Publication reference:

Sampson MJ, Singh H, Dhatariya KK, Jones C, Walden E and Bradley C (2009) Psychometric validation and use of a novel diabetes in-patient treatment satisfaction questionnaire. *Diabetic Medicine,* 26, 729-735. http://www3.interscience.wiley.com/cgi-bin/fulltext/122372006/PDFSTART

http://www3.interscience.wiley.com/journal/122372006/suppinfo

Education and psychological aspects

Psychometric validation and use of a novel diabetes inpatient treatment satisfaction questionnaire (the DTSQ-IP)

Diabetes Inpatient Treatment Satisfaction (DTSQ-IP)

MJ Sampson [1]

H Singh [2]

KK Dhatariya [1]

C Jones [1]

E Walden [1]

C Bradley [3]

[1] Elsie Bertram Diabetes Centre, Norfolk and Norwich University Hospital NHS Trust, Norwich, UK, NR4 7UY.

[2] Department of Psychiatry and Neurobehavioral Sciences, University of Virginia Health System, P.O. Box 800223, Charlottesville, Virginia 22908, USA

[3] Diabetes Research Group, Health Psychology Research, Dept. of Psychology, Royal Holloway, University of London, Egham, Surrey, UK, TW20 0EX

Correspondence to Professor Mike Sampson Elsie Bertram Diabetes Centre Norfolk and Norwich University Hospital NHS Trust , Norwich, UK NR4 7UY Tel. UK 01603 287094 Fax UK 01603 287320 mike.sampson@nnuh.nhs.uk

Word count: 3982 Tables : 2 Figures : 0 Appendices on line : 1

Abstract

Aims To develop the first psychometrically validated Diabetes Treatment Satisfaction Questionnaire for in-patients (DTSQ-IP) and examine determinants of in-patient diabetes treatment satisfaction.

Methods We studied 366 in-patients with insulin-treated diabetes at a single UK centre. We developed a 19-item DTSQ-IP to assess in-patient diabetes treatment satisfaction, and collected data on in-patient length of stay (LOS) and in-patient care at the same time.

Results Psychometric analyses including Principal Components Analysis and Cronbach's alpha reliability coefficient showed that a single satisfaction score (excluding two items scored individually) can be computed for the entire DTSQ-IP indicating very good internal consistency reliability (0.92). The DTSQ-IP detected considerable dissatisfaction with meal choice and timing (13.7% of in-patients would never have chosen similar meals at home), and with in-patient hypoglycaemia (35.3% felt that their blood sugars were too low most of the time). In-patients on surgical wards, women, and those long established on insulin were significantly more dissatisfied, particularly with competence of hospital staff. Patients who administered their own insulin were not significantly less dissatisfied overall, but were so with the choice of meals ($p = 0.005$). Multiple regression analysis produced a model accounting for 8.2% of variability in DTSQ-IP ($r = 0.29$; $p = 0.0058$) and 21.7% of variability in LOS ($r = 0.46$; $p = 0.0001$).

Conclusions The DTSQ-IP is a novel, psychometrically validated and sensitive tool that adds to the DTSQ portfolio. The DTSQ-IP facilitates efforts to assess and improve treatment satisfaction in in-patients with diabetes.

Keywords diabetes, in-patients, length of stay, questionnaire, satisfaction

Abbreviations DISN, diabetes in-patient specialist nurse; DTSQ-IP, Diabetes Treatment Satisfaction Questionnaire for in-patients; LOS, length of in-patient stay; MDI, multiple daily insulin

Introduction

Up to 10% of unselected in-patient populations have diabetes (**1-3**), and the clinical and financial importance of good in-patient diabetes care are well recognised (**4-6**). High levels of in-patient dissatisfaction with the quality of in-patient diabetes care have been described (**7,8**), but this has not been analysed in any structured way. For example, we do not know how duration of diabetes or insulin use, loss of control over insulin injections, poor blood glucose control, poor quality of meals, or staff competence, influence in-patient diabetes treatment satisfaction. In-patients with diabetes stay in hospital longer, regardless of the cause of admission (**1-3**) and intuitively one would expect that variables contributing to in-patient diabetes treatment dissatisfaction would also contribute to prolonged in-patient length of stay (LOS) (**1-3**).

The original Diabetes Treatment Satisfaction Questionnaire (DTSQ) was designed to measure patient satisfaction with diabetes treatment (**9-11**). The latest version of the DTSQ for adults (there are separate versions for teenagers and parents of younger children) is suitable for people with Type 1 or Type 2 diabetes and consists of a six-item scale assessing treatment satisfaction, with two additional items assessing perceived frequency of hyperglycaemia and hypoglycaemia. The DTSQ has been used extensively with out-patients with diabetes to assess patient satisfaction with diabetes treatment and changes in treatment (**12-17**), and has been recommended by the World Health Organisation and the International Diabetes Federation for assessing outcomes of diabetes care (**18**). However, the in-patient experience of patients with diabetes is different, and complicated by intercurrent illness, loss of control over diet and medication, and by dependence on ward staff who may have had limited training in diabetes care. There has been no previous attempt to develop a psychometrically validated instrument to capture the views of in-patients with diabetes. This is an important omission, as quantifying the level and causes of in-patient dissatisfaction with diabetes treatment is a necessary first step to improving in-patient diabetes care. It could also be useful economically to look at relationships between in-patient diabetes care, treatment satisfaction, and prolonged in-patient LOS.

We have now developed and psychometrically validated a diabetes treatment satisfaction questionnaire specifically for in-patients (DTSQ-IP), derived from the original DTSQ for out-patients (**10,11**), and examined the determinants of DTSQ-IP scores in a large, in-patient population with diabetes.

Patients and Methods

Development of the initial DTSQ-IP

As part of in-patient diabetes service improvement at the Norfolk and Norwich University Hospital NHS Trust, we wished to survey in-patient diabetes treatment satisfaction. The initial DTSQ (**12-17**) was

expanded by EW, MJS and CB to include additional items relating specifically to aspects of in-patient diabetes treatment and the instructions were adapted to direct patients to think only about treatment during their current hospital stay. These additional aspects were initially identified by EW in exploratory discussions with 15 in-patients with insulin-treated diabetes managed on surgical or medicine-for-the-elderly wards, a diabetes in-patient specialist nurse team, and ward staff involved in diabetes care. This first draft was then sent for comments from patient representatives on local clinical diabetes networks, and from a clinical team of 12 diabetes specialist physicians and specialist diabetes nurses at Norfolk and Norwich University Hospital. No changes were suggested at this stage, and the draft was tested on 85 in-patients with diabetes at this site (46 questionnaires returned). The draft DTSQ-IP was further refined and then used in a wider population.

Population and overall study design

All data in the validation survey were obtained in the 989-bed Norfolk and Norwich University Hospital NHS Trust, Norwich, UK. Since 2002, a diabetes in-patient specialist nurse (DISN) has been in post, supporting management for all in-patients with diabetes and this service has been described elsewhere (1). In-patients referred to the DISN service were the subject of this survey. Between 1st February 2004 and 30th October 2005 the DISN gave all direct patient contacts (n = 770) the newly piloted DTSQ-IP, asked all patients to complete this questionnaire anonymously and return the papers to the ward staff on the day of discharge. Of this primary population, 408 (53%) returned questionnaires, of whom 366 were aware that they had been insulin treated at some point during their in-patient stay. These 366 patients provided the data for this analysis as those who were unaware of insulin treatment, or who did not receive insulin, were unable to answer insulin-related questions in the DTSQ-IP. At the same time as patients completed the DTSQ-IP, they provided written information on their age, sex, length of in-patient stay, diabetes care before admission (location of care and insulin use) and duration of diabetes and insulin use prior to admission. We also asked patients to record any surgical procedure, if they were cared for on medical or surgical wards, who measured their blood glucose levels during their in-patient stay (patient or staff) and who gave insulin injections (patient or staff).

Data analysis

All data are shown as a mean and standard deviation (SD) or as a median and interquartile range [IQR]. Differences between groups were analysed by unpaired t-test or Mann Whitney U-test, as appropriate. The main dependent variables were composite DTSQ-IP score and LOS (days); stepped multiple regression analyses were undertaken to determine contributors to variability in these dependent variables, with entry of each independent variable into the multiple regression if they were significantly related ($p < 0.05$) to the dependent variable on simple linear regression.

Results

Clinical features (Table 1)

The clinical features of the study group (n=366) are shown in Table 1. As some patients were uncertain about the classification of their diabetes (as Type 1 or Type 2), in their anonymously returned questionnaires, all patients were therefore classified as 'insulin treated' prior to admission (n = 280; 76.8%), or receiving insulin for the first time as an in-patient (n = 86; 23.2%). The latter group included 48 participants (14.1 %) who had newly diagnosed insulin-treated diabetes.

Psychometric evaluation of the DTSQ-IP: exploratory factor analysis and internal consistency reliability

Detailed psychometric evaluation of the DTSQ-IP is summarised in the supplementary materials (Appendix S1; Table S1-S4) available at http://www.diabetes.org. In summary, principal components analysis was conducted on all 19 DTSQ-IP items to investigate the structure of the questionnaire and determine whether a single total *In-patient Treatment Satisfaction Score* was indicated, with all items loading more than 0.4 onto a single component. Any items that have lower loadings do not belong to the primary construct of treatment satisfaction and need to be excluded, analysed separately or, if they load highly with other items on another component, included in a separate subscale. All of the items, except items 2 (*perceived frequency of hyperglycaemia*) and 3 (*perceived frequency of hypoglycaemia*), loaded highly onto the single component. The internal consistency reliability of the DTSQ-IP was tested using Cronbach's alpha statistics. The overall scale alpha improved to 0.92 (from 0.89) when items 2 and 3 were removed from the reliability analyses and all item-total correlations exceeded 0.47, far exceeding the minimum of 0.2 recommended by Kline [**25**] as evidence that items belong together on a scale. All items contributed to the internal consistency reliability of the measure as shown by the reduction in alpha if any item is deleted (Appendix 1 online). The total *In-patient Treatment Satisfaction Score* can, therefore, be computed as the sum of the 17 DTSQ-IP items (i.e. all items except items 2 and 3), with a possible composite score range of 0 to 102.

DTSQ-IP scale and item scores (Table 2)

The overall mean DTSQ-IP composite score was 79.2±16.5 out of a possible maximum of 102, and the majority of in-patients expressed high levels of satisfaction with each DTSQ-IP item (Table 2). However, 51.3% scored 6 or 5 on item 3, indicating that they felt their blood glucose levels were too low for much of the time. This compares with 20.9% scoring 6 or 5 on item 2, indicating that they felt their blood glucose levels were too high for much of the time. Thus, hypoglycaemia was a greater concern than hyperglycaemia. A major area of dissatisfaction was available meal choices, where 21.1 % indicated that they would never or rarely have made similar meal choices at home (item 13: scores 0 and 1). Only

27.3% of in-patients said they would often have made similar meal choices at home (item 13: scores 5 and 6). A substantial minority of in-patients also expressed extreme dissatisfaction with the choice of meals available (12.6%; item 12: scores 0 and 1) and appropriateness of meals considering their insulin treatment (12.3%; item 14: scores 0 and 1). The lowest mean score for any of the 17 scale items was for choice of meals (3.2±1.9).

Determinants of DTSQ-IP composite score (n=366)

There were significant inverse relationships between a higher DTSQ-IP score and sex (in that women reported greater dissatisfaction ; r = - 0.11; p = 0.041), duration of diabetes (r = - 0.14; p = 0.008), length of in-patient stay (r = - 0.15; p = 0.005), number of insulin injections used per day before admission (r = - 0.13; p = 0.01), duration of insulin use before admission (r = - 0.12; p = 0.02), and being managed on a surgical ward (r = - 0.12 ; p = 0.02). These relationships indicate poorer satisfaction scores in women, in-patients with longer duration of diabetes, those with longer length of in-patient stay and those using more insulin injections per day prior to admission. Multiple regression produced a model accounting for 8.2% of variability in DTSQ-IP score (r = 0.29; p = 0.006), but only length of in-patient stay (t = - 2.24; p = 0.01) and the number of insulin injections used per day before admission (t = - 2.24; p = 0.02) remained significant independent contributors to a lower DTSQ-IP score in this model.

In the smaller population with a recorded in-patient stay of 0 – 14 days (n = 272; derived from median length of stay ± one interquartile range), only the number of insulin injections per day before admission (r = - 0.137; p = 0.02), and being managed on a surgical ward (r = - 0.139; p = 0.023) were significantly related to a lower DTSQ-IP score indicating reduced satisfaction. Multiple regression demonstrated that surgical ward management was the only variable independently related to DTSQ-IP score (t = - 2.02; p = 0.044) suggesting that management on surgical wards is associated with less satisfaction with diabetes treatment compared to management of patients on medical wards.

Determinants of in-patient length of stay (n=366)

Multiple regression produced a model that accounted for 21.7% of variability in LOS (r = 0.46; F = 15.7; p = 0.0001), and having surgery (t = - 4.83; p < 0.0001), admission not due to diabetes (t = + 3.75; p = 0.0002) and having fewer daily insulin injections before admission (t = - 3.29; p = 0.001) were independent contributors to this model**,** indicating a longer LOS was associated with having surgery, being admitted for reasons felt to be unrelated to diabetes, and having fewer insulin injections daily before admission.

Differences between medical and surgical inpatients in DTSQ-IP scores

There were no significant differences in DTSQ-IP scores between in-patients undergoing surgery (n = 90) and those not (n = 275; p > 0.1). However, DTSQ-IP composite score was lower showing less satisfaction for in-patients on surgical wards (n = 91) compared with those on medical wards (n = 271) (75.9±18 vs. 80.8±15, respectively; p = 0.02). The only individual DTSQ-IP item that showed significant differences between patients on the different wards was in-patient perceptions of staff knowledge of diabetes equipment which was poorer on surgical compared with medical wards (4.3±1.9 vs. 5.2±1.3 respectively; p < 0.0001). This suggests that surgical patient dissatisfaction with their diabetes treatment related more to staff competencies on surgical wards, rather than to having surgery.

Differences in DTSQ-IP total and item scores between in-patients who self administered their insulin injections and those who did not.

There were no significant differences in DTSQ-IP composite score (all p > 0.1) between in-patients who administered their insulin themselves (n=130), those who had their insulin administered by nursing staff (n=164), or those where both in-patient and nursing staff administered insulin (n=68). Patients who administered their own insulin, however, had significantly worse scores than other groups on two of the DTSQ-IP items. First, in-patients who gave their own insulin reported more dissatisfaction with hypoglycaemia than in-patients whose insulin was given by both staff and patient (item 3; mean 3.9±1.8 vs. 2.2±1.4, respectively; p = 0.001). Secondly, patients who gave their own insulin described significantly less satisfaction with the choice of meals available (item 12) compared with those who were receiving insulin from nursing staff (3.6±1.8 vs. 4.2± 1.8, respectively; p = 0.005).

DTSQ-IP scores for in-patients who self monitored their blood glucose and those who did not

There were no significant differences in DTSQ-IP composite score or for item 10 (how satisfied are you with the monitoring of your diabetes?) (all p > 0.1) between in-patients who measured their own blood glucose (n=31), those for whom ward nurses measured blood glucose levels (n=252), or those where both in-patient and nursing staff measured blood glucose levels (n=73).

Differences in DTSQ-IP total score by insulin experience

In-patients who received insulin for the first time during their admission (n=84) had significantly higher DTSQ-IP scores (82.8 [14.1]), indicating greater satisfaction than those who were insulin experienced and had been receiving insulin for one or more years (77.4±17.5; p < 0.01). The most significantly different score was for item 16 (staff knowledge of diabetes equipment), where insulin-experienced in-patients were significantly more dissatisfied than those new to insulin (4.0±1.8 vs. 4.7±1.6, respectively; p = 0.001)

Discussion

This survey of 366 inpatients with insulin-treated diabetes allowed us to validate psychometrically the DTSQ-IP, and analyse relationships between diabetes management, diabetes treatment satisfaction and in-patient LOS. The DTSQ-IP is the first psychometrically validated instrument for assessing in-patient diabetes treatment satisfaction. Battacharyya et al (**19**) reported using an adaptation of the DTSQ designed for in-patients and called the IPSQ, but used an unauthorised version of the DTSQ with several errors, including scales from 1 to 6 instead of the original 0 to 6, an inappropriate method of scoring, and additional items designed for the IPSQ which included items that were not concerned with satisfaction. Other than this, there are no published data on quantifying in-patient diabetes treatment satisfaction, despite the millions of patients admitted each year to UK, European and USA Hospitals alone (**1- 3**).

The dominant area of concern was patients feeling their blood glucose levels had been too low (item 3, Table 2), with more than half of this sample of patients giving the highest (worst) two levels of rating for this item. Hyperglycaemia, item 2, was reported to be less of a problem, but nevertheless 21% of patients indicated the highest (worst) two levels of rating (Table 2). All participants had seen a DISN, and uncontrolled hyperglycaemia or hypoglycaemia are indications for referral to a DISN at our centre (**1**), so there may be referral bias in this sample for these items. The level of dissatisfaction we found with poor in-patient glycaemic control (particularly low blood glucose levels) may be understood in the light of dissatisfaction with the timing of insulin and quality and timing of meals. It was striking that 21% of in-patients said that they would never, or rarely, have made similar meal choices at home, and a significant minority were extremely dissatisfied with meal timing, appropriateness of the meal for prescribed insulin, or with the suitability of meal content. Although these are observational data, it is likely that this level of dissatisfaction with meal times and content in insulin-treated patients would be a significant contributor to glycaemic variability and hypoglycaemia risk. This dissatisfaction would be amplified by the common practice reported in the literature of nursing staff giving insulin doses based on blood glucose measurements taken more than 30 minutes before insulin administration, or not within the recommended time before food intake (**20,21**). Many UK hospitals impose what is felt to be a 'healthy' diet on patients during their short in-patient stay, which may be an inappropriate novelty for many in-patients and a potential hypoglycaemic hazard for patients managed with insulin.

There was a wide range of practice in who gave insulin doses (35.7% of patients gave their own insulin) and who monitored blood glucose (8.9% by patient alone), but there was no difference in DTSQ-IP score between groups defined by who gave insulin or monitored blood glucose levels. In this particular hospital, insulin-experienced in-patients can continue to give their own insulin once nursing staff have confirmed patient competencies and desire to do this. This option of patient choice may have contributed to lack of difference in overall DTSQ-IP scores between those who self-administered their insulin and those who did not – i.e. patients' diabetes treatment preferences are being met in this respect. Patients self-administering insulin or self-monitoring their blood glucose levels were, however,

significantly more dissatisfied with availability of meals and choice of meals. While many patients had the choice to self-manage insulin and self-monitor blood glucose, they had little or no control over meal times and content, which were determined by the institution, and choices were limited. This may well have contributed to less satisfaction with meal-related items among patients self-managing their insulin and blood glucose monitoring.

We also found that insulin-treated patients who underwent surgery did not differ in overall DTSQ-IP scores from patients not having surgery, but that being managed on a surgical ward was a significant marker for poorer mean DTSQ-IP scores. Less satisfaction with staff competencies in handling diabetes equipment was the principal DTSQ-IP item difference in patients managed on surgical wards (item 16). This suggests that it is training and competencies in diabetes care among staff on surgical wards, rather than having surgery, that contribute to poor DTSQ-IP scores. This observation has implications for the training of all surgical ward staff. We also observed that significantly lower average DTSQ-IP scores in insulin-experienced in-patients was in large part due to dissatisfaction with staff competencies in this area. Insulin-experienced patients are in a better position to recognise lack of staff competence than are patients with no prior experience of insulin.

We were surprised that in the total sample we could find a model that accounted for only 8.2% of variability of DTSQ-IP scores, and that a high number of insulin injections on admission was the only diabetes care variable significantly contributing to dissatisfaction shown in lower DTSQ-IP scores. More detailed data collection on in-patient diabetes care in relation to variability in DTSQ-IP should improve this estimate and help to identify the sources of dissatisfaction. For example, we did not collect data on use of subcutaneous insulin 'sliding scales', which have been reviewed adversely (**22**), and relationships with treatment satisfaction score. The Norfolk and Norwich University Hospital (and half of all UK hospitals) still support the use of subcutaneous insulin sliding scales (**23**), which use fixed insulin dose algorithms that determine an insulin dose independently of clinician judgement or patient choice. In addition, this study did not collect data on discharge diagnosis, and it is possible that this would contribute to improve the value of DTSQ-IP data; for example patients undergoing abdominal surgery and not eating for 48 hours may have different DTSQ-IP scores from those of patients having lower limb vascular surgery.

The USA National discharge data described an excess mean in-patient LOS of 2.0 days in middle-aged diabetes in-patient populations (**2**), and there are equivalent data from local populations (**1, 3**). The causes of this excess LOS are unclear, but as LOS can be reduced to some extent by enhanced in-patient diabetes care (**1**), some must be due to poor diabetes management (**1**). However, there are no data that have examined contributors to variability in LOS in a more general diabetes in-patient population. It is interesting that the group treated with multiple daily insulin (MDI) injections on admission had a poorer DTSQ-IP score overall, but that an MDI regimen was significantly independently associated with shorter LOS. Thus, patients experienced in using multiple injections find

their in-patient stay less satisfactory, but an MDI regimen is associated with earlier discharge. Patients on MDI had a longer duration of diabetes, and had been treated with insulin for significantly longer (data not shown, $p < 0.0001$) than those managed with once or twice daily insulin prior to admission. It is possible that these more insulin-experienced MDI patients are more aware of deficiencies in staff in-patient management, yet more able to avoid glycaemic variability during recovery when re-established on their usual insulin regimens.

There are limitations to this study. In particular, the DTSQ-IP study population was an insulin-treated population seen by a DISN as part of an enhanced in-patient diabetes service, and present observations may not be applicable to patients who do not receive insulin during their in-patient stay, or who were not felt by ward staff to need enhanced in-patient diabetes care (**1**). It is also unclear if the data reflect experiences of diabetes in-patients from different ethnic backgrounds. At the time of this study, the DTSQ-IP was only available in English and only those patients reading and writing English fluently could participate. The DTSQ-IP is not designed to be used in children or adolescents, in individuals not receiving insulin at some point in their in-patient stay, or by in-patients not seen by a diabetes specialist nurse. It should also be stressed that these data are observational and cross-sectional, and there is a pressing need for prospective controlled studies evaluating specific interventions to improve DTSQ-IP scores along with other key outcomes. The diabetes care data collected at the same time as the DTSQ-IP did not include detail on use of sliding scale insulin, perioperative management guidelines used, insulin / dextrose regimens used in patients with acute coronary syndromes, discharge diagnoses, the use of alternatives to oral food intake and patient understanding of sources of nutrition, or on cognitive changes related to anaesthesia and medication.

Since the present study was conducted, we have undertaken further qualitative work to adapt the DTSQ-IP to include items of particular concern to British South Asians with diabetes (adding items concerned with privacy and with communication with staff) and have linguistically validated the questionnaire into five South Asian languages for use in a nationwide study of 58 UK hospitals. This national study, now in the early stages of data collection, will deal with many of the limitations of the present preliminary study.

In conclusion, we have developed and validated a novel DTSQ-IP and quantified the high levels of in-patient diabetes treatment dissatisfaction in an insulin-treated population for the first time. The DTSQ-IP is sensitive enough to detect significant differences in satisfaction between groups and relationships with process of diabetes care. The DTSQ-IP will be a useful instrument in conducting trials to evaluate interventions to reduce LOS and improve in-patient satisfaction with diabetes care.

Competing interests: Clare Bradley is a director and majority share holder in Health Psychology Research Ltd which licenses her questionnaires for others to use including the DTSQ-IP used in the study reported here.

Acknowledgements

We are grateful to the Norwich and Norfolk Diabetes Trust for financial support.

Access to DTSQ-IP: Please contact the copyright holder, Professor Clare Bradley via the website of http://www.healthpsychologyresearch.com. Correspondence relating to the DTSQ-IP to Professor Clare Bradley, c.bradley@rhul.ac.uk.

References

1 Sampson MJ , Crowle T, Dhatariya K, Dozio N, Heyburn PJ, Jones C et al. Trends in bed occupancy for inpatients with diabetes before and after the introduction of a diabetes inpatient specialist nurse. *Diabet Med* 2006; **23**: 1008-1015.

2 Ray NF, Thamer M, Taylor T, Fehrenbach SN, Ratner R. Hospitalisation and expenditures for the treatment of general medical conditions among the US diabetic population in 1991. J *Clin Endocrin Metab*. 1997; **81**: 3671-3679.

3 Sampson MJ, Dozio N, Ferguson BA, Dhatariya K. Total and excess bed occupancy by age, specialty and insulin use for nearly one million diabetes patients discharged from all English Hospitals. *Diabetes Res Clin Pract* 2006; **77**: 92-98.

4 American Diabetes Association. *American Diabetes Association Position Statement. Inpatient Diabetes and Glycemic Control: A Call to Action Conference.* Consensus Development Conference 2006. Available at http://www.diabetes.org Last accessed 10 June 2008.

5 Lien LF, Angelyn Bethel M, Feinglos MN. In hospital management of type 2 diabetes mellitus. *Med Clin North Am* 2004; **88**: 1085-1105.

6 Clement S, Braithwaite SS, Magee MF, Ahmann A, Smith EP, Schafer RG et al. Management of diabetes and hyperglycemia in hospitals. *Diabetes Care* 2004; **27**: 553-591.

7 Audit Commission. *Testing Times: A Review of Diabetes Services in England and Wales*. London: Audit Commission, 2000. Available at http://www.audit-commission.gov.uk Last accessed 1 January 2009.

8 Department of Health. *National Service Framework for Diabetes: One year on*. London: DoH, 2004, Available at http://www.dh.gov.uk/PublicationsandStatistics/Publications Last accessed October 2008.

9 Bradley C, Lewis KS. Measures of psychological well-being and treatment satisfaction developed from the responses of people with tablet-treated diabetes. *Diabet Med* 1990; **7**: 445-451.

10 Bradley C. The Diabetes Treatment Satisfaction Questionnaire: DTSQ. In: Bradley C, ed. *Handbook of Psychology and Diabetes: A Guide to psychological Measurement in Diabetes Research and Practic*. Chur, Switzerland: Harwood Academic Publishers, 1994.

11 Bradley C, Speight J. Patient perceptions of diabetes and diabetes therapy: assessing quality of life. *Diabetes Metab Res Rev* 2002; **18**: S64-S69.

12 DAFNE Study Group. Training in flexible, intensive insulin management to enable dietary freedom in people with type 1 diabetes: dose adjustment for normal eating (DAFNE) randomised controlled trial. *BMJ* 2002; **325**:746-748.

13 Witthaus E, Stewart J, Bradley C. Improved psychological outcomes after initiation of insulin treatment in patients with Type II diabetes. *Diabetologia* 2000; **43**(Suppl 1): A205.

14 Jennings AM, Lewis KS, Murdoch S, Talbot JF, Bradley C, Ward JD. Randomized trial comparing continuous subcutaneous insulin infusion and conventional insulin therapy in type II diabetic patients poorly controlled with sulfonylureas. *Diabetes Care* 1991; **14**: 738-744.

15 Witthaus E, Stewart J, Bradley C. Treatment satisfaction and psychological well-being with insulin glargine compared with NPH in patients with Type 1 diabetes. *Diabet Med* 2001; **18**: 619-625.

16 Howorka K, Pumprla J, Schlusche C, Wagner-Nosiska D, Schabmann A, Bradley C. Dealing with ceiling baseline treatment satisfaction level in patients with diabetes under flexible, functional insulin treatment: assessment of improvements in treatment satisfaction with a new insulin analogue. *Qual Life Res* 2000; **9**: 915-930.

17 Witthaus E, Ashwell SG, Johnston P, Stephens J, Home PD, Bradley C. Quality of life is improved with insulin + regular human insulin in patients with Type 1 diabetes. *Diabetologia* 2004; **47**(Suppl 1): A306.

18 Bradley C, Gamsu DS. Guidelines for encouraging psychological well-being: report of a Working Group of the World Health Organization Regional Office for Europe and International Diabetes Federation European Region St Vincent Declaration Action Programme for Diabetes. *Diabet Med* 1994; **11**: 510-516.

19 Bhattacharyya A, Christodoulides C, Kaushal K, New JP, Young RJ. Inpatient management of diabetes mellitus and patient satisfaction. *Diabet Med* 2000; **19**: 412-416.

20 Manning EH, Jackson L. An evaluation of the timing between key insulin administration-related processes: the reasons why these processes happen when they do and how to improve their timing. *Aust Health Rev* 2005; **29**: 61-67.

21 Cohen LS, Sedhom L, Salifu M, Friedman EA. Inpatient diabetes management : examining morning practice in an acute care setting. *Diabetes Educ* 2007; **33**: 483-492.

22 Umpierrez GE, Palacio A, Smiley D. Sliding scale insulin use: myth or insanity? *Am J Med* 2007; **120**: 563-567.

23 Sampson MJ, Brennan C, Jones C, Dhatariya K, Walden E. A national survey of inpatient diabetes services in the UK. *Diabet Med* 2007; **24**: 643-649.

Supporting information

Additional Supporting Information may be found in the online version of this article:

http://www3.interscience.wiley.com/journal/122372006/suppinfo

Table S1. DTSQ-IP: Principal Components Analyses (Unforced) of all 19 items.

Table S2. DTSQ-IP: Forced Principle Components Analyses (PCA) (single factor solution).

Table S3. DTSQ-IP: Internal consistency reliability of all 19 items using Cronbach's α statistics.

Appendix S1. Principle Components Analysis.

Table 1 ***Characteristics of insulin-treated inpatients with diabetes who completed an in-patient DTSQ-IP after review by a diabetes in-patient specialist nurse.***

Number	366
M : F	211 (57.6%) : 155 (42.3 %)
Age range (years) 16 -25	22 (6.1 %)
26 – 36	32 (8.8 %)
37 – 47	33 (9.2 %)
48 – 58	45 (12.5 %)
59 – 69	92 (25.5 %)
≥70	136 (37.7 %)
In-patient length of stay (days)	7.0±7.0
Registered for hospital outpatient care	238 (67.4%)
Diabetes duration (years) *	17.1±12.0
Insulin received for first time on admission	86 (23.4 %)
Insulin treated prior to admission	280 (76.6%)
Duration of insulin treatment (years) *	14.6±14.0
Undergoing surgery	91 (24.8%)
Medical ward: surgical ward	271 (74.8 %) : 91 (25.1 %)
Blood glucose monitoring by: Patient alone Nursing staff Both	 31 (8.5 %) 257 76 (20.9 %) (70.6 %)
Insulin given by: Patient alone Nursing staff Both	 130 (35.7 %) 165 (45.3 %) 69 (18.9 %)

Data shown as mean±SD, as median [IQR], or as n (%). There is a slightly smaller number than total of 366 in some cells due to non-completed or illegible returns.

** Diabetes duration and duration of insulin use in in-patients not receiving insulin for the first time*

Table 2. Frequency of response (%) to each item of the DTSQ-IP in 366 insulin-treated in-patients with diabetes.

	Frequency of response (%)						
Item and score	**0**	**1**	**2**	**3**	**4**	**5**	**6**
(1) How satisfied are you with your current treatment?	1.1	1.6	1.4	7.4	9.3	27.6	51.6
(2) How often have you felt that your blood sugars have been unacceptably high recently?	20.9	18.9	15.0	16.1	8.2	7.6	13.3
(3) How often have you felt your blood sugars have been unacceptably low recently?	3.7	6.0	10.0	14.5	14.5	16.0	35.3
(4) How convenient have you been finding your treatment to be recently?	1.9	1.6	4.9	10.7	15.1	28.2	37.5
(5) How flexible have you been finding your treatment to be recently?	1.4	0.8	5.5	15.0	15.6	28.7	33.1
(6) How satisfied are you with your understanding of your diabetes?	0.5	1.6	3.3	6.3	16.1	30.3	41.8
(7) Would you recommend this form of treatment to someone else with you kind of diabetes?	3.8	1.4	1.4	8.2	10.1	25.2	49.9
(8) How satisfied would you be to continue with your present form of treatment?	1.4	1.4	2.7	7.7	13.7	32.2	41.0
(9) How satisfied are you with your current diabetes treatment plan?	1.4	0.8	1.6	8.2	13.4	29.0	45.6
(10) How satisfied are you with the monitoring of your diabetes?	1.4	0.8	1.6	8.2	13.4	29.0	45.6
(11) How satisfied are you with the availability & timing of snacks & meals?	3.3	3.3	6.3	9.3	21.3	22.1	34.4
(12) How satisfied are you with the choice of meals available?	7.4	5.2	6.8	14.8	20.5	19.1	26.2
(13) How often would you make a similar meal choice at home?	13.7	7.4	12.6	18.6	20.5	13.1	14.2
(14) How appropriate are the meals considering your insulin treatment?	6.0	6.3	8.2	13.7	18.6	23.2	24.0
(15) How satisfied are you with the timing of your insulin in relation to meal times?	4.1	4.6	5.5	10.4	13.1	25.4	36.9
(16) How satisfied are you with the staff knowledge of your diabetes equipment?	1.9	3.0	3.3	6.3	11.7	24.0	49.7
How satisfied are you with your contacts with (the DISN) in terms of							
(17a) number of visits?	1.1	4.9	5.7	8.7	12.3	23.5	43.7
(17b) time spent with you?	0.8	1.9	3.0	8.7	9.8	26.0	49.7
(17c) clarity of information?	1.4	0.5	2.7	7.1	9.3	22.7	56.3

In all items, except items 2 and 3, 0 indicates lowest item satisfaction, and 6 highest item satisfaction. Response options (RO) for items 1, 6 & 8: '0', very dissatisfied to '6'= very satisfied. RO for items 2 & 3: '0', none of the time to '6', most of the time. RO for item 4: '0', very inconvenient to '6', very convenient. RO for item 5: '0', very inflexible to '6', very flexible RO for item 7: '0', no, I would definitely not recommend the treatment '6', yes, I would definitely recommend the treatment. RO for all items except items 13 & 14: '0', very dissatisfied to '6', very satisfied. RO for item 13: '0', none of the time to '6', often and '0', not at all appropriate to '6', very appropriate for item 14.

http://www3.interscience.wiley.com/journal/122372006/suppinfo

Appendix S1. Principle Components Analysis

Principal Components Analysis (PCA) with varimax rotation, based on the correlation matrix was conducted on all 19 DTSQ-IP items (N=366) to determine the structure of the DTSQ-IP. Table A (PCA 1) shows this initial analysis. PCA 1 revealed 4 components with double loadings for 2 items [indicated by'd' in Table A where they can be seen to load >0.4 on two components]. Items 2 (perceived frequency of *hyperglycaemia*) and 3 (perceived frequency of *hypoglycaemia*) loaded well on the fourth component while all other items showed quite poor loadings on this particular component. It is recommended that items 2 and 3 be assessed individually while analysing data from the original DTSQ on which the design of the DTSQ-IP was based. In the next step, PCA 2 with a forced single-factor solution was conducted on all 19 DTSQ-IP items [Table B] to determine whether a single total *Inpatient Treatment Satisfaction Score* was indicated, with all items loading >0.4 onto a single component. As expected, all items, except items 2 and 3, loaded highly onto this single component. Subsequently, items 2 and 3 were removed from the PCA and loadings were reassessed for the remaining 17 items on a single component [PCA 3 in Table B]. Results showed that all 17 items loaded well onto the single component (each factor loading >0.4). The internal consistency reliability of the DTSQ-IP was tested using Cronbach's alpha statistics. First, reliability analysis was conducted including all 19 DTSQ-IP items. As expected, item-total correlations for all items (except items 2 and 3) were well above the minimum satisfactory level of 0.2 recommended by Kline (**25)** [Table C]. Items 2 and 3 also detracted from the overall scale alpha (0.89). These findings were in line with results from the PCA showing that items 2 and 3 should be analysed individually while computing a total score for other items of the DTSQ-IP. Next, item 2 and 3 were removed from the reliability analysis. The scale alpha improved to 0.92 (from 0.89) and all item-total correlations were well in excess of the minimum 0.2. All items contributed to the internal consistency reliability of the measure as shown by the reduction in alpha if any item is deleted [Table D]. The total *Inpatient Treatment Satisfaction Score* can therefore, be computed as the sum of the 17 DTSQ-IP items (i.e. all items except items 2 and 3), with a possible score range of 0 to 102. The number of missing values that can be tolerated in the scale identified above (not including items 2 and 3) was determined by removing first the item within the scale whose removal caused the greatest fall in the scale alpha. This is the strongest item and it is the worst possible case for internal consistency if this item is missed. Cronbach's alpha was then calculated without this item. If the alpha remained above 0.8, the item whose removal next causes the greatest fall in the scale alpha was removed and Cronbach's alpha was re-computed. This process was repeated cyclically until the scale alpha fell below 0.8. Based on these analyses, it was revealed that up to eight items could be tolerated as missing from the DTSQ-IP before the alpha fell below the recommended 0.8 value. Thus, if 9 or more items are missed, then the total *Inpatient Treatment Satisfaction Score* should not be computed for that particular participant. In cases where participants had missed a tolerable number of items (i.e. eight items or fewer not including items 2 and 3), an average score was computed using the remaining item scores (for each participant separately), to replace the missing item(s) score(s).

Table S1. DTSQ-IP: Principal Components Analysis (Unforced) of all 19 items

Item summary	PCA 1 4 components with Eigenvalues >1 (63.8% of variance) 1	2	3	4
(1) …current?	**.645**	.361	.181	-.008
(2) …unacceptably high?	.186	-.034	-.065	**-.732**
(3) …unacceptably low?	.168	-.032	.022	**.752**
(4) …convenient?	**.723**	.290	.032	.000
(5) …flexible?	**.621**	.313	.179	.086
(6)…understanding?	**.555**	.052	.271	-.072
(7)…recommend?	**.705**	.149	.339	.010
(8)…continue?	**.820**	.100	.043	.010
(9) …current treatment plan?	**.760**	.140	.255	-.041
(10) …monitoring?	**.692**	.240	.264	.015
(11) …food availability & timing? [d]	**.426**	**.649**	.014	-.013
(12) …choice of meals?	.191	**.867**	.079	-.036
(13) …similar to home meals?	.113	**.791**	.085	.059
(14) …appropriateness of meals?	.210	**.842**	.134	-.006
(15) …insulin timing? [d]	**.569**	**.488**	.112	.017
(16) …staff knowledge?	.389	**.437**	.339	-.062
(17a) …no. of DISN visits?	.179	.112	**.861**	.017
(17b) …DISN time spent?	.219	.105	**.881**	.036
(17c) …DISN clarity of information?	.322	.102	**.811**	.103

[d] indicates double loading (i.e. item loads >0.4 on 2 components).
Cell entries marked in bold refer to loadings >0.4.

Table S2. DTSQ-IP: Forced Principal Component Analyses (PCA) (single factor solution)

Item summary	PCA 2 Forced 1-factor (39.7% of variance)	PCA 3 Forced 1-factor (44.3% of variance)
(1) …current treatment?	**.744**	**.744**
(2) …unacceptably high?	.084	*Item omitted*
(3) …unacceptably low?	.128	*Item omitted*
(4) …convenient?	**.705**	**.705**
(5) …flexible?	**.703**	**.703**
(6) …understanding?	**.551**	**.551**
(7) …recommend?	**.744**	**.744**
(8) …continue?	**.683**	**.683**
(9) …current treatment plan?	**.745**	**.744**
(10) …monitoring?	**.751**	**.750**
(11) …food availability & timing?	**.664**	**.663**
(12) …choice of meals?	**.630**	**.631**
(13) …similar to home meals?	**.535**	**.537**
(14) …appropriateness of meals?	**.653**	**.654**
(15) …insulin timing?	**.727**	**.727**
(16) …staff knowledge?	**.657**	**.657**
(17a) …no. of DISN visits?	**.545**	**.545**
(17b) …DISN time spent?	**.579**	**.580**
(17c) …DISN clarity of information?	**.627**	**.627**

Cell entries marked in bold refer to loadings >0.4.

Table S3. DTSQ-IP: Internal consistency reliability of all 19 items using Cronbach's alpha statistics

	Scale alpha = 0.894	
Item summary	**Corrected item-total correlation**	**Cronbach's alpha if item deleted**
(1) …current treatment?	.69	.885
(2) …unacceptably high?	.06	.908
(3) …unacceptably low?	.09	.904
(4) …convenient?	.64	.886
(5) …flexible?	.65	.886
(6)…understanding?	.49	.890
(7)…recommend?	.66	.885
(8)…continue?	.61	.887
(9) …current treatment plan?	.68	.885
(10) …monitoring?	.69	.885
(11) …food availability & timing?	.63	.886
(12) …choice of meals?	.59	.887
(13) …similar to home meals?	.49	.891
(14) …appropriateness of meals?	.62	.886
(15) …insulin timing?	.68	.884
(16) …staff knowledge?	.61	.887
(17a) …no. of DISN visits?	.48	.890
(17b) …DISN time spent?	.50	.890
(17c) …DISN clarity of information?	.57	.888

Table S4. DTSQ-IP: Internal consistency reliability (of all items except 2 & 3) using Cronbach's alpha statistics

Item summary	Scale alpha = 0.916	
	Corrected item-total correlation	Cronbach's alpha if item deleted
(1) …current treatment?	.69	.909
(4) …convenient?	.64	.910
(5) …flexible?	.65	.910
(6)…understanding?	.48	.914
(7)…recommend?	.68	.909
(8)…continue?	.60	.911
(9) …current treatment plan?	.67	.910
(10) …monitoring?	.68	.909
(11) …food availability & timing?	.62	.911
(12) …choice of meals?	.61	.911
(13) …similar to home meals?	.51	.915
(14) …appropriateness of meals?	.63	.910
(15) …insulin timing?	.67	.909
(16) …staff knowledge?	.61	.911
(17a) …no. of DISN visits?	.48	.915
(17b) …DISN time spent?	.52	.913
(17c) …DISN clarity of information?	.56	.912