

# Monitoring glucose in blood or urine in type 2 diabetes: current practice

Hilary Hearnshaw, Sandra Whitlock, Jeremy Dale

## ARTICLE POINTS

**1** It is not certain whether or when or how urine glucose monitoring or blood glucose monitoring should be used in type 2 diabetes.

**2** We do not know which of these methods is actually used in primary care in the UK.

**3** A sample of primary healthcare professionals trained in diabetes care were asked what their current practice was in terms of home monitoring for type 2 diabetes.

**4** Many people are asked to do home blood glucose monitoring, but there is wide variation in timing and frequency.

**5** There is opportunity for reducing the costs of widespread ineffective glucose testing, when evidence for a cost-effective monitoring scheme is established.

## KEY WORDS

- Blood testing
- Urine testing
- Self-monitoring
- Current practice

Dr Hilary Hearnshaw is a Reader in Primary Care and Director of Research, Warwick Diabetes Care; Sandra Whitlock is a Research Fellow, Centre for Primary Health Care Studies; and Professor Jeremy Dale is Professor of Primary Care and Director of Warwick Diabetes Care, University of Warwick.

## Introduction

**It is not clear whether urine glucose monitoring or blood glucose monitoring is more effective at reducing HbA<sub>1c</sub> levels. It is also not clear what the recommended programme for blood glucose testing should be for type 2 diabetes, i.e. how many tests per day and at what times of day or night (Fass et al, 1997; Coster et al, 2000). In light of this uncertainty, we sought to determine what primary care health professionals actually recommended to their patients and how they implement the research evidence on monitoring of glucose levels to help patients maintain blood glucose within the normal range.**

**M**aintaining blood glucose levels within a normal range reduces tissue damage and hence reduces complications of diabetes. Since complications, such as retinopathy, nephropathy and neuropathy can cause pain, discomfort and disability for the patients they are to be avoided if at all possible. Treating complications is costly for both patients, in time and loss of function, and the health service providers (Wagner et al, 2001).

## Current knowledge

Maintenance of blood glucose control is enhanced by adjustment of diet, exercise or medication based on knowledge of blood glucose levels. Blood glucose levels can be estimated directly and almost instantaneously by the patient, using fingertip samples of blood with testing strips. Estimates of blood glucose levels over the previous few hours can also be made by measuring the urine glucose level. This is done by dipping a strip in a fresh sample of urine. Although blood glucose measuring methods are deemed to provide more useful information in controlling blood glucose levels, they are more expensive than urine glucose testing methods. There is also some doubt as to whether self-monitoring of blood glucose levels is more beneficial than urine testing in achieving better glycaemic control in people with type 2 diabetes (Gallichan, 1997).

The American Diabetes Association guidelines suggest that although the optimal

frequency of testing blood glucose is not known, it should be sufficient to facilitate reaching glucose goals (Mensing et al, 2002). Furthermore, it is recognised that for effective self-monitoring, the results must be accompanied by informed interpretation and knowledge of how to use them to adjust diet, exercise or medication.

It is clear that no single answer will suit every patient. For the healthcare professional, blood glucose monitoring gives data which is more useful than urine glucose monitoring. However, most people with type 2 diabetes who are not on insulin can gain sufficient information from urine glucose monitoring. Some people may prefer urine tests to blood tests; some may not have the dexterity to perform blood tests unaided. One study has shown that many people do not use self-monitoring of blood glucose, and of those who do, only half self-adjust their treatment (Hjelm et al, 2001).

## Current practice

Warwick Diabetes Care runs courses leading to the Certificate in Diabetes Care. Healthcare professionals from all over the UK attend these courses and improve their knowledge and practice of diabetes care, many of whom are in primary care settings (Hearnshaw et al, 2001). It might be expected that holders of the Certificate in Diabetes Care would therefore have a consistency of practice in the advice they offer to patients.

PAGE POINTS

**1** The aim was to quantify the variation in practice and discover whether there is an opportunity for cost saving or for improving effectiveness in how people are advised to monitor their glucose levels.

**2** We were particularly interested in how decisions were made to ask people to measure blood or urine glucose levels. This could guide the implementation of cost-effective treatment and prescribing by health service providers.

**3** A questionnaire was developed based on information gathered from the telephone interviews with diabetes-aware general practices.

**4** Only 32.2% respondents reported that they used urine testing for most/all patients (including those on insulin).

**5** Half of the respondents (49.6%) said that they asked only a few patients to do urine testing.

**Aims**

We report a survey of certificate holders' routine practice in advising people with type 2 diabetes to use self-monitoring of urine or blood glucose. The aim was to quantify the variation in practice and discover whether there is an opportunity for cost saving or for improving effectiveness in how people are advised to monitor their glucose levels. We were particularly interested in how decisions were made to ask people to measure blood or urine glucose levels. This could guide the implementation of cost-effective treatment and prescribing by health service providers.

**Method**

A questionnaire was developed to survey current practice in diabetes-aware general practices in the UK. To help us to develop the questionnaire, eight telephone interviews were conducted with GPs and nurses selected at random from graduates of the University of Warwick Certificate in Diabetes Care Course.

The questionnaire was based on information gathered from the telephone interviews, and contained relevant and unambiguous questions. Questionnaires were sent to 461 holders of the Certificate in Diabetes Care, as part of a pack inviting them to join the Warwick Diabetes Care Research Framework ([www2.warwick.ac.uk/fac/med/diabetes/research/framework/](http://www2.warwick.ac.uk/fac/med/diabetes/research/framework/)). To encourage a prompt response we offered respondents the opportunity to participate in a draw for a small prize if they responded by a set date.

The questionnaire comprised five questions:

- What do you usually ask people with type 2 diabetes to do by way of monitoring their urine or blood glucose at home?
- How do you decide whether to ask them to monitor urine or blood?
- How often do you ask patients to test (often refers to the testing not the asking)?
- What testing equipment do you recommend: testing strips for urine; testing strips for blood; machines for reading blood testing strips; other (please describe)?

A total of 79 questionnaires were returned which constituted a response rate of 17%. The responses to the questionnaire

were examined and some small refinements were made.

The revised questionnaire was then sent to a further 1112 graduates between March and June, 2003, together with an application form to join the Warwick Diabetes Care Research Framework. No further incentives were offered but respondents could complete the questionnaire without committing themselves to participation in the Research Framework if they so wished. A further 164 (15%) responses were received, giving a total of 243 (16%) responses.

**Analysis**

The quantitative data from the questionnaires was analysed using SPSS v11. The qualitative data was used to explain the results of this analysis.

**Results**

We asked respondents whether they usually asked people with type 2 diabetes to do urine or blood glucose monitoring at home. It is clear from the responses (outlined in Table 1) that blood testing is a popular choice; 93% of respondents indicated that this would be used for all or most patients (including most patients on insulin). Conversely, only 32.2% respondents reported that they used urine testing for most/all patients (including those on insulin). Half of the respondents (49.6%) said that they asked only a few patients to do urine testing.

Respondents were invited to comment on their responses, and 62 did so. Of this number, 20 said that they were trying to encourage blood testing. Their comments included:

*'I encourage most patients to use blood testing for greater accuracy.'*

*'Tend to ask patients to do blood testing unless there is a specific reason why they are unable to do so.'*

One respondent said that they were:

*'Now beginning to do less blood and more urine testing in type 2.'*

Another said:

*'It is PCT policy to start all people with type 2 diabetes on urine testing unless patient asks [to do blood testing] or they are on insulin.'*

Other respondents (n=8) said that the

choice of blood/urine largely depended on the capacity/choice of the patient.

**Blood glucose vs urine glucose home monitoring**

The most common reason stated by respondents for the decision on whether to do urine or blood glucose monitoring, was that blood testing was usually chosen if the patient was on insulin, as can be seen in Table 2. A further 24% of respondents said that the decision was based on patient choice and 18% that it was based on their own choice depending on the patient. A total of 59 respondents commented on this question. Many of the comments suggested that blood glucose testing was ideal but that not all patients liked it or could manage it.

*‘Some do not like blood tests.’*

*‘A few patients, mostly elderly, cannot cope with blood monitoring on a daily basis.’*

*‘Advantages of blood testing are discussed but patient compliance is important.’*

Two respondents commented that urine testing was now reserved for ketones rather than diabetes control and another stated:

*‘Testing/monitoring of urine for glucose is unhelpful and unnecessary.’*

**Frequency of testing**

There is wide variation in practice on how often people with type 2 diabetes are asked to do routine tests, as can be seen in Table 3. The most frequently asked number of days a week to test is was two for both blood and urine testing. Of the respondents, 104 (72%) asked patients for four or fewer days per week for blood testing, whereas 82 (87%) ask for four or fewer days per week for urine testing. The most frequently asked number of times per day to test is once for both blood and urine testing. 90 (70%) respondents asked for once or twice a day blood tests and 69 (93%) once or twice a day urine tests.

Of those asking patients to do blood tests, 17% also asked for tests to be carried out at varied times, as did 18% of those asking for urine tests. Sixty respondents added comments to elucidate their

**Table 1: Do you usually ask people with type 2 diabetes to do urine or blood glucose monitoring at home?**

	Blood n (%)	Urine n (%)
Most patients but not all	78 (35)	17 (15)
If on insulin	70 (32)	7 (6)
Most patients on insulin	34 (15)	0 (0)
All patients	23 (10)	13 (11)
A few patients only	13 (6)	57 (50)
Rarely or never used	1 (1)	17 (15)
Other	2 (1)	4 (4)
<b>Total</b>	<b>221</b>	<b>115</b>

**Table 2. How do you decide whether to request urine or blood monitoring ?**

	Number of responses (%)
Usually blood if on insulin	97 (29)
Patient choice	78 (24)
My choice, depending on patient	60 (18)
Short term need for blood glucose monitoring	45 (14)
All patients asked to monitor blood glucose	38 (11)
Usually urine	12 (4)
Other	2 (1)
<b>Total</b>	<b>332</b>

response. Many noted that the frequency of testing depended on whether the patient’s diabetes was well controlled, their general state of health or their motivation. Some respondents pointed out that it was hard to generalise:

*‘Routine testing advice is very dependent on the individual patient and their ability in general.’*

**Equipment for testing**

We asked participants how testing equipment was selected to prescribe or recommend to people with type 2 diabetes. The majority (67.4%) were influenced by the needs of the patient. Just over one-third (36%) based their decision on the usability of the equipment for the patient, 18% based their decision on the cost for the patient and 14% on the patient’s request. This is shown in Table 4.

Sixty-six comments were made, of which just under 40% indicated that the pharmaceutical companies influenced their choice of equipment in some way. Some

**PAGE POINTS**

**1** There is wide variation in practice on how often people with type 2 diabetes are asked to do routine tests.

**2** The most frequently asked number of days a week to test is once for both blood and urine testing.

**3** Of those asking for blood tests 17% also asked for tests to be carried out at varied times, as did 18% of those asking for urine tests.

**Table 3 How often do you ask patients to do routine tests (once their diabetes has stabilised)?**

<b>Blood testing</b>	<b>Number of days per week</b>			<b>Number of times per day</b>			<b>Prompts for testing</b>		
	Number of days	Responses	%	Number of times	Responses	%	Prompt	Responses	%
	1	12	8.3	1	46	35.9	Pre-prandial	70	33.7
	2	38	26.2	2	35	27.3	Fasting	44	21.2
	3	11	7.6	3	6	4.7	Post-prandial	40	19.2
	4	2	1.4	1-2	9	7.0	Varied times	35	16.8
	5	1	0.7	1-3	8	6.3	Bedtime	16	7.7
	6	2	1.4	1-4	14	10.9	Occasionally during night	2	1.0
	7	20	13.8	4+	9	7.0	Post-medication	1	1.0
	1-2	11	7.6	Varies	1	0.8			
	1-3	19	13.1						
	2-4	11	7.6						
	2-7	15	10.3						
	Varies/ up to patient	3	2.1						
	<b>Total</b>	<b>145</b>		<b>Total</b>	<b>128</b>		<b>Total</b>	<b>208</b>	
<b>Urine testing</b>	<b>Number of days per week</b>			<b>Number of times per day</b>			<b>Prompts for testing</b>		
	Number of days	Responses	%	Number of times	Responses	%	Prompt	Responses	%
	0	7	7.4	0	2	2.7	Pre-prandial	9	12.5
	1	18	19.1	1	51	68.9	Fasting	31	43.1
	2	26	27.7	2	15	20.3	Post-prandial	13	18.1
	3	9	9.6	3	1	1.4	Varied times	13	18.1
	4	1	1.1	1 or 2	3	4.1	Bedtime	6	8.3
	5	1	1.1	4+	2	2.7			
	6	0	0						
	7	9	9.6						
	1-2	6	6.4						
	1-3	10	10.6						
	2-4	5	5.3						
	2-7	1	1.1						
	Varies/ up to patient	1	1.1						
	<b>Total</b>	<b>94</b>		<b>Total</b>	<b>74</b>		<b>Total</b>	<b>72</b>	

comments (29%) indicated that drug representatives usually made these products available. A further 11% of comments indicated that the drug companies had other influence, such as training or vouchers.

Some respondents commented that the choice of testing equipment was influenced by a diabetes specialist, biochemist or district consultant (4%). Adding these to the 32 who reported selection based on

recommendations by the PCT and the 13 based on recommendations by pharmacists, gives a total of 58 (19%) respondents who based their selection of equipment on professional recommendations.

**Shared practice**

Finally, we asked whether respondents' colleagues in their practices asked patients to follow different testing routines or methods, and to describe what these were.

A total of 35% respondents answered this question; 39% of these suggested that they tried to follow a common protocol or work to similar practices. Twelve (21%) suggested that all of the diabetes work was dealt with by just one healthcare professional:

*'They leave it to me.'*

*'I am the only practice nurse in practice who is carrying the diabetic clinics.'*

*'They generally refer to me.'*

A few respondents (18%) suggested that there was some disparity within the practice:

*'Whatever they fancy. Our surgery has no protocols and is resistant to change.'*

*'No fixed pattern.'*

**Discussion**

The questionnaire responses showed that although most people on insulin are asked to use blood glucose tests, not everyone asks all patients on insulin to do blood tests. For many healthcare professionals it depends on the ability and preference of the patient. There is variation in frequency of tests requested and for many, that depends on a particular situation. The majority of respondents ask most people with type 2 diabetes to do blood glucose tests, rather than the urine test.

**Wide variation in practice**

For practitioners who make a choice, (rather than always using blood tests or always using urine tests) this may be based on the ability or preference of the people with type 2 diabetes, or sometimes on the cost. The respondents in this study were all educated in diabetes care, and so may be assumed to represent the more skillful practitioners in diabetes care. However, the low response rate would suggest the respondents may be people who are more active in diabetes care than average, as they are more likely to respond to the questionnaire. They are therefore probably not representative of the entire UK population of healthcare professionals who offer diabetes advice.

Nevertheless, even in this group there is wide variation in practice on requesting testing, and the frequency of timing of

**Table 4: How do you decide which testing equipment to prescribe or recommend?**

How do you decide which testing equipment to prescribe or recommend?	Number (%)
Usability for patient	109 (36)
Cost for patient	55 (18)
Patient request	41 (14)
Recommended/required by PCT	32 (11)
Other	30 (10)
Recommended by pharmacist	13 (4)
Recommended by other patients	12 (4)
Cost for your practice	12 (4)
<b>Total</b>	<b>304</b>

testing. This confirms the need for evidence on the cost-effectiveness of blood glucose monitoring in type 2 diabetes (Coster et al, 2000). If such evidence were available, practitioners and patients would be able to make informed decisions on how patients can manage their own blood glucose levels.

Urine tests are cheaper, and less invasive than blood tests for the patient. Nevertheless, some patients prefer to use blood tests, especially if they are on insulin medication. Because blood testing is costly, it is important to know how best to use it and when the benefits of blood rather than urine testing outweigh the costs.

A further uncertainty is the appropriate frequency of testing. Different advice on testing frequencies is generated by newly diagnosed, intercurrent illness, change of treatment or starting on insulin. It takes time and resources to manage these different schemes. Are these well spent? If the target is to facilitate normal blood glucose, do healthcare professionals know what regimens facilitate this, or how to decide what scheme to recommend to patients? There is no one solution for everybody, but are healthcare professionals skilled at helping the patient to determine their own appropriate testing regimen, by offering informed advice?

**Is this generalisable to all diabetes care providers?**

In critique of this study, the respondents in this survey are healthcare professionals who have an interest in diabetes care. The majority of respondents work in practices

**PAGE POINTS**

**1** The questionnaire responses showed that although most people on insulin are asked to use blood glucose tests, not everyone asks all patients on insulin to do blood tests.

**2** The respondents in this study were all educated in diabetes care, and so may be assumed to represent the more skillful practitioners in diabetes care.

**3** There is a need for evidence on the cost-effectiveness of blood glucose monitoring in type 2 diabetes.

PAGE POINTS

**1** The low response rate to the questionnaire also means that we cannot claim that our results are representative of the group of practitioners surveyed.

**2** The results provide a useful illustration of the variation in practice by these diabetes-trained professionals.

**3** We still do not know which are the wasteful activities and so we cannot advise on how to be more cost-effective.

with an agreed protocol for diabetes care or as a healthcare professional with a special interest in diabetes who provides diabetes care for all people with diabetes. Thus, we can assume that the practice of the population of primary healthcare professionals throughout the UK is no better than these results and that they are probably less well informed. The low response rate to the questionnaire also means that we cannot claim that our results are representative of the group of practitioners surveyed. Despite this, the results provide a useful illustration of the variation in practice by these diabetes-trained professionals.

**Conclusion**

The evidence presented here of the variation and uncertainty about glucose monitoring is also evidence of wastefulness of both patient and NHS resources. The respondents cannot all be efficient when there are such wide discrepancies in

practice. Unfortunately, we still do not know which are the wasteful activities and so we cannot advise on how to be more cost-effective. ■

Coster S, Gulliford MC, Seed PT, Powrie JK, Swaminathan R (2000) Monitoring blood glucose control in diabetes mellitus: a systematic review. *Health Technology Assessment* **4**(12):

Faas A, Schellevis FG, van Eijk JTM (1997) The Efficacy of self-monitoring of blood glucose in NIDDM subjects: a criteria-based literature review. *Diabetes Care* **20**:1482–86

Gallichan M (1997) Self monitoring of glucose by people with diabetes: evidence based practice. *British Medical Journal* **314**: 964

Hearnshaw HM, Hopkins J, Wild A et al (2001) Mandatory, multidisciplinary training in primary diabetes care. Can it meet the needs of primary care groups? *Practical Diabetes International* **18**(8): 274–80

Hjelm K, Nyberg P, Apelqvist J (2001) Self-monitoring of blood glucose; frequency, determinants and self-adjustment of treatment in an adult Swedish diabetic population. *Practical Diabetes International* **18**: 157–63

Mensing C, Boucher J, Cypress M et al (2002) National standards for diabetes self-management education. *Diabetes Care* **25**: S140–S47

Wagner EH et al (2001) Effect of improved glycaemic control on health care costs and utilization. *Journal of the American Medical Association* **285**: 182–89