabetes compared to Caucasians.

Burden: Diabetes is a metabolic disease that is associated with significant morbidity and mortality related to complications: cardiovascular disease (stroke, myocardial infarction, and amputations), kidney disease, and diabetic retinopathy.

Access to Care: The prevention and treatment of diabetes requires patient education and lifestyle modification, ongoing medical treatment, monitoring and support. Language and cultural differences (differing diet, lifestyle, and religious traditions) can all impair access to chronic disease management and local services are challenged to develop culturally appropriate services. Ramadan and other religious fasting traditions require patient-centred management plans; while fasting if often not an obligation many people will want to participate in fasting to maintain religious and community connections.

Key Risk Factors Type 2 Diabetes: Advanced age, abdominal obesity, ethnicity, family history, and stress are all predictors for diabetes. Low socioeconomic status and impaired access to quality health care is associated with increased diabetic- related complications and the migration and settlement process are associated with increased stress and a shift to a more sedentary lifestyle.

Screening Test: A fasting plasma glucose level of 7.0 mmol/L has a moderate sensitivity (40%–87%) but good specificity (96%–99%) to predict plasma glucose level of 11.1 mmol/L in 2-hour Oral Glucose Tolerance Test, and is the current standard for diagnoses of type 2 diabetes.

Treatment: Treatment includes lifestyle interventions (diet, increased exercise, and stress reduction), hypoglycaemic agents and/or insulin for additional hyperglycaemic control, reduction of blood pressure to <130/80 and treatment of dyslipidemias. Culturally- appropriate interventions and multidisciplinary teams can improve delivery and effectiveness of interventions compared to standard care.

Special Considerations:

Screening is more cost-effective for high-risk ethnic groups and people in the hypertensive and obese subgroups

- Link patients with abnormal fasting glucose to additional screening and treatment: blood pressure, waist circumference, lipid profile, HbA1C and diet, exercise, and medication interventions as needed. Persons with hypertension, dyslipidemia are at high risk for complications from diabetes and have the most to benefit from treatment of obesity, high cholesterol, hypertension and hyperglycaemia.
- A Fasting Plasma Glucose of ≥7.0mmol/L and a 2 hour Plasma Glucose ≥11.1 mmol/L is diagnostic of T2 Diabetes Mellitus. In patients with a Fasting Plasma Glucose of 5.7-6.9mmol/L, a 75g Oral Glucose Tolerance Test should be considered.
- Patients with diabetes may choose to observe Ramadan or other religious fasting traditions; patient-centred management plans and diabetes education are needed to support these patients.

DOI 10.1503/cmaj.090313.