VIEWPOINTS

Screening for type 2 diabetes in non-pregnant adults in New Zealand: practice recommendations

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This article is written to help general practitioners (GPs), practice nurses and other primary care health providers in the early detection of diabetes. In preparing this article we used available systematic reviews[1] and consulted widely with colleagues in New Zealand, however, the views remain our own.

Need for new screening guidelines

Most patients will have no symptoms from their diabetes, which can therefore be detected only by screening. This means performing a simple test to see if it is worth doing further diagnostic tests. However, the 1995 New Zealand Society for the Study of Diabetes (NZSSD) screening guidelines[2] became outdated when the diagnostic criteria for diabetes changed in 1999.[3] The earlier diagnostic fasting venous plasma glucose criteria of ≥7.8 mmol/L has been reduced to ≥7.0 mmol/L. This has caused an increase of nearly 20% in the number of people classified as having diabetes.[4,5] Table 1 shows current estimated percentages of people with diabetes by age and ethnic groupings.

Table 1.	Estimated prevalence of people with diabetes in New Zealand, by age and ethnic groups. Figures are percent diagnosed (additional percent undiagnosed).			
age (years)	European	Maori	Pacific	Asian
30-39	0.7 (1.2)	2.2 (3.5)	1.1 (1.8)	1.0 (1.6)
40-49	1.5 (2.3)	6.7 (10.8)	4.7 (7.5)	4.1 (6.6)
50-59	3.8 (6.0)	13.2 (21.1)	12.1 (19.3)	8.0 (12.9)
>60	5.9 (9.4)	15.4 (24.6)	11.7 (18.7)	12.8 (20.5)

Figures for known prevalence are based on a community survey in South Auckland.[23] Figures for undiagnosed prevalence are based on the known prevalence inflated by 1.6, a factor derived from re-analysis of a workforce survey in Tokoroa in New Zealand.[24]

Furthermore, since 1995 there is new evidence that treating diabetes and its associated metabolic abnormalities prevents micro- and macro-vascular complications,[6-8] making it even more important to use screening tests that miss few people with undiagnosed diabetes. This inevitably means screening more people, most of whom will not have diabetes. Nevertheless, many of those without diabetes may prove to have lesser degrees of impaired glucose metabolism, including impaired glucose tolerance (IGT). Recent studies have shown that treating IGT with lifestyle changes or drugs reduces the number of people going on to develop frank

diabetes.[9-11] Finally, screening for diabetes is likely to detect other associated and modifiable health risks including obesity, raised lipids, high blood pressure, smoking and sedentary lifestyles.

Diagnosis of diabetes

Formal diagnosis of diabetes is made by; either, characteristic symptoms of diabetes plus one diagnostic elevated glucose, or two diagnostic glucose values in the absence of symptoms. Characteristic symptoms of diabetes means one or more of; weight loss, blurred vision, excess tiredness, recurrent infections, excess drinking or excess urine volume - unless the symptoms have another explanation. Diagnostic glucose values, shown in Table 2, are a fasting venous plasma glucose ≥7.0 mmol/L, or ≥11.1 mmol/L on either a random venous plasma glucose or the 2 hour value of the oral glucose tolerance test (OGTT). (All routine New Zealand laboratory glucose tests on adults are done on venous plasma). When the person has no symptoms of diabetes, two diagnostic tests are required, on separate days.

Table 2.	Venous plasma glucose values for diagnosis of diabetes mellitus and other categories of hyperglycaemia (mmol/L).[3]	
diabetes mellitus		
	fasting	≥7.0
	or 2 hour post-glucose	≥11.1
	or both	
impaired glucose tolerance (IGT)		
	fasting (if measured)	<7.0
	and 2 hour post-glucose load	7.8-11.0
impaired fasting glycaemia (IFG)		
	fasting	6.1-6.9
	2 hour post-glucose load (if measured)	<7.8

The fact that two glucose values (fasting ≥7.0 and random / OGTT ≥11.1 mmol/L) can be used to diagnose diabetes means that while some people with diabetes will have only a raised fasting glucose, some will have only a raised random or 2 hour value on the OGTT, and some may have both (Figure 1).

Those diagnosed by an elevated 2 hour glucose value may be more at risk of cardiovascular disease than those with only an elevated fasting glucose.[12] Actual numbers in each category vary with the population tested. However, in an

elderly European population, one third of people with diabetes had a fasting value <7 mmol/L but a 2 hour value ≥11.1 mmol/L on an OGGT.[13] In another study in a high-risk US population, one quarter of all people with diabetes had a fasting glucose <6.0 mmol/L.[14] Furthermore, because the OGTT uses a larger glucose test meal than most people ever normally consume, a person's random glucose will rarely be as high as their 2 hour OGTT test value. These factors have important implications for choice of screening tests to use and how to interpret them.
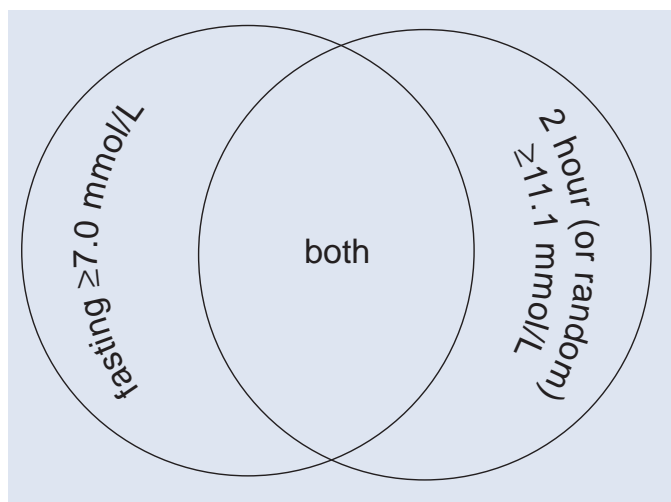

Figure 1. Diabetes can be diagnosed by a fasting glucose ≥7.0 mmol/L, a 2 hour value on an glucose tolerance test (or random glucose) ≥11.1 mmol/L, or both. Impaired fasting glucose (IFG) is intermediary between normal and diabetes diagnosed on the fasting criterion. Impaired glucose tolerance (IGT) is intermediary between normal and diabetes diagnosed on the 2 hour criterion.

Who to test

We recommend screening people who have a 5% or more risk of having undiagnosed diabetes (Table 1). While the choice of 5% is arbitrary, it is consistent with the 1995 NZSSD guidelines[2] and with draft Australian guidelines.[1] In addition, many people are at 'high risk' of undiagnosed diabetes because they have co-morbidities known to increase diabetes risk; obesity, high blood pressure, low HDL cholesterol, raised triglycerides, a parent or sibling with diabetes, cardiovascular disease, peripheral vascular disease, cerebrovascular disease or polycystic ovary syndrome. Therefore, we recommend screening for diabetes in Europeans age 50 years or more, non-Europeans age 40 years or more, and both groups ten years earlier if they are at 'high risk' as defined above.

Most of those screened will not have diabetes. Nevertheless, some 5% of those people without diabetes at initial screening will progress to diabetes within three years, so all those with a negative screening test should be recalled for re-screening three yearly. In contrast, the progression to diabetes is faster for people known to have IGT or impaired fasting glucose (IFG) or previous gestational diabetes, with some 5% developing diabetes every year. Therefore, we recommend screening this sub-group yearly.

Which test?

A 'fasting' glucose test means that the person has had no food or drink, except water, for 8 hours prior to the test.[15] A fasting glucose should be done in the morning, as a test done in the afternoon can be as much as 1 mmol/L lower than in the morning,[16] which could result in a falsely negative screening result. If the fasting glucose result is ≥7.0 mmol/L then the person has diabetes if they have

characteristic symptoms or if they have a repeat glucose above the diagnostic level on another day.

If the fasting glucose result is 6.0-6.9 mmol/L, the person has IFG. This should be followed up with an OGTT as he or she may have diabetes according to the 2 hour test. In the above example of the elderly European population,[13] calling values <7.0 mmol/L a 'negative' screen, ie one requiring no further testing, would result in missing one third of all those who actually have diabetes (which is the same as saying the screening test had a sensitivity of 67%).

Even some people with a fasting glucose of 5.5-6.0 mmol/L will have diabetes on the 2 hour test of the OGTT. In the example of the high risk US population,[14] calling values <6.0 mmol/L a 'negative' screen would result in missing one quarter of those with diabetes (which is the same as saying the screening test had a sensitivity of 75%). We therefore recommend an OGTT for this group if they are otherwise at 'high risk' as specified above. A person with a fasting glucose <5.5 mmol/L is highly unlikely to have current diabetes.

A 'random' glucose test is performed in no fixed relation to time since eating or amount of prior food or drink. A random glucose may therefore be more difficult to interpret than a fasting glucose, ie it can be more difficult to decide whether to send the person for further testing. A practitioner is entitled to make a judgement as to how closely the random glucose approaches the conditions of a 'fasting' glucose or those of a 2 hour OGTT, and decide follow-up accordingly. In mid-2000 we asked all private New Zealand laboratories for their 'normal range' for random glucose, and found that they varied widely (unpublished). We recommend using a cut-off, admittedly arbitrary, of 6.0 mmol/L, ie a random glucose ≥6.0 mmol/L warrants further testing, either with an OGTT if the person is at 'high risk' as defined above, otherwise with a fasting glucose.

The HbA_{1c} test has been used for many years to monitor glucose control in people with known diabetes. However, over the past ten years there have been several studies assessing its usefulness as a screening test for diabetes, either used alone or used at the same time as a fasting glucose.[14,17-20] The appeal is that HbA_{1c} is not affected by when the person last ate or drank, and it may help identify the people who would have a raised 2 hour test on an OGTT despite a non-diabetic fasting glucose. Unfortunately, HbA_{1c} is dogged by the fact that there can be clinically significant differences in results when the same blood is tested by different methods. There are currently two main methods used in New Zealand, each with minor variations. Furthermore, as for random glucose, laboratories around the country report different 'normal ranges', and current comments are designed to help practitioners interpret the tests when used for monitoring diabetes, not when used for screening. Nevertheless, many laboratories report so many low results - for example, one third under 5.5% (GB unpublished) - that it seems many GPs are already using HbA_{1c} as part of their screening process for diabetes. No international body currently recommends screening using HbA_{1c}. Further research is needed on the usefulness of using HbA_{1c} as the primary test to screen for diabetes.

Many primary health care providers screen for diabetes using capillary blood testing ('finger-prick') meters and strips designed for people with known diabetes to monitor their glucose at home. These meters are simple and convenient, and some GPs and practice nurses comment that they prefer to test a patient 'on the spot' for patient convenience or to reduce the chance that the patient will not or cannot attend the laboratory if given a laboratory request form. While we accept that this is a judgement for practitioner and patient, unfortunately the meters are technically a poor substitute for a laboratory glucose. For example, when the 'true' venous plasma is 7.0

mmol/L, 95% of the readings of one of the best New Zealand meters will fall between 4.9 and 8.2, with a mean of 6.6 mmol/L.[21] (For comparison, 95% of the laboratory readings will fall between 6.8 and 7.2 mmol/L). While meter performance is adequate for home glucose monitoring, when used to screen people whose true fasting venous glucose is around 7.0 mmol/L, about half of them may be misclassified as having diabetes when they do not, or vice-versa. On the other hand, this is clearly not a problem when the true fasting glucose is, say 9.0 mmol/L or more. We therefore recommend treating the results of capillary meter testing with considerable caution, especially if the result is within 2 mmol/L of the cut-off point being used to decide if further testing is warranted. Ideally, we recommend restricting meter use to screening patients who have symptoms characteristic of diabetes, and subsequently confirming results with a laboratory glucose.

Where to test

Diabetes screening is currently undertaken in a wide range of community, primary care and secondary care settings. However, general practice is the only setting in which 80-90% of people at risk of undiagnosed diabetes attend in any one year,[22] is the setting most likely to have the complex information needed to identify people at 'high risk' and is the only setting with established systems capable of recalling people for follow-up screening in one or three years. Therefore, we see general practice or equivalent primary health care as the only appropriate setting for any form of systematic screening. To achieve this, however, requires more systematic use of reminders, recalls and related systems of care than are currently in use in most general practices - a challenge for all.

Conclusion

We have recommended who, how and where to screen for diabetes. We believe the evidence firmly supports the value of finding and treating diabetes, IGT and the associated metabolic and lifestyle disorders. The best opportunity for this in New Zealand is through what we call 'systematic opportunistic screening' in general practice or equivalent primary health care.

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