



Development and validation of a diabetes knowledge questionnaire

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Introduction

Improving methods and strategies for evaluating diabetes patient education interventions has been increasingly advocated by both provider and consumer organisations globally.^{1–3}

Evaluation efforts have traditionally been hampered by lack of formal agreement about goals and systematically derived benchmarks^{4–9} and lack of standardised and validated evaluation measures.^{10–12} To address this problem, Diabetes Australia developed an Australian National Consensus Position on Outcomes and Indicators for Diabetes Patient Education (O&I).^{13,14} The O&I consensus identified four patient-centred key outcome areas of knowledge and understanding, self-management, self-determination and psychological adjustment expressed in the order in which each area is most influenced by diabetes education.

A subsequent study identified and evaluated available tools on their ability and suitability for measuring changes in the four key outcomes.¹⁵ While three knowledge assessment tools were identified, none met all of the systematically derived quality appraisal criteria. The first of the three tools, the diabetes knowledge test (DKT), was developed and validated in the mid-1980s by the Michigan Diabetes Research and Training Centre to address the need for a valid and reliable diabetes specific knowledge instrument that could be used by diabetes educators and researchers.^{16,17} Later scales have been adapted from the DKT to suit particular groups and

ABSTRACT

An Australian National Consensus Position on Outcomes and Indicators for Diabetes Education identified knowledge and understanding as the outcomes most directly affected by diabetes education. A subsequent literature review failed to identify a validated, suitable questionnaire for measuring knowledge. Consequently, we aimed to develop a minimum diabetes knowledge questionnaire (DKQ) suitable for people with both type 1 and type 2 diabetes.

Content validity was established through literature review, Delphi survey of 52 opinion leaders and a workshop of Australian Diabetes Educators ($n \geq 300$). The resulting instrument was tested for internal consistency on 129 and for reliability on 57 people with type 1 and type 2 diabetes, respectively.

The final questionnaire contains: 12 multiple choice questions common to type 1 and type 2 diabetes, e.g. normal blood glucose levels, complications, diet, exercise, self-monitoring of blood glucose, annual check-ups, support services, and sick-days; two questions for people on oral medication/insulin only; and one question (sick-days) for people with type 1 diabetes only.

For the first 12 questions, the internal consistency was good (Cronbach's $\alpha=0.73$); with the additional item for type 1 diabetes, the internal consistency was slightly better ($\alpha=0.79$) as it was with the additional items for people on medication/insulin ($\alpha=0.76$). No particular item seemed to adversely affect the overall consistency of the questionnaire.

Comparing test-retest pilots, total scores showed good reliability with no evidence of change over time ($t=1.73$; $df=56$; $p<0.85$), and a correlation of 0.62.

The DKQ is now ready to use for evaluating knowledge outcomes of diabetes education. Copyright © 2011 John Wiley & Sons.

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KEY WORDS

outcome; measure; knowledge; questionnaire; diabetes education

interventions.^{18–20} As some questions do not reflect current Australian guidelines (e.g. a free food is not defined as having less than 20 calories per serving), and uses terminology not used in the Australian context (e.g. an insulin reaction), the DKT is not suitable for use in Australia.

In 1984, a series of three diabetes knowledge assessment scales (DKNA, DKNB and DKNC, each of 15 items) were developed and validated for the Australian environment.²¹ None of the DKN scales has since been updated and they no

longer reflect current guidelines and standards of care (e.g. they refer to urine sugar testing which is no longer recommended) and, like the DKT, they contain many questions regarding insulin therapy which did not fit our criteria for a generic tool that is applicable to all people with type 1 or 2 diabetes. The third identified validated knowledge questionnaire, the ADKnowl, was developed and tested in the UK.²² It consists of 23-item sets with a total of 104 questions/items which makes it a more comprehensive, thus a more onerous and resource intensive tool for

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application in a clinical setting, and hence did not meet our criteria for a brief tool.

Given the lack of an up-to-date, validated instrument, we aimed to develop, pilot and validate a generic, brief DKQ capable of measuring knowledge change following a diabetes education intervention and which would be suitable for people with both type 1 and 2 diabetes.

Methods

Ethical approval for the study was obtained from the University of Sydney's Human Ethics Research Committee. Although the definition of knowledge is a matter of on-going debate, for the purpose of this project the following definition was adopted: 'knowledge is the confident understanding of a subject, potentially with the ability to use it for a specific purpose'.

Design of the questionnaire

Delphi survey. A purposive sample of 52 nationally recognised diabetes educators, dietitians, endocrinologists, podiatrists, psychologists, primary care physicians, and researchers were invited to participate in an email Delphi survey. The Delphi method is widely used in the development of research scales and questionnaires as a systematic, interactive method where a panel of experts answers questionnaires in two or more rounds.²³ In the first round, participants were asked to indicate, on a standard questionnaire, their opinion on the most important topics to be included in the questionnaire. The second round consisted of 20 questions with five multiple choice options, developed by the researcher (CAE) based on the domains that were answered as 'very important' by $\geq 60\%$ of first-round survey respondents. All questions were based on current Australian clinical and/or educational guidelines for the care of people with type 1 and 2 diabetes. Additional domains identified were only included if they were listed by $\geq 15\%$ of respondents. Comments were incorporated into the second-round questionnaires.

Participants were asked to indicate their opinion of each question

as to whether it should be included in the final questionnaire (from strongly agree to strongly disagree), whether the question should be included if the phrasing was modified (from strongly agree to strongly disagree) and, if they had to choose between two questions referring to the same domain, which one they would prefer to see included in the questionnaire.

Diabetes educators' consultation workshop. To further test content and face validity, the 20-item draft questionnaire was presented at a consultation workshop comprising members of the Australian Diabetes Educators Association (ADEA) during a national diabetes conference in 2007.²⁴ Participants were asked to discuss the questionnaire in small groups, and indicate on a standard survey, for each of the 20 questions, whether the questions should be included in the final questionnaire (yes or no response), and any comments they had with regard to the phrasing of the questions.

Responses from Delphi surveys and the ADEA workshop were coded, analysed and collated into a pilot questionnaire.

The readability of the questionnaire was assessed by using the Flesch Reading Ease score.²⁵ The test is based on the average number of syllables per word and words per sentence with scores ranging from 0–100. The higher the score the easier a document is to comprehend, with 60–70 considered an acceptable score for literate adults.

Testing the questionnaire

For all pilot tests, a detailed study information sheet was provided to prospective participants and written consent was obtained.

People with type 1 and 2 diabetes were recruited from: (a) three diabetes centres attached to large metropolitan teaching hospitals in Sydney; (b) attendees of group education programmes held at Diabetes Australia – New South Wales (DANSW [since July 2010 trading as Australian Diabetes Council]), a charitable, not for

profit organisation located in the Sydney central business district; and (c) from one private diabetes educator setting. Health professionals (primarily diabetes educators) were asked to distribute the pilot questionnaires to consecutive attendees at regular clinic visits or education programmes.

Reliability testing (test-retest) was carried out by random selection of 300 people with type 1 or 2 diabetes from the DANSW membership database. Letters of invitation were mailed out and consenting respondents were sent identical questionnaires on two different occasions with a two-week interval. Instructions accompanied the initial questionnaire requesting participants not to take part in diabetes education nor consult books, websites or colleagues, within the two-week interval.

Statistical analysis

Questionnaires were scored, with each correct answer worth 1 point, each 'unsure' answer worth 0.5 and an incorrect answer received no points. This scoring system allows for all responses to be added in the total and is based on the premise that it is preferable for the participant to recognise that they are 'unsure' of the answer, than for them to 'think' they know the correct answer when in fact they are incorrect.

To determine internal consistency, item-to-total correlations and Cronbach's coefficient alpha (α) were used. For these reasons, it is suggested that Cronbach's α should be above 0.70 but not higher than 0.90.²⁶ Pearson's r correlation coefficient was used to examine the relationship between the total knowledge score (calculated by summing the scores of all items) and age, type and duration of diabetes. Descriptive statistics were used to describe the sample.

Stability (test-retest reliability) was assessed using Pearson's product-moment correlation coefficient and paired t-tests to examine consistency and stability of responses. Commonly cited minimal standards for reliability coefficients are 0.70 for group data.²⁶



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Table 1. Results from the first round of Delphi – domains to be included in the knowledge questionnaire

<p>Domains identified as ‘very important’ by ≥60% of Delphi respondents</p> <ol style="list-style-type: none"> 1. Normal range of blood glucose level 2. Duration/chronic nature 3. Consequences short- and long-term 4. Nutrition 5. Physical activity 6. Foot care 7. Medication taking 8. Sick-day management 9. Self-monitoring of blood glucose 10. Appropriate attendance for medical care 11. Support services
<p>For people on insulin therapy and/or insulin stimulating tablets</p> <ol style="list-style-type: none"> 12. Hypoglycaemia 13. Medication 14. Sick-day management
<p>Additional domains identified as ‘very important’ by ≥15% of Delphi respondents</p> <ol style="list-style-type: none"> 15. Family adjustment/support 16. Effects on and management of mental health

All responses were collated, coded and analysed by using the Statistical Package for the Social Sciences (SPSS 13.0, SPSS Inc, Chicago, IL, USA).

Results
Content validity

Two rounds of the Delphi survey were conducted for the development of questionnaire items. The response rate for the first round was 71% (37/52) and 62% for round two (23/37).

In round one, 14 of 20 domains were identified as ‘very important’ by ≥60% of respondents (see Table 1). A large number of key opinion leaders commented that only people treated on diabetes medication and/or insulin needed to know about hypoglycaemia and medication. Similarly, respondents indicated that sick-day management should include a separate question for people with type 1 diabetes to

Table 2. Consensual comments expressed by ADEA workshop participants

<ul style="list-style-type: none"> • Don’t use ‘false’ options; keep questions positive • Simplify language to accommodate for people with low literacy level • A question is needed with regard to carbohydrate food • Separate questionnaire or section for type 1 and type 2 diabetes in particular with regard to sick-day management (including ketone testing), hypoglycaemia treatment and medications (i.e. insulin)
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Table 3. Pilot diabetes knowledge questionnaire: question topics

<p>12 questions common to people with type 1 and 2 diabetes:</p> <ol style="list-style-type: none"> 1. Ideal blood glucose levels 2. HbA_{1c} 3. Chronic nature (no cure) 4. Dietary guidelines 5. Benefits of physical activity 6. Frequency of physical activity 7. General diabetes long-term complications 8. Diabetes foot complications 9. Self-monitoring of blood glucose 10. Sick-day management 11. Annual check-ups 	<ol style="list-style-type: none"> 12. Support services – National Diabetes Services Scheme (NDSS – a government subsidised support scheme)
	<p>Two questions to be completed by people on oral medication and/or insulin only:</p> <ol style="list-style-type: none"> 13. Diabetes medication 14. Hypoglycaemia
	<p>One question to be completed by people with type 1 diabetes only:</p> <ol style="list-style-type: none"> 15. Sick-day management

emphasise the need for ketone testing as a self-care requirement unique to type 1 diabetes.

Two additional topics (i.e. family adjustment/support and mental health), indicated as very important by ≥15% of respondents, were also incorporated into the round-two questionnaire.

Twenty questions with five multiple choice options, eliciting either ‘one false answer’ or ‘one correct answer’ response, were developed by the researcher based on the 16 agreed topics in round one.

Synthesis and analysis following round-two surveys resulted in the deletion of the items measuring mental health and family support as these were difficult to phrase and received negative feedback from the majority of respondents.

A number of questions were rephrased to incorporate respondents’ constructive suggestions for simplifying the language and shortening the questions.

The ADEA workshop was attended by over 300 people. A total of 64 questionnaires were returned, each resulting from a group discussion of between three and seven participants. Results of summarised consensual comments are illustrated in Table 2.

The final questionnaire, incorporating responses from the Delphi survey and the ADEA workshop, contains 15 questions: nine questions eliciting a ‘one answer’ response to five multiple choice options, and six questions eliciting an ‘as many as apply’ to six multiple choice options. An ‘unsure’ option was included for each question.

Table 3 lists the question topics: 12 topics common to people with type 1 and 2 diabetes, two questions for people taking diabetes medication/insulin, and one question for those with type 1 only.

Seven demographic questions were added including: age, gender, duration and type of diabetes, type of medication (if any) and previous visit to a diabetes educator and/or dietitian.

Flesch test readability score for the total questionnaire was 66.5.

Pilot testing

In all, 129 people completed the pilot test of whom 47% were male and 39% had type 1 diabetes; 10% had never seen a diabetes educator and 13% had never seen a dietitian.

Internal consistency. Analysis of the 129 pilots showed good internal consistency with a Cronbach’s α of 0.73





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for the first 12 questions, common to all individuals. Appendix 1 (available online at www.practicaldiabetesinternational.com) lists for each question the scale's mean and variance if the item is deleted. With the additional question for type 1 diabetes regarding sick-day management, the internal consistency was slightly better ($\alpha=0.79$). Similarly, Cronbach's α was slightly better at 0.76 with the two additional questions regarding medication and hypoglycaemia.

No question seemed to particularly adversely affect the overall consistency of the questionnaire. Although seven items would improve the consistency in responding if removed, none would increase the alpha by more than 0.01, and so do not warrant removing.

Test-retest reliability. Comparing the first and second rounds of the 57 completed pilots, total scores showed good reliability with no evidence of change over time ($t=1.73$; $df=56$; $p<0.85$), with a test-retest correlation of 0.62.

Construct validity. In support of the tool's construct validity, there was no significant difference between males and females ($t=1.07$; $df=97$; $p>0.28$) and no significant association with age ($r=0.04$) or duration of diabetes ($r=0.12$). However, as would be expected, individuals with type 1 diabetes scored slightly higher (mean 29 [SD 3.7]) than individuals with type 2 diabetes (mean 26 [SD 5.0]; $t=2.48$; $df=94$; $p<0.01$).

Discussion

The purpose of this study was to develop a valid and reliable questionnaire capable of assessing the effect of a diabetes education intervention on knowledge of diabetes and its self-management requirements in people with type 1 and 2 diabetes.

Although it is well acknowledged that knowledge acquisition does not readily translate into behaviour change, a myriad of studies discuss the need for assessing knowledge as an important measure of effectiveness of diabetes educational interventions and as a prerequisite for informed health decision

Key points

- An Australian National Consensus Position on Outcomes and Indicators for Diabetes Patient Education identified *knowledge* and *understanding* as the key outcomes most directly influenced by diabetes education
- A subsequent literature review failed to identify a validated, suitable questionnaire for measuring diabetes knowledge
- We developed, piloted and validated a generic, brief diabetes knowledge questionnaire for application before and after education interventions and suitable for people with both type 1 and type 2 diabetes
- Methods to establish content validity included a literature review, a Delphi survey of national key opinion leaders and a workshop of Australian Diabetes Educator Association members
- The resulting 15-item diabetes knowledge questionnaire (DKQ), with an additional seven demographic questions, was pilot tested for internal consistency and for stability (test-retest) on 129 and 57 people with type 1 and type 2 diabetes, respectively
- Results showed good reliability and internal consistency and a highly acceptable 'Flesch Reading Ease' score, hence making the tool applicable to people with a low literacy level
- The DKQ can now be applied by health professionals as part of quality assurance and improvement for assessing their own diabetes education practice and as a research tool

making.^{27–31} Others advocate that acquiring adequate knowledge of this chronic illness is the cornerstone for enabling people towards diabetes self-management and hence prevention of ill health.²⁰ The O&I Consensus Position^{13,14} identified knowledge as the outcome mostly affected by diabetes education. Nonetheless, a further three key outcomes, i.e. self-management behaviours, self-determination and psychological adjustment, were identified and recommended to form part of the outcome assessments of diabetes education interventions – albeit with appropriate validated instruments.¹⁵

The DKQ is unique in the way in which it includes separate questions for people not taking diabetes medication (12 items), people taking diabetes medication and/or insulin (two items) and an additional item for people with type 1 diabetes only (total 15 items), therefore making it a more widely applicable tool.

The DKQ is a brief, 15-item knowledge questionnaire with seven additional demographic questions added if required, taking between 5–15 minutes to complete – hence making it feasible to apply in a busy clinical setting.

The readability, using the 'Flesch Reading Ease' test, was considered

highly acceptable, hence making the tool applicable to people with a low literacy level.

The importance of consumer input has been increasingly advocated by consumer and health care provider organisations. Although the Delphi survey did not specifically obtain input from people with diabetes, the draft questionnaire was pilot tested on a small sample of people with diabetes, and their feedback was sought and incorporated before the large scale pilot test was conducted. Further, a number of Delphi and ADEA workshop participants who responded in their professional capacity also have diabetes themselves.

Valid outcome data can only be achieved if education providers assure adequate item to content coverage, i.e. all questions in the DKQ need to be covered during an education intervention.

Further testing for the scale's responsiveness/sensitivity to change through an education session is now needed. This is currently underway at the Australian Diabetes Council where the DKQ is applied to assess the effect of an ongoing diabetes group education programme on type 2 diabetes patients' knowledge before and after the programme.



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Limitations

Although we do not claim that the DKQ will be applicable globally, it is important to note that the questionnaire is based on international³ and Australian evidence-based guidelines which have been derived from the international peer reviewed literature.⁶

In the face of ongoing changes in diabetes standards/guidelines of care and technologies, the DKQ will need regular revision to assure content accuracy and re-validation if changes are made.

Conclusion

The Diabetes Knowledge Questionnaire has undergone rigorous validation and has shown good reliability and internal consistency; it can now be applied by health professionals as part of quality assurance and improvement for assessing their own diabetes education practice and as a research tool.

Appendices 2 and 3 (available online at www.practicaldiabetesinternational.com) show the text of the final Diabetes Knowledge Questionnaire and scoring instructions, respectively.

A formatted version of the full questionnaire is also available from <http://www.australiandiabetesCouncil.com/Resources/PDFs/Diabetes-Knowledge-Questionnaire-DKQ-2009.pdf>.

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Declaration of interests

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Appendix 1. Diabetes Knowledge Questionnaire pilot test (n=129): results of internal consistency

Question (item) no.	Question topic	Corrected item: total correlation	Scale variance if item deleted	Scale mean if item deleted	Cronbach's α if item deleted
1	Ideal range of blood glucose level (BGL)	34.55	18.273	0.197	0.725
2	HbA _{1c} result indicating lowest risk	34.64	17.855	0.128	0.734
3	Diabetes chronic nature/no cure	34.64	18.255	0.131	0.729
4	Which statement re diabetes diet is true	34.55	17.473	0.519	0.712
	Benefits of physical activity (PA):				
5a	Controls BGLs	34.64	18.455	0.073	0.732
5b	Lowers blood pressure	34.82	16.564	0.500	0.705
5c	Affects mood	35.27	16.818	0.570	0.704
5d	Skin cancer risk	34.45	18.873	0.000	0.730
5e	Lowers cholesterol	34.91	15.291	0.810	0.679
6	How often exercise or PA	34.45	18.873	0.000	0.730
	Well-controlled diabetes reduces risk of:				
7a	Kidney damage	34.64	16.855	0.558	0.705
7b	Blindness	34.45	18.873	0.000	0.730
7c	Melanoma	34.45	18.873	0.000	0.730
7d	Heart disease	34.73	17.018	0.425	0.711
7e	Foot ulcers	34.64	16.855	0.558	0.705
7f	Unsure	34.45	18.873	0.000	0.730
	Foot problems most at risk of:				
8a	Poor circulation	34.55	17.473	0.519	0.712
8b	Loss of feeling in the feet	34.55	18.073	0.277	0.722
8c	Foot ulcers	34.91	16.891	0.398	0.712
8d	Hammer toe	34.55	18.873	-0.035	0.735
8e	Infections	34.64	18.255	0.131	0.729
8f	Unsure	34.45	18.873	0.000	0.730
9	Why advised to self-monitor BG	34.82	16.564	0.500	0.705
	What to do if ill:				
10a	Check BGLs	34.55	18.273	0.197	0.725
10b	Stop all diabetes medications/insulin	34.45	18.873	0.000	0.730
10c	Drink lots of unsweetened fluids	35.09	19.691	-0.240	0.755
10d	Seek medical attention if very unwell	34.55	18.073	0.277	0.722
10e	Exercise to lower BGLs	34.64	18.255	0.131	0.729
10f	Unsure	34.45	18.873	0.000	0.730
11	Frequency of medical check-ups	34.82	18.764	-0.033	0.742
	The National Diabetes Services Scheme:				
12a	Allows purchase of BG testing strips	34.64	16.655	0.622	0.701
12b	Offers to provide free syringes	34.82	16.564	0.500	0.705
12c	Is for low income earners only	34.45	18.873	0.000	0.730
12d	Is for all types of diabetes	34.45	18.873	0.000	0.730
12e	Is free to join	34.82	17.964	0.153	0.730
12f	Unsure	34.55	17.473	0.519	0.712
13	Which statement re medications is true	34.45	18.873	0.000	0.730
14	Hypoglycaemia treatment	34.45	18.873	0.000	0.730
	Type 1: if feeling unwell and unable to eat:				
15a	Check BG	34.64	18.855	-0.041	0.738
15b	Drink carbohydrate fluid if BGL <15mmol/L	35.45	18.873	0.000	0.730
15c	Hospital if vomiting/diarrhoea	34.82	18.964	-0.079	0.745
15d	Stop taking all insulin	34.55	19.073	-0.110	0.738
15e	Medical help to adjust insulin doses	34.73	19.418	-0.185	0.750
15f	Unsure	34.45	18.873	0.000	0.730

For questions 1–4, 6, 9,11,13,14 – one correct answer only; all other questions – as many as apply answers.



Appendix 2. Text of the Diabetes Knowledge Questionnaire

DIABETES KNOWLEDGE QUESTIONNAIRE TEST YOUR KNOWLEDGE AND UNDERSTANDING OF DIABETES AND ITS MANAGEMENT YOUR NAME:	
<p>Dear participant</p> <p>Please read the instruction for each question carefully as the required responses change from 'circle ONE answer only' to 'circle AS MANY as apply'.</p> <p>Please assist us by answering ALL questions on EVERY page.</p>	
<p>1. What is the ideal range for blood glucose (sugar) levels a person with diabetes should aim for? <i>Please circle ONE answer only</i></p> <p>a. 2 to 6mmol/L b. 7 to 13mmol/L c. 4 to 8mmol/L d. 4.5 to 15mmol/L e. Unsure</p>	<p>c. It can help to regulate a person's mood d. It can reduce the risk of skin cancer e. It can lower cholesterol levels f. Unsure</p>
<p>2. A blood test called HbA_{1c} (or A_{1c}) measures the average blood glucose levels over the past 2 to 3 months. What is the HbA_{1c} result that indicates a lowest risk of developing long-term diabetes complications? <i>Please circle ONE answer only</i></p> <p>a. Less than or equal to 7% b. Less than 8% c. 9% d. Less than or equal to 10% e. Unsure</p>	<p>6. How often should people with diabetes exercise or be physically active? <i>Please circle ONE answer only</i></p> <p>a. Most days of the week for at least 30 minutes b. Once a week for at least 30 minutes c. Once a month for one hour d. At least every fortnight for two hours e. Unsure</p>
<p>3. Diabetes is a condition that: <i>Please circle ONE answer only</i></p> <p>a. Can be cured by adopting a healthy lifestyle b. Can be cured with tablets and/or insulin c. Is currently not curable d. Is always life threatening when first diagnosed e. Unsure</p>	<p>7. Well-managed diabetes decreases the risk of: <i>Please circle AS MANY as apply, or circle 'Unsure'</i></p> <p>a. Kidney damage b. Blindness c. Melanoma d. Heart disease e. Foot ulcers f. Unsure</p>
<p>4. Which of the following statements about diabetes and diet is true? <i>Please circle ONE answer only</i></p> <p>a. People with diabetes should eat a sugar free diet b. It is OK to eat fried take away food three times a week c. Red meat is a carbohydrate food d. A diet which is low in fat, high in fibre, low in added sugar is recommended for everyone with diabetes e. Unsure</p>	<p>8. What foot problems are people with diabetes most at risk of? <i>Please circle AS MANY as apply, or circle 'Unsure'</i></p> <p>a. Poor circulation b. Loss of feeling in the feet c. Foot ulcers d. Hammer toe e. Infections f. Unsure</p>
<p>5. Why is doing regular exercise or being physically active good for your health? <i>Please circle AS MANY as apply, or circle 'Unsure'</i></p> <p>a. It can help to control blood glucose levels b. It can lower blood pressure</p>	<p>9. Why are people with diabetes advised to test their own blood glucose (BG)? <i>Please circle ONE option only</i></p> <p>a. To alert them to changes in BG level patterns b. To help make decisions in relation to exercise, treating 'hypos' (low BG) or sick-day management c. It can make people more confident in looking after their diabetes d. All of the above e. Unsure</p>
<p><i>(continued on next page)</i></p>	



Appendix 2. Text of the Diabetes Knowledge Questionnaire (continued from previous page)

- 10. What should a person with diabetes do if s/he becomes ill (e.g. flu, gastric upset, infection)? Please circle AS MANY as apply, or circle 'Unsure'**
- Check blood glucose level more frequently (every 2 to 4 hours)
 - Stop taking all diabetes tablets and/or insulin
 - Drink lots of non-sweet fluid if blood glucose levels are over 15mmol/L
 - Seek medical attention if very unwell and unable to check blood glucose
 - Try to do as much exercise as possible to lower blood glucose levels
 - Unsure

- 11. People with diabetes need a medical check-up of their eyes, nerve and kidney function at least: Please circle ONE answer only**
- Every month
 - Six monthly
 - Once a year
 - Every two to three years
 - Unsure

- 12. The National Diabetes Services Scheme (NDSS): Please circle AS MANY as apply, or circle 'Unsure'**
- Allows members to purchase blood glucose testing strips at reduced price
 - Offers members free syringes and insulin pen needles
 - Is only available to people on low incomes
 - Is available to people with all types of diabetes
 - Is free to join
 - Unsure

The following questions (13 and 14) are to be completed by people taking diabetes medication (i.e. blood glucose lowering tablets or insulin) If you are not taking any diabetes medication please go to question No 16

- 13. Which of the following statements about diabetes medication is true? Please circle ONE answer only**
- If blood glucose levels are normal for two months, diabetes medication can be stopped
 - Tablets for diabetes work by increasing blood glucose levels
 - Regular medical check-ups are necessary to assess the need for adjustments to diabetes medication
 - People taking diabetes medication do not need to worry about healthy eating
 - Unsure

- 14. If a person with diabetes has a hypo (low blood glucose level) reaction, s/he should: Please circle ONE answer only**
- Immediately take some insulin or diabetes tablets
 - Rest and wait until s/he feels better

- Immediately have some sugary food or drink (e.g. jelly beans, soft drink)
- Drink some diet soft drink
- Unsure

The next question (No 15) is to be completed by people with or carers of people with type 1 diabetes only

- 15. A person with type 1 diabetes feeling unwell and unable to eat should: Please circle AS MANY as apply, or circle 'Unsure'**
- Check blood glucose and ketone levels at least every 2 hours
 - Drink carbohydrate containing (sugary) fluids if blood glucose below 15mmol/L
 - Go to the hospital if persistent vomiting and/or diarrhoea
 - Stop taking all insulin
 - Seek medical advice for adjusting insulin doses
 - Unsure

16. Finally, we would like to ask you some questions about yourself. This questionnaire is strictly confidential. Please assist us by answering all questions.

What is your age? years

What is your gender? Female Male

How long have you had diabetes?
..... years or months or days

What type of diabetes do you have?
Type 1 Type 2 Unsure
Other please specify

Do you take diabetes medication? Yes No
If yes glucose lowering tablets and/or insulin

If you ticked insulin **how many injections per day?**
 1 2 3 4
 Other, please specify

If you ticked glucose lowering tablets, **how many different tablets?**
 1 2 3
 Other, please specify

Have you ever seen a Diabetes Educator? Yes No

Have you ever seen a Dietitian? Yes No

Thank you very much for completing this questionnaire!



Appendix 3. Diabetes Knowledge Questionnaire scoring instructions

<p>For all questions with ONE answer:</p> <p>1 = correct 0 = incorrect 0.5 = unsure</p> <p>For all questions with AS MANY as apply answers enter for each option i.e. a. b. c. d. e.:</p> <p>1 = correct 0 = incorrect</p> <p>For Question 9: Enter 0.3 if option a. or b. or c. are circled individually or 1 = correct, i.e. option d.</p> <hr/> <p>For people with type 2 diabetes NOT taking diabetes medication the total possible score is 26.</p> <p>For people with type 2 diabetes taking diabetes medication the total possible score is 28.</p> <p>For people/carers of people with type 1 diabetes the total possible score is 32.</p>	<p>Correct answers</p> <table border="1"> <thead> <tr> <th>Question number</th> <th>Correct answer(s)</th> </tr> </thead> <tbody> <tr><td>1</td><td>c</td></tr> <tr><td>2</td><td>a</td></tr> <tr><td>3</td><td>c</td></tr> <tr><td>4</td><td>d</td></tr> <tr><td>5</td><td>a, b, c, e</td></tr> <tr><td>6</td><td>a</td></tr> <tr><td>7</td><td>a, b, d, e</td></tr> <tr><td>8</td><td>a, b, c, e,</td></tr> <tr><td>9</td><td>d</td></tr> <tr><td>10</td><td>a, c, d</td></tr> <tr><td>11</td><td>c</td></tr> <tr><td>12</td><td>a, b, d, e</td></tr> <tr><td>13</td><td>c</td></tr> <tr><td>14</td><td>c</td></tr> <tr><td>15</td><td>a, b, c, e</td></tr> </tbody> </table>	Question number	Correct answer(s)	1	c	2	a	3	c	4	d	5	a, b, c, e	6	a	7	a, b, d, e	8	a, b, c, e,	9	d	10	a, c, d	11	c	12	a, b, d, e	13	c	14	c	15	a, b, c, e
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