

The Moderating Effect of Treatment Type on the Relationship Between Diabetes Patients' Treatment Satisfaction and Their Intention to Use an Artificial Pancreas

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ABSTRACT

This research paper investigates whether treatment types affect the relation between diabetes patients' treatment satisfaction and their intention to use an artificial pancreas. It provides insights for Inreda Diabetic B.V. on how to enhance their marketing strategy for the artificial pancreas, which they are currently developing. Therefore, 601 diabetes patients were approached of which 413 filled out a survey developed for the purpose of the research. In the survey, three general questions were devoted to defining the patients' treatment type and the number of years they have used it. Further, six questions were asked to measure patients' treatment satisfaction and two questions were asked evaluate their intention to use an artificial pancreas. In total, 393 patients fit the requirements of the research and their data was analyzed via regression analysis. The results show a weak negative correlation between treatment satisfaction with insulin pens and insulin pumps and the respective patients' intention to use the artificial pancreas. Solely satisfaction with sensor-augmented insulin pumps is found to be insignificant. There are differences between the satisfaction levels of treatment types, but no differences in the intensity of their negative effect. The research adds to existing literature as it sheds light on the relationship between treatment satisfaction and patients' intention to use an artificial pancreas, and enables Inreda Diabetic B.V. to gain deeper insights for their marketing strategy. Further research is necessary in order to determine other factors which significantly impact patients' intention to use an artificial pancreas.

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Keywords

Diabetes patients, treatment satisfaction, treatment types, intention to use an artificial pancreas

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1. INTRODUCTION

In the health care sector, researchers are continually working on device and treatment improvements to enable patients to have a better and easier life. Such improvements tackle problems ranging from medical errors to costs of health care. In particular technological innovations in products and treatments are seen as a valuable opportunity to improve care by monitoring diseases more effectively and implicitly reducing treatment costs (Herzlinger, 2006). This reflects the situation in the diabetes market where several technological devices have been introduced in the last years. At present, the Dutch company Inreda Diabetic B.V., founded in 2004, is developing an artificial pancreas (AP) to improve diabetes patients' quality of life. The device mimics the work of a pancreas and thus provides the patients' body with insulin and, if needed, glucagon; the first one being essential for their survival. Several trials were already run and a marketing strategy is currently being worked out. The first step in the communication objective is to develop awareness among potential customers and study their knowledge and perceptions about the product (Brennan, Canning & McDowell, 2011). Therefore, research is conducted in order to find out which factors influence patients' intention to use an artificial pancreas while already undergoing another diabetes treatment. This may depend on their satisfaction with their present treatment. Patients are one of the firm's major stakeholder groups and thus this possible interdependency is seen worth investigating as it is expected to contribute to the successful marketing of the artificial pancreas.

Until today, medical literature has not yet measured patient satisfaction with different insulin devices; it has only investigated general insulin treatment satisfaction (Anderson et al., 2004) or has compared two types of insulin therapies (as in Litton, Friedman, Oden, Lee & Freemark, 2002; Hirsch et al., 2008; Rubin & Peyrot, 2009). Patient satisfaction is an issue increasingly emerging in the health care sector and is used for different purposes such as comparing health care systems, evaluating a health care system (Jackson, Chamberlin & Kroenke, 2001), finding ways to improve problem areas (Jackson & Kroenke, 1997; Locker & Dunt, 1987) and reviewing the health care system from a patient's point of view (Sitzia & Wood, 1997). Furthermore, future product usage is seen as a consequence of a patient's degree of satisfaction with the treatment (Atkinson, Kumar, Cappelleri, & Hass, 2005). These aspects outline the relevance of examining the degree to which diabetes patients are satisfied with their current treatment and at the same time enables Inreda Diabetic B.V. to gain important knowledge for the marketing strategy of the artificial pancreas.

The research goal of this paper is to measure whether the effect of treatment satisfaction on a patient's intention to use an artificial pancreas differs depending on the type of treatment the patient is currently receiving.

The following research question was therefore worked out: Does the influence of treatment satisfaction (TS) on patients' intention to use (ITU) an artificial pancreas differ between the treatment types (TT) they currently receive?

Moreover, the following sub-question will be answered as well to give a deeper understanding of the interdependencies of given variables: What are the different effects TT has on the influence of TS on ITU an artificial pancreas?

The focus of this paper is the examination of the moderating effect of most common diabetes treatments for Type 1 patients on the relationship between treatment satisfaction and a patient's intention to use an artificial pancreas, as it aims at making implications for the marketing strategy of Inreda Diabetic B.V.'s artificial pancreas. Type 1 patients are dependent on insulin intake in contrast to Type 2 diabetes patients, who only have the possible risk of getting "insulin dependent in later stages of their disease" (Klein, 2009, p.35). Hence, the AP is more likely to be used by Type 1 than by Type 2 patients. This research will therefore focus on Type 1 patients and their most commonly used diabetes treatments, which are insulin pens, insulin pumps and sensor-augmented insulin pumps (Raesfeld Meijer & Oukes, 2014).

In the following, the research paper proceeds by looking at commonplace factors influencing treatment satisfaction and the effect of treatment type on treatment satisfaction as proposed by health care literature. After the literature review, testable hypotheses are made based on theory and visualized in a model. The methodology will then describe the actual research setting, the subjects of study, their measurements, data collection method, and the conducted data analysis. The results of the survey are presented and discussed, and conclusions as well as theoretical and practical implications are stated. Limitations of the research are elaborated and further research suggested. For better text comprehension a table with abbreviations that are used in this paper is provided (see Appendix, p.12, Table 1).

2. THEORETICAL FRAMEWORK

2.1 Literature Review

In the subsequent section current medical literature is reviewed regarding the variables used in this paper.

2.1.1 Treatment Satisfaction

A few decades ago, there was a shift towards consumerism putting consumer satisfaction as measure of quality in all public service sectors (Williams, Coyle & Healy, 1998). The focus was put on running 'quality management systems' and embracing a 'customer service-oriented culture' (McIver, 1991). When this shift reached the health care market, examining patient's satisfaction increasingly gained on importance. Patient satisfaction was realized to have a great impact on patients' compliance to prescribed treatment (Stancey, 1974) and over the long term even influenced their quality of life (Locker & Dunt, 1987). According to Pascoe (1983) most authors unconsciously defined patient satisfaction with a discrepancy approach, where satisfaction is the difference between actual and ideal outcome. He defines patient satisfaction as "a health care recipient's reaction to salient aspects of the context, process, and result of their service experience" (p.189) which comes close to Kane, Maciejewski and Finch's (1997) and to Anderson et al.'s (2004) definitions. Authors found that the majority of patients, when asked about their general satisfaction with their treatment, express high levels of satisfaction. However, this is different when asked about specific aspects of their treatment in which case patients express lower levels of satisfaction (Locker & Dunt, 1987).

Different factors may influence patients' degree of satisfaction. According to Ley (1972) and supported by studies conducted in the US (Houston & Pasamen, 1972), the degree of communication about the illness and the treatment is one of the major factors affecting treatment satisfaction. This is backed by Tucker & Kelley (2000) who found that communication, access, outcomes, and quality determine 42% of the difference in treatment

satisfaction. Furthermore, unmet expectations were seen as source of dissatisfaction for a long time (Marple, Kroenke, Lucey, Wilder & Lucas, 1997). However, empirical research by Jackson, Kroenke and Chamberlin (1999) and by McKay, Goldberg & Fruin (1973) found no direct relationship between patients' unmet expectations and their degree of satisfaction. Other influences may be a patient's mental state, psychological distress or depression (Wyshak & Barsky, 1995). In order to measure patient satisfaction, various techniques of data gathering were used; from qualitative techniques such as direct and open questions in the early decade to questionnaires which foster interviewees' recall abilities (Locker & Dunt, 1987).

In the last decades different kinds of questionnaires were developed to measure patient satisfaction. In that way, Bradley already developed a questionnaire in 1994 recording satisfaction with diabetes regimen, the Diabetes Treatment Satisfaction Questionnaire (DTSQ). It consists of eight questions that measure a range of different aspects like convenience, as in most surveys, and flexibility, understanding of diabetes, demands on the treatment and hypoglycemic control, hyperglycemia and the general control of diabetes. Unlike general surveys such as the Treatment Satisfaction Questionnaire for Medication (TSQM) (Atkinson et al., 2005), the DTSQ also evaluates satisfaction levels with treatment outcomes and the experience obtained by following certain treatments. The DTSQ is designed for Type 1 and Type 2 diabetes patients and aims at measuring satisfaction by grading the benefits of a new treatment. It does not only look at blood glucose control but also examines the improvement of a patient's quality of life (Bradley, 1994).

The Patient Satisfaction with Insulin Therapy Questionnaire (PSITQ) by Capperli, Gerber, Kourides, and Gelfrand (2000) also only approaches diabetes patients who are using some kind of insulin therapy. The main factors examined are social comfort and convenience which is interchangeably called ease of use, similar as in the DTSQ and other questionnaires. Whereas convenience or ease of use seems to be a common subject to measure treatment satisfaction (Rubin & Peyrot, 2009; Capperli et al., 2000), social comfort is rather seldom mentioned and used even though it was proven to be a significant variable. It generally relates to the social stigma and the use of an insulin delivery device in public (Capperli et al., 2000).

A general questionnaire often used in health care to evaluate treatment satisfaction is the Treatment Satisfaction Questionnaire for Medication (TSQM). The improved version, TSQM version II from 2005 by Atkinson et al., is based on a hierarchical Decision Balance Model of Treatment Satisfaction stating that patients' positive experience of a treatment's effectiveness outweighs their negative experiences due to the treatment's side effects and any usage inconveniences. It does not integrate patients' expectations of the treatment as it was proven not to be a significant factor for improving treatment satisfaction (McKay, 1973; Jackson, Chamberlin & Kroenke, 1999) and the consequences of their experiences and satisfaction level.

2.1.2 *Intention to Use an Artificial Pancreas*

In addition to the factors mentioned above, which have a significant influence on a patient's treatment satisfaction, Atkinson et al. (2005) also state that treatment satisfaction further influences a patient's future intention to use another treatment. Equivalently, Pascoe (1983) found that dissatisfaction leads people to switch to other services. Venkatesh and Davis (2000) applied 'intention to use' in their technology acceptance model 2

(TAM 2) for identifying user behavior. Generally, behavioral intention is perceived as a better predictor of a person's actual usage behavior than other predictors (Agudo-Peregrina, Hernandez-Garcia and Pascual-Miguel, 2013) such as expectations fulfillment (Ginzberg, 1981). Luarn and Linn (2004) further state, that the intention to use a device is determined by the individual's perceived knowledge about the device or system and the "perceived financial resources" (p.880).

2.1.3 *Treatment Types*

Next to the convenience of an insulin therapy via insulin pens, low costs of this treatment are seen as a major advantage over other treatments. As a result, insulin pens are one of the most commonly used insulin delivery devices in parts of the Western world (Pickup & Keen, 2002). However, unlike insulin pumps, the authors found no improvements in a patient's diabetic control as a consequence of the insulin pen usage.

The insulin pump, providing a Continuous Subcutaneous Insulin Infusion (CSII) was found to reduce HbA1c levels when switching from injection therapy to the insulin therapy (Litton et al., 2002; Hirsch et al., 2008). Furthermore, CSII treatment for toddlers and children led to the reduction of parental contact to health personnel and increased confidence in the therapy. Greater quality of life was reached along with high levels of treatment satisfaction (Litton et al., 2002). The negative effects of CSII such as infections at the needle injection site and needle obstructions that occurred in a French research (Bougnères, Landier, Lemmel, Mensire & Chaussain, 1984) can be avoided by replacing the needle regularly (Litton et al., 2002). Furthermore, severe periods of hypoglycemia in the first year of the treatment (Bode, Steed & Davidson, 1996) may be reduced significantly through training and experience and thus increase the effectiveness of the insulin pump (Bending, Pickup & Keen, 1985).

In recent years, a cumulated technological advancement occurred in blood glucose monitoring and insulin delivery by combining continuous glucose monitoring (CGM) with CSII. The advantage proven in several studies are even increased HbA1c levels (Bergenstal et al., 2010) and thereby outpaced CSII and injection therapy in its blood glucose monitoring abilities and insulin delivery (Rubin & Peyrot, 2009). Generally, the combined treatment through sensor-augmented pump therapy (SAPT) is perceived as having more advantages than CSII based on greater satisfaction. The probability to switch to another device is smaller and the likelihood to be recommended higher. (Rubin & Peyrot, 2009)

Thus, research found that the advantages of a sensor-augmented insulin pump do not only outweigh those of insulin pumps but also of insulin pens in regard to improved glycated hemoglobin levels and overall satisfaction.

More information about the devices and how they are operated can be found in the Appendix under 'Research Setting' (p.12).

2.2 *Model*

As it was suggested in literature on diabetes, dissatisfaction with presently used treatment leads diabetes patients to switch to another device (Pascoe, 1983; Atkinson et al., 2005). This implies that there is a negative relationship between patients' satisfaction and their intention to use another device. However, this has never before been set in the context of the intention to use an artificial pancreas and thus, this interaction effect will be investigated in this paper by the following hypothesis:

H1. Diabetes patients' satisfaction with their current treatment has a negative effect on their intention to use an artificial pancreas.

Furthermore, three insulin delivery types which are most commonly used for treating diabetes Type 1 are examined; insulin pens, insulin pumps, and sensor-augmented insulin pumps (Raesfeld Meijer & Oukes, 2014). Hypotheses two to four about these treatment types were created and tested in the context of patient's intention to use an artificial pancreas. The likelihood of patients to switch when using insulin pens and being offered another device such as the CSII or the SAPT was shown to be very probable (as in Litton et al., 2002; Hirsch et al., 2008). It can be expected that patients who are satisfied with their insulin pen treatment are not likely to switch. Thus, this hypothesis is formed:

H2. Treatment satisfaction with insulin pens has a negative effect on a patient's intention to use an artificial pancreas.

Increased quality of life, trust in the device and reductions in health care costs (Litton et al., 2002), as well as the possibility to overcome all treatment disadvantages through training and some experience with the device usage (Bending, Pickup & Keen, 1985), are factors mentioned in medical literature expressing patient satisfaction with their CSII therapy. This leads to the suggestion that patients are less likely to switch to another insulin delivery device such as the artificial pancreas. The assumption is put into subsequent hypothesis:

H3. Treatment satisfaction with insulin pumps has a negative effect on a patient's intention to use an artificial pancreas.

SAPT is perceived to have the highest benefits compared to injection and pump therapy through increased overall satisfaction (Rubin & Peyrot, 2009). Hence, a negative relationship between TS with SAPT and a patient's intention to use and accept an AP is assumed.

H4. Treatment satisfaction with sensor-augmented insulin pumps has a negative effect on a patient's intention to use an artificial pancreas.

Generally, it was assumed and confirmed by several authors that sensor-augmented insulin pumps forge greater overall patient satisfaction than pump therapy, followed by injection therapy. This is due to increased quality of life and blood glucose control. (Bradley, 1994; Rubin & Peyrot, 2009; Hirsch et al, 2008; Litton et al., 2002) The low prospect of switching to another device when using the SAPT was also empirically proven by Rubin & Peyrot (2009). Thus, the following hypothesis will be tested in regard to patients' intention to use an artificial pancreas.

H5. The negative effect of satisfaction on a patient's intention to use an artificial pancreas is highest for pens, lower for insulin pumps and lowest for sensor-augmented insulin pumps.

To increase reading comprehension by visual means, all five hypotheses are illustrated in a model (see Figure 1). The treatment types mentioned in H2-H5 are put under the overarching topic of treatment type. In the model, 'treatment satisfaction' is the predictor variable (independent), which negatively influences the continuous outcome variable 'patient's intention to use an artificial pancreas' (dependent). These two are moderated by the categorical variable 'treatment type' (independent).

3. METHODOLOGY

3.1 Subjects for Study

The study examines diabetes patients' treatment satisfaction with their current treatment and its influence upon their intention to use an artificial pancreas. For empirical testing, a survey was created. Samples were taken from a database with 2100 diabetes patients

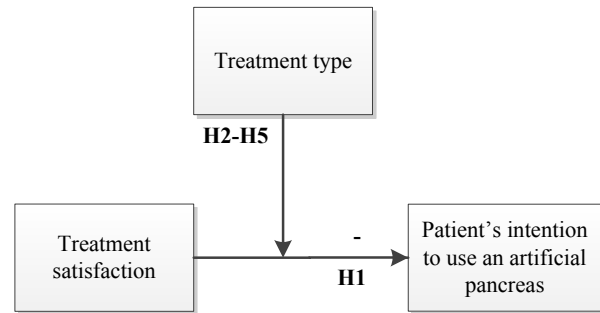


Figure 1. Satisfaction with current treatment type and its effects on patients' intention to use an artificial pancreas

provided by Inreda Diabetic B.V. 601 patient contacts were selected as respondents for the 'Patients Acceptance and Readiness for Artificial Pancreas Survey'. These patients voluntarily signed up at Inreda Diabetic B.V. for participating in the company's research. Most of them reside in the Netherlands. A response rate of 413 completed responses was noted on June 16, 2014 in the Netherlands, of which 399 respondents were Type 1 patients and 14 were Type 2 diabetes patients.

3.2 Measurements

The created survey questions are based on already existing questionnaires for treatment satisfaction and intention to use as it is time consuming and difficult to come up with own scales (Schmitt & Klimoski, 1991). The chosen items were selected on the ground of high reliability measures as expressed through high Cronbach's Alphas. Only closed-ended questions were used for this questionnaire as they provide uniformity of responses and can be processed more easily into valuable statistical output (Babbie, 2010). Moreover, closed-ended questions are straightforward and give the respondent clear answer options which reduce the possibility of misunderstandings and eventually invalid data. This is unlike open-ended questions where the likelihood of misunderstandings and the researcher bias is greater (Babbie, 2010). Additionally, the questions were kept concise to minimize any confusion for the reader and to reduce the time needed to fill out the survey to only ten to fifteen minutes.

For determining patients' satisfaction with their diabetes treatment, items from Bradley's (1994) DTSQ were applied. The original items were developed to suit both Type 1 and Type 2 diabetes patients. Therefore, they fit the purpose of this paper well, which partially consists of measuring diabetes patients' satisfaction with one of the commonplace treatment types. Nevertheless, small adjustments were performed as the factor analysis, measuring construct validity, showed two items to be loading on another factor than TS (see Appendix, p.12, Table 3). However, the outcome of the reliability measure, Cronbach's Alpha, determined them to be unreliable by their own. Thus, two items of the original eight-item questionnaire were excluded. The remaining six were measured on a seven-point Likert scale, mostly ranging from 'very dissatisfied' to 'very satisfied' as in the initial survey. The construct has a Cronbach's Alpha of 0.753. The items originally cover convenience, flexibility, blood glucose control and overall satisfaction of the diabetes treatment. Yet, items two and three, recording satisfaction with blood glucose levels, were not included in this paper (see Table 2).

Social comfort, as used in Capperli et al. (2000), focuses on the influence of the treatment usage in public on the individual's

satisfaction level, instead of the overall satisfaction with the current treatment and its effect on the individual's intention to use an AP. Therefore, social comfort is not in the focus of this paper and excluded. Similarly, items addressing unmet expectations were left out of the questionnaire as it was proven to have no direct influence on patients' overall satisfaction (McKay, 1973). Items for measuring a patients' intention to use an artificial pancreas are based on items mentioned by Venkatesh and Davis (2000). They consist of two items measured on a seven-point Likert scale ranging from 'strongly disagree' to 'strongly agree'. Slight changes were made to adapt the items to the context of the artificial pancreas. Hereby, the broad term 'system' was replaced by the concrete device 'artificial pancreas' (see Table 2). The internal consistency is significant with a Cronbach's Alpha of 0.866.

The moderating factor, treatment type, was not found to be precisely defined in current literature. In this study, it consists of three types of insulin delivery devices treating diabetes patients based on real life usage. To gather general data about patients' treatment type and their duration of device usage, three questions were worked out (see Table 2). Thereby, the item called METHOD in makes the respondents choose between four answer options, i.e. insulin pen, insulin pump, insulin pump & CGM and other. The other two following questions as displayed in Table 2 ask respondents to fill in the number of years they have used their insulin pump (INSUP) or sensor-augmented insulin pump (CGMPUMP) if applicable.

3.3 Instruments for data collection

In order to avoid misunderstandings among the respondents due to the survey's wording, the document was translated from English into Dutch by native speakers before distribution. The survey was finalized in Dutch and German as most patients in Inreda Diabetic B.V. are Dutch and few are from Germany. The response options to each question were expressed mostly on a seven point Likert scale (strongly disagree to strongly agree, except for treatment satisfaction measures) with few yes/no questions. The survey was created in LimeSurvey, an open-source software application used for online questionnaires with the ability to create statistics based on the responses received (LimeSurvey Manual, 2014).

After the draft version of the survey was developed, it was pre-tested by Inreda Diabetic B.V. to ensure their satisfaction, unbiased wording of the questions and, ultimately, validation. It was further re-tested and adjustments were made to ensure unbiasedness and coherent wording. LimeSurvey's integrated email function enabled respondents to be approached via a formal email, explaining the circumstances of the research and providing them with a link which leads them to the survey. The survey started with welcoming the respondent to the research and introducing the purpose as well as the function of the artificial pancreas. Visualizations should help the reader to understand the AP. At the end of the welcome message all institutions cooperating in PCDIAB are listed: AMC Amsterdam, University of Graz, University of Twente, Profil Research, Full Group, Novo Nordisk and Inreda Diabetic B.V. A main benefit of the survey application is that it gives respondents the opportunity to stop

Table 2. Variables and items used in the Patient Acceptance and Readiness for Artificial Pancreas Survey

Construct	Definition	Original Items	Author of original items	Cronbach's Alpha	Adapted items	Cronbach's Alpha
Treatment Satisfaction	A health care recipient's reaction to salient aspects of the context, process, and result of their service (Pascoe, 1983).	1. How satisfied are you with your current treatment?	Bradley (1994)	0.79-0.89	TH_1_TH01: How satisfied are you with your current treatment?	0.752
		2. How often have you felt that your blood sugars have been unacceptably high recently?			Excluded	
		3. How often have you felt that your blood sugars have been unacceptably low			Excluded	
		4. How convenient have you been finding your treatment recently?			TH_3_TH_04: How convenient have you been finding your treatment recently?	
		5. How flexible have you been finding your treatment to be recently?			TH_4_TH_05: How flexible have you been finding your treatment to be recently?	
		6. How satisfied are you with your understanding your diabetes?			TH_1_TH_06: How satisfied are you with your understanding your diabetes?	
		7. Would you recommend this form of treatment to someone else with your kind of diabetes?			TH_5_TH_07: Would you recommend this form of treatment to someone else with your kind of diabetes?	
		8. How satisfied would you be to continue with your present form of treatment?			TH_6_TH_08: How satisfied would you be to continue with your present form of treatment?	
Intention to Use an Artificial Pancreas	The intention of a subject sample to use a particular device or technology in practice	1. Assuming I have access to the system, I intend to use it.	Venkatesh & Davis (2000)	0.83 -0.97	ITU_01: Assuming I have access to an artificial pancreas, I intend to use it.	0.866
		2. Assuming I have access to the system, I predict that I would use it.			ITU_02: Assuming I have access to an artificial pancreas, I predict that I would use it.	
Treatment Type	The application of a device to treat a disease.				METHOD: How is your diabetes currently treated?	n/a
					INSUP: If you have a pump, how many years do you have it?	
					CGMPUMP: If you have a CGM, how many years do you have it?	

somewhere in between and finalize the survey at a later point of time.

3.3.1 Validity

An exploratory factor analysis with oblimin rotation was performed to see whether the grouping of the items is “representing meaningful constructs” (Rank, n.d., a, p.8). The analysis was done on the items level. Therefore, all eight items originally suggested by Bradley (1994) and the two items by Venkatesh and Davis (2000) to measure intention to use were analyzed.

The SPSS outcome showed that the KMO test achieved a significant (Sign. 0.000) and good value (Field, 2009) of 0.727, which indicates that ‘patterns of correlations are compact’ (p.647) and that the analysis produced reliable factors.

The ‘total variance explained’ matrix in the SPSS output revealed three initial eigenvalues being above the significance level of 1, resembling three actual, unobserved factors being measured with given items. Hence, the factor analysis (see Appendix, p.12, Table 3) clearly displays the actual existence of three factors instead of the prior observed two variables. This was already indicated in the total variance matrix. In Table 3, the highest communality in each row, which is above 0.5 signalizes a high factor loading on the certain factor. This means that question two and three of the TS items have an unexpectedly low factor loading on factor 1 (-0.175 and -0.121) compared to other items of the measurement but instead a high factor loading on factor 3 (0.841 and 0.714). Concluding, these two items appear to configure a new factor, measuring satisfaction with blood glucose level. Furthermore, based on Table 3 (see Appendix, p.12), question six should be excluded as the highest factor loading on factor 1 is still below the significance level.

3.3.2 Reliability

In order to measure the internal consistencies of the constructs their respective Cronbach’s Alpha was calculated. It can be derived from the items of each construct and hence, ensures homogeneity of items (Rank, n.d., b). A value of about 0.7 is hereby regarded as significant (SPSS Wizard, 2012). The Cronbach’s Alpha of treatment satisfaction, excluding items two and three, is 0.753. Item six was not excluded as the deletion of this item only insignificantly increases the overall construct’s reliability. The construct ‘intention to use an AP’ scored a high Cronbach’s Alpha of 0.866, similar as in other studies where it scored a Cronbach’s Alpha from 0.83 to 0.97 (Venkatesh & Davis, 2000). Even though items two and three of treatment satisfaction were treated separately and measured as distinct constructs, reliability analysis indicated low internal consistency of only 0.422 and thus, these were excluded from the data analysis. Following, the eight items originally used to measure treatment satisfaction were reduced to six items.

Generally, items two and three, concerned with frequency of hypo-/hyperglycemia did not achieve high factor loadings in any of the studies described by Bradley (1994) but were left in the original questionnaire as they were seen by the author as

important for assessing treatment satisfaction in certain contexts. However, they should count as single items.

3.4 Data Analysis

In this paper, a quantitative, multivariate analysis based on a cross-sectional study is conducted. The analysis was done through the statistics software SPSS. Therefore, data collected via LimeSurvey was exported into SPSS. All 14 Type 2 diabetes patients who filled out the survey as well as one patient who chose ‘other’ as her diabetes type were excluded from the data analysis as this research focuses on Type 1 diabetes patients. Furthermore, the patients who entered data incorrectly were ruled out as well, which sums up to five more patients being excluded. In total, the sample used for the data analysis consists of 393 Type 1 patients. However, eight persons indicated the use of another treatment method than insulin pen, pump and insulin pump with CGM. But as the focus of this paper is put on the most common treatment types, the eight cases are also left out of the analysis part, where the treatment types are examined. Several tests were run to test aforementioned hypotheses.

Firstly, several descriptive tables were created to give the reader an overview of the sample and some general patient data.

Secondly, a Pearson’s correlation test was run to investigate the correlation between items where values lie between -1 and +1 to either imply positive or negative linear relationships. Values close to 0 indicate no linear relationship, ± 0.1 a small effect, ± 0.3 a medium effect and ± 0.5 a large effect (Field, 2009).

Thirdly, a regression analysis was conducted for each treatment type to see whether there is a relation between the independent and the dependent variable.

4. RESULTS

4.1 Descriptive Statistics

Table 4 and 5 (see Appendix, pp.12-13) show a total sample size of 393 Type 1 patients; of which 218 are female and 175 are male. Most of them come from the Netherlands and have an HBO degree. The participants in the sample have an average age of 39 years and were diagnosed with diabetes at a mean age of 21 years (see Appendix, p.13, Table 4). 152 respondents use the insulin pen, whereas 181 use the insulin pump to treat their diabetes and only 52 use the pump combined with the CGM. Further eight respondents use another method or combination of devices such as insulin pen matched with CGM. Table 6 provides an overview of the size of independent and dependent variables on each treatment type. Striking is the fact that the minimum value of treatment satisfaction is lowest for insulin pens and highest for insulin pump & CGM usage. The mean for insulin pump & CGM is highest as well. In regard to the intention to use an AP, it seems as if users of the combined method are generally more likely to use the device than users of other devices, based on a high minimum value. The combined treatment also has the greatest mean and lowest standard deviation compared to the other two treatment methods. Insulin pen has the highest standard deviation rate in TS as well as ITU.

Table 6. Overview of the size of Treatment Satisfaction and Intention to Use an Artificial Pancreas for each Treatment Type

Treatment Type	N	Percentage	Treatment Satisfaction				Intention to Use			
			Minimum	Maximum	Mean	Std. Deviation	Minimum	Maximum	Mean	Std. Deviation
Insulin pen	152	38.7%	1.83	6.5	4.5559	1.07977	2	7	6.431	0.91175
Insulin pump	181	46.1%	2.67	6.5	5.1897	0.78994	3	7	6.525	0.79105
Insulin pump & CGM	52	13.2%	3.33	6.5	5.2276	0.74098	4	7	6.606	0.68839

variable is actually explained via the independent variable only by 5.5%. Consequently, 94.5% of a patient's intention to use an artificial pancreas is explained by other factors.

Similarly, Hypothesis 3, assuming treatment satisfaction with insulin pumps to have a negative effect on the intention to use an AP, is accepted due to the fact that it has a weak and significant beta. The regression weight is hereby negative as with injection therapy, which means that the greater satisfaction, the lower the intention to use another device. The negative relationship which is stronger for insulin pens than for insulin pumps supports theory where it is found that insulin pen users are likely to switch when being offered another device (Litton et al., 2002; Hirsch et al., 2008) compared to CSII users, who perceive their device to have greater benefits.

Hypothesis 4, describing a negative effect of treatment satisfaction with sensor-augmented insulin pumps on patients' intention to use an AP is rejected due to a very weak positive but not significant correlation and linear relation between the variables. It basically means that there is no observable effect between TS and ITU in regard to SAPT.

The data analysis revealed that generally, there are differences in treatment satisfaction depending on the type of treatment the patient receives. This is displayed in Table 6 where sensor-augmented insulin pump has the highest mean with the lowest standard deviation compared to the other devices. This would comply with diabetes literature which outlines that more advanced devices like the SAPT provide greater quality of life and foster greater treatment satisfaction (Bergental et al., 2010; Rubin & Peyrot, 2009). Nonetheless, it contradicts with Rubin and Peyrot's (2009) finding that the high level of overall satisfaction with SAPT reduces the likelihood to switch to another device.

It was assumed in Hypothesis 5 that the negative effect would be highest for insulin pens, lower for insulin pumps and the lowest for sensor-augmented insulin pumps. This hypothesis is rejected as it is not true for the latter two treatment methods. The negative effect between TS and ITU is for SAPT users not lower than for insulin pump users, which can be seen at their average level of treatment satisfaction and intention to use (see Table 6). The standard deviations between the two methods are also not very different. However, the negative effect for insulin pens, determined via the mean and standard deviation, is quite distinct than those of the other two diabetes treatments and thereby express a larger negative effect. The intention to use an artificial pancreas is for the treatment types almost the same, only varying by 0.1 even though their satisfaction levels vary more. This may be explained by Roger (1983) who found that complexity, as well as trialability, greatly influences the dispersion of a new

innovation as in this case, the artificial pancreas. Complexity is defined by him as "the degree to which an innovation is perceived as difficult to understand and to use" and "trialability is the degree to which an innovation may be experimented with on a limited basis" (p.231). The weak and positive relationship of TS for SAPT on ITU may be explained by the users' perceived ease of use of the AP. As the sensor-augmented insulin pump is the most advanced treatment type, it comes closest to the artificial pancreas, in regard to how it works and how it has to be handled. Many SAPT users use the combined therapy as they suffer from great fluctuations in blood glucose levels and the treatment provides them with better blood glucose control. This may further explain their interest in using the AP, as it offers even increased glucose control. As a result, the more satisfied the patient is with her SAPT, the more likely she will acknowledge the increased benefits of an artificial pancreas and, as it is similar in its handling, they are likely to switch to the AP. Contrasting, insulin pen and pump users are more likely to switch their treatment if they are more dissatisfied with their current device, as they probably perceive the artificial pancreas as more complex. This is indicated by the negative correlations as seen in Table 7. These patients may not be familiar with a treatment such as the AP and hence, need to try out the device first before they switch. This would explain their greater reluctance to switch to an artificial pancreas, which is seen in the lower degrees of average ITU and greater standard deviations than in the combined therapy (see Table 6).

All in all, the analysis revealed that treatment satisfaction does have a different effect on a patient's intention to use an artificial pancreas between the treatment types. There is a correlation between treatment satisfaction and a patient's intention to use an artificial pancreas and they vary between the methods.

To ensure the reader's comprehension, the outcome of the research is displayed in table 12.

5.1 Contributions

Existing healthcare literature suggested and proved varying satisfaction levels for the three treatment types used in this paper. These differences are supported based on the conducted empirical research. However, no research was done yet measuring the effect of satisfaction with a certain treatment upon a patient's intention to use an artificial pancreas. Consequently, this study gives meaningful and valid insights. It proves the prior assumption of a possible effect between treatment satisfaction and a patient's intention to use another device being moderated by treatment type to be true in the context of the artificial pancreas. A weak relationship is found and thus, also practical recommendations can

Table 12. Overview of the Research Outcome

Hypothesis	Outcome	Reason
H1. Diabetes patients' satisfaction with their current treatment has a negative effect on their intention to use an artificial pancreas.	☑	Negative, weak, significant
H2. Treatment satisfaction with insulin pens has a negative effect on a patient's intention to use an artificial pancreas.	☑	Negative, weak, significant
H3. Treatment satisfaction with insulin pumps has a negative effect on a patient's intention to use an artificial pancreas.	☑	Negative, weak, significant
H4. Treatment satisfaction with sensor-augmented insulin pumps has a negative effect on a patient's intention to use an artificial pancreas.	☒	No significant correlation found
H5. The negative effect of satisfaction on a patient's intention to use an artificial pancreas is highest for pens, lower for insulin pumps and lowest for sensor-augmented insulin pumps.	☒	No meaningful differences between ITU scales among the TT even if differences in TS exist

be given to Inreda Diabetic B.V. on this subject.

The negative effect of treatment satisfaction on intention to use an artificial pancreas is revealed to be greatest for insulin pens. Therefore, Inreda Diabetic B.V. should try to approach insulin pen users presenting the advantages of an AP, so that they do not switch to another device than the AP. As the insulin pen is very different from the artificial pancreas in terms of technology and usage, it may be best to offer special trainings for these patients to give them the possibility to get used to the new device. This would increase the product's trialability. Furthermore, an open day could be organized to offer diabetes patients insights into the device and to give them the opportunity to ask question face-to-face and convince them of the benefits of the AP. In such a way, misunderstandings can be clarified and prejudices be resolved. This may bring SAPT users to switch as well, considering them already being familiar with an advanced device and their average intention to use an AP being high. Generally, Inreda Diabetic B.V. should adjust their guides for the different user groups depending on their knowledge and experience about the artificial pancreas.

5.2 Limitations

Even though this research contributed to existing literature and gives practical contributions it also faces several limitations. Firstly, due to time restrictions it was not possible to investigate other, possibly relevant factors concerning patients' intention to use an artificial pancreas. Secondly, the results of this research are not generalizable as it focuses on the diabetes market and the survey being constructed to explicitly approach diabetes patients. Thirdly, the research's outcome can also not be transferred to other countries such as Austria and Germany as samples from these countries might produce different outcomes. Fourthly, the sample is likely to be biased as it consisted of volunteers signed up for cooperation with Inreda Diabetic B.V. They are biased as they already have knowledge about the device and its advantages. They perceive the device as beneficial and thus are encouraged to participate in the survey and to actually use the artificial pancreas. Fifthly, there may be additional factors affecting patients' intention to use an artificial pancreas besides treatment satisfaction which are not investigated in this study.

5.3 Recommendation for Future Research

As there is only a weak linear relation found between diabetes patients' treatment satisfaction and their intention to use an artificial pancreas being moderated by three treatment types, it is

necessary to look at other factors influencing the relationship. Additionally, based on this study, more research should be done investigating whether satisfaction with specifically blood glucose control is influencing a patient's intention to use an artificial pancreas. More research is also required in comparing patient's switching factors among different countries as Inreda Diabetic B.V. is also targeting the Austrian and German market. Such factors may include nationality, as each country has different health care and insurance systems, which may affect the opportunities for diabetes patients to receive the newest device. This may implicate that some patients are more reluctant to device improvements or novelty products, as their national product market rather encourages the usage of simple devices due to lower costs. Besides that, culture or even gender may influence a patient's intention to use an artificial pancreas.

6. CONCLUSION

To sum up, the empirical research conducted in this paper investigates whether diabetes treatment types differently affect the influence of diabetes patients' treatment satisfaction on their intention to use an artificial pancreas, as being developed by Inreda Diabetic B.V. at present. As already indicated in healthcare literature, the analysis finds a low but significant negative correlation. More research is needed in order to find other factors which majorly affect patients' intention to use an artificial pancreas.

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8. REFERENCES

- Agudo-Peregrina, Á. F., Hernández-García, Á., & Pascual-Miguel, F. J. (2013). Behavioral intention, use behavior and the acceptance of electronic learning systems: Differences between higher education and lifelong learning. *Computers in Human Behavior*.
- Alternative Devices for Taking Insulin. (2009). U.S. Department of Health and Human Services. National Institutes of Health. *NIDDK National Institute Of Diabetes And Digestive And Kidney Diseases*.
- Anderson, R. T., Skovlund, S. E., Marrero, D., Levine, D. W., Meadows, K., Brod, M., & Balkrishnan, R. (2004). Development and validation of the insulin treatment satisfaction questionnaire. *Clinical therapeutics*, 26(4), 565-578.
- Atkinson, M. A., Eisenbarth, G. S., Michels, A. W. (2014). Type 1 diabetes. *The Lancet*, 383, S69-82
- Atkinson, M. J., Kumar, R., Capperli, J. C., & Hass, S. L. (2005). Hierarchical construct validity of the treatment satisfaction questionnaire for medication (TSQM version II) among outpatient pharmacy consumers. *Value in health*, 8, S9-S24.
- Babbie, E. R. (2010). The practice of social research. *Cengage Learning*. (12)
- Bending, J. J., Pickup, J. C., & Keen, H. (1985). Frequency of diabetic ketoacidosis and hypoglycemic coma during treatment with continuous subcutaneous insulin infusion. Audit of medical care. *The American journal of medicine*, 79(6), 685-691.
- Bergental, R. M., Tamborlane, W. V., Ahmann, A., Buse, J. B., Dailey, G., Davis, S. N., ... & Wood, M. A. (2010). Effectiveness of sensor-augmented insulin-pump therapy in Type 1 diabetes. *New England Journal of Medicine*, 363(4), 311-320.
- Bradley, C. (1994). The diabetes treatment satisfaction questionnaire: DTSQ. *Handbook of Psychology and Diabetes: a guide to psychological measurement in diabetes research and practice*, 111-132.
- Bode, B. W., Steed, R. D., & Davidson, P. C. (1996). Reduction in severe hypoglycemia with long-term continuous subcutaneous insulin infusion in type I diabetes. *Diabetes care*, 19(4), 324-327.
- Booz & Co. (2011). Diabetes Care in The Netherlands: Improving Health and Wealth. Novo Nordisk
- Bougnères, P. F., Landier, F., Lemmel, C., Mensire, A., & Chaussain, J. L. (1984). Insulin pump therapy in young children with Type 1 diabetes. *The Journal of pediatrics*, 105(2), 212-217.
- Bowerman, B. L., & O'Connell, R. T. (1990). Linear statistical models: An applied approach (2nd ed.). Belmont, CA: Duxbury.
- Brennan R., L. Canning and R. McDowell (2011) Business-to-Business Marketing. *SAGE Publications Ltd*. Los Angeles, Chapter 7.
- Capperli, J. C., Gerber, R. A., Kourides, I. A., & Gelfand, R. A. (2000). Development and factor analysis of a questionnaire to measure patient satisfaction with injected and inhaled insulin for Type 1 diabetes. *Diabetes Care*, 23(12), 1799-1803.
- Consultation, W. H. O. (1999). Definition, diagnosis and classification of diabetes mellitus and its complications (Vol. 1).
- Field, A.P. (2009). Discovering Statistics Using SPSS. *SAGE Publications Ltd*. London, England
- Ginzberg, M. J. (1981). Early diagnosis of MIS implementation failure: promising results and unanswered questions. *Management Science*, 27(4), 459-478.
- Herzlinger, R. E. (2006). Why innovation in health care is so hard. *Harvard business review*, 84(5), 58.
- Hirsch, I. B., Abelseth, J., Bode, B. W., Fischer, J. S., Kaufman, F. R., Mastrototaro, J., ... & Buckingham, B. A. (2008). Sensor-augmented insulin pump therapy: results of the first randomized treat-to-target study. *Diabetes technology & therapeutics*, 10(5), 377-383.
- Houston, C. S., & Pasanen, W. E. (1972). Patients' perceptions of hospital care. *Hospitals*, 46(8), 70.
- Hovorka, R. (2011). Closed-loop insulin delivery: from bench to clinical practice. *Nature Reviews Endocrinology*, 7(7), 385-395.
- International Diabetes Federation (2013). IDF Diabetes Atlas (6th ed.). Brussels, Belgium: The International Diabetes Federation
- Jackson, J. L., Chamberlin, J., & Kroenke, K. (2001). Predictors of patient satisfaction. *Social science & medicine*, 52(4), 609-620.
- Jackson, J. L., Kroenke, K., & Chamberlin, J. (1999). Effects of Physician Awareness of Symptom-Related Expectations and Mental Disorders. *Arch. Fam. Med.*, 8(2), 135-142.
- Jackson, J. L., & Kroenke, K. (1997). Patient satisfaction and quality of care. *Military Medicine*, 162, 273-277.

- Kane, R. L., Maciejewski, M., & Finch, M. (1997). The relationship of patient satisfaction with care and clinical outcomes. *Med. Care*, 35, 714-730.
- Klein, S. (2009). Artificial Pancreas: Components, Function, and State of the Art. *Medical Frontiers*, 6(1), 33-38.
- Ley, P. (1972). Comprehension, memory and the success of communications with the patient. *Journal of the Institute of Health Education*, 10(1-4), 23-29.
- LimeSurvey Manual. (2014). *LimeSurvey Manual*. Retrieved from http://manual.limesurvey.org/LimeSurvey_Manual.
- Litton, J., Rice, A., Friedman, N., Oden, J., Lee, M. M., & Freemark, M. (2002). Insulin pump therapy in toddlers and preschool children with Type 1 diabetes mellitus. *The Journal of pediatrics*, 141(4), 490-495.
- Locker, D., & Dunt, D. (1978). Theoretical and methodological issues in sociological studies of consumer satisfaction with medical care. *Social Science & Medicine. Part A: Medical Psychology & Medical Sociology*, 12, 283-292.
- Luarn, P., & Lin, H. H. (2005). Toward an understanding of the behavioral intention to use mobile banking. *Computers in Human Behavior*, 21(6), 873-891.
- Marple, R. L., Kroenke, K., Lucey, C. R., Wilder, J., & Lucas, C. A. (1997). Concerns and expectations in patients presenting with physical complaints: frequency, physician perceptions and actions, and 2-week outcome. *Archives of internal medicine*, 157(13), 1482.
- McIver, S. (1991). Obtaining the views of outpatients. King's Fund Centre.
- McKay, A., Goldberg, E. M., & Fruin, D. J. (1973). Consumers and a social services department. *Social Work Today*, 4(16), 486-491.
- National Collaborating Centre for Women's and Children's Health. (2004). Type 1 diabetes diagnosis and management of type 1 diabetes in children and young people. *NICE Clinical Guidelines*, 15 (2)
- Pascoe, G. C. (1983). Patient satisfaction in primary health care: a literature review and analysis. *Evaluation and program planning*, 6(3), 185-210.
- Pickup, J., & Keen, H. (2002). Continuous Subcutaneous Insulin Infusion at 25 Years Evidence base for the expanding use of insulin pump therapy in type 1 diabetes. *Diabetes care*, 25(3), 593-598.
- Raesfeld Meijer, A. M. v. & Oukes, T. (2014). Analysis and Report. Bachelor Project. Lecture conducted from University of Twente, Enschede.
- Rank, D. (n.d.,a). Sampling Reliability and validity Factor analysis. Business research methods Session 6. Lecture conducted from University of Technology Berlin, Berlin.
- Rank, D. (n.d.,b). Correlation and regression. Business research methods Session 7. Lecture conducted from University of Technology Berlin, Berlin.\
- Rogers, E. M. (1983). Diffusion Of Innovations. New York: *The Free Press*. (3)
- Rubin, R. R., & Peyrot, M. (2009). Treatment satisfaction and quality of life for an integrated continuous glucose monitoring/insulin pump system compared to self-monitoring plus an insulin pump. *Journal of diabetes science and technology*, 3(6), 1402-1410.
- Schmitt, N. W., Klimoski, R. J. (1991). Research Methods in Human Resources Management. *Human Resources Development Quarterly*, 3, 310-313.
- Sitzia, J., & Wood, N. (1997). Patient satisfaction: a review of issues and concepts. *Social science & medicine*, 45(12), 1829-1843.
- SPSS Wizard. (2012). Retrieved June 18, 2014, from <http://www.spsshandboek.nl/>.
- Stacey, M. (1974). Consumer complaints procedures in the British national health service. *Social Science & Medicine* (1967), 8(8), 429-435.
- Tucker 3rd, J. L., & Kelley, V. A. (2000). The influence of patient sociodemographic characteristics on patient satisfaction. *Military medicine*, 165(1), 72-76.
- Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: four longitudinal field studies. *Management science*, 46(2), 186-204.
- Williams, B., Coyle, J., & Healy, D. (1998). The meaning of patient satisfaction: an explanation of high reported levels. *Social science & medicine*, 47(9), 1351-1359.
- Wyshak, G., & Barsky, A. (1995). Satisfaction with and effectiveness of medical care in relation to anxiety and depression: patient and physician ratings compared. *General hospital psychiatry*, 17(2), 108-114.

9. APPENDIX

9.1 Research Setting

Currently, about 382 million people worldwide suffer from diabetes (International Diabetes Federation, 2013). Diabetes mellitus is a chronic disease which occurs if the pancreas does not produce enough insulin or cannot effectively handle it to process glucose in the body taken in through daily diets. Insulin is necessary to regulate one's blood sugar level and, if not regulated well, can lead to hypoglycemia, the "level of blood glucose at which physiological neurological dysfunction begins" (National Collaborating Centre for Women's and Children's Health, 2004, p.89). There are different types of diabetes where the main types are Type 1 diabetes and Type 2 diabetes. Type 1 diabetes patients are dependent on daily insulin intake for their survival and mostly face the disease from an early age onwards (Consultation, 1999). Type 2 diabetes is the most common type of diabetes and occurs mostly in adulthood. The patients require insulin for control but not for survival purposes.

Different types of devices were developed which are primarily used for treating Type 1 diabetes patients. The most common insulin treatments are: insulin pens, insulin pumps and sensor-augmented insulin pumps.

1. Insulin pens look like a pen and may have a cartridge if not already prefilled, to be disposed of after usage. At the tip of the pen, a needle can be screwed on and a plunger pressed after the required insulin dose is chosen (NIDDK, 2009).
2. Insulin pumps (CSII) are worn outside the body and are about the size of a cell phone. Through the usage of a cartridge most pumps ensure a reservoir of insulin. A disposable infusion set brings the hormone into the patient's body and injects a steady, 'basal' amount of insulin throughout the day or a one-time large 'bolus' dose. Nevertheless, an additional blood glucose monitoring device is required to determine the amount of insulin needed (NIDDK, 2009).
3. Sensor augmented insulin pumps currently consist of two independently operating technologies, a continuous glucose monitoring device (CGM) and an insulin pump ensuring insulin delivery when blood glucose level rises above the threshold and enhances hyperglycemia (Atkinson, Eisenbarth & Michels, 2013).

The latest technological development is an artificial pancreas, which provides diabetes patients with "automated closed-loop insulin delivery" (Hovorka, 2011, p. 385) and combines three elements: a glucose sensor, an insulin pump, and a control algorithm. Due to its autonomous, continuous monitoring and insulin delivery, an artificial pancreas is assumed to be used by Type 1 diabetes patients as they are generally insulin dependent.

9.2 Tables and Figures

Table 1. Abbreviations for Units of Measurement

Abbreviation	Units of Measurement
AP	Artificial pancreas
TS	Treatment satisfaction
ITU	Intention to use
TT	Treatment types
HbA1c	Glycated haemoglobin
CSII	Continuous subcutaneous insulin infusion
SAPT	Sensor-augmented pump therapy
CGM	Continuous glucose monitoring
DTSQ	Diabetes Treatment Satisfaction Questionnaire
TSQM	Treatment Satisfaction Questionnaire for Medication
PSITQ	PSITQ: Patient Satisfaction with Insulin Therapy Questionnaire

Table 4. Patient's Age, Year of Diabetes Diagnosis and Duration of Device Usage

Scales	N	Minimum	Maximum	Mean	Std. Deviation
Age	393	3	85	39.27	15.989
Diabetes diagnosis	393	1	69	21.17	13.616
Years of insulin pump usage	241	0	29	6.68	5.51
Years of pump usage combined with CGM	68	0	10	1.97	1.867

Table 3. Factor Loadings of the Exploratory Factor Analysis

Scale	Factors		
	1	2	3
Q8_TS	0.76	-0.155	
Q5_TS	0.76		
Q4_TS	0.734		-0.139
Q1_TS	0.63		-0.259
Q7_TS	0.571		0.13
Q6_TS	0.468	0.16	
Q1_ITU		0.931	
Q2_ITU		0.93	
Q3_TS	0.121		0.841
Q2_TS	-0.175		0.714

Extraction Method: Principal Component Analysis.

a. 3 components extracted.

Table 5. Distribution in Gender, Place of Residence, Education Level and Treatment Type

Scales	Frequency	Percentage
Gender		
Female	218	55.5
Male	175	44.5
Total	393	100
Place of Residence		
Netherlands	377	95.9
Belgium	10	2.5
Germany	3	0.8
Other	3	0.8
Total	393	100
Education level		
Basis education	23	5.9
VMBO, HAVO, VWO	89	22.6
MBO	108	27.5
HBO	129	32.8
WO	44	11.2
Total	393	100
Treatment Type		
Insulin pen	152	38.7
Insulin pump	181	46.1
Insulin pump & CGM	52	13.2
Total	385	98
Missing	8	2
Total	393	100

Table 8. Correlation between Satisfaction with Insulin Pen and Intention to Use Items

	Mean	Std. Deviation	1	2	3	4	5	6	7	8
Overall satisfaction	4.39	1.632	1							
Knowledge	5.78	1.079	.364**	1						
Convenience	3.99	1.678	.439**	.270**	1					
Flexibility	4.57	1.597	.318**	.180*	.642**	1				
Recommendation	5.3	1.544	.284**	.199**	.448**	.509**	1			
Continuance	3.3	1.56	.462**	.113	.615**	.543**	.413**	1		
Intention to use	6.43	0.988	-.183*	-.041	-.102	-.079	.000	-.307**	1	
Prediction of usage	6.43	0.987	-.211**	-.012	-.246**	-.236**	.023	-.366**	.705**	1

** . Correlation is significant at the 0.01 level (1-tailed).

* . Correlation is significant at the 0.05 level (1-tailed).

Table 9. Correlation between Satisfaction with Insulin Pump and Intention to Use Items

	Mean	Std. Deviation	1	2	3	4	5	6	7	8
Overall satisfaction	4.85	1.374	1							
Knowledge	6.02	0.872	.248**	1						
Convenience	4.78	1.496	.454**	.267**	1					
Flexibility	5.17	1.167	.345**	.057	.501**	1				
Recommendation	5.69	1.014	.184**	.062	.178**	-.045	1			
Continuance	4.64	1.41	.519**	.208**	.395**	.354**	.231**	1		
Intention to use	6.57	0.724	-.0174	-.015	-.102	-.020	-.156*	-.142*	1	
Prediction of usage	6.48	0.94	-.123*	-.030	-.123*	-.073	-.196**	-.171*	.804**	1

** . Correlation is significant at the 0.01 level (1-tailed).

* . Correlation is significant at the 0.05 level (1-tailed).

Table 10. Correlation between Satisfaction with Insulin Pump & CGM and Intention to Use Items

	Mean	Std. Deviation	1	2	3	4	5	6	7	8
Overall satisfaction	4.92	1.57	1							
Knowledge	6.06	0.752	.303*	1						
Convenience	4.21	1.551	.409**	.191	1					
Flexibility	5.25	1.219	.564**	.262*	.449**	1				
Recommendation	5.69	1.112	-.070	-.072	-.007	-.029	1			
Continuance	5.23	1.182	.401**	.161	.369**	.395**	-.407**	1		
Intention to use	6.63	0.658	.067	.321*	-.192	-.006	.138	-.066	1	
Prediction of usage	6.58	0.75	.072	.322**	-.242*	-.054	.076	-.020	.913**	1

** . Correlation is significant at the 0.01 level (1-tailed).

* . Correlation is significant at the 0.05 level (1-tailed).

9.3 SPSS Syntax

```

DATASET ACTIVATE DataSet1.
USE ALL.
COMPUTE filter_$=(AGE < 100 & DIAGAGE < 100 & DIATYP = 1).
VARIABLE LABELS filter_$ 'AGE < 100 & DIAGAGE < 100 & DIATYP = 1 (FILTER)'.
VALUE LABELS filter_$ 0 'Not Selected' 1 'Selected'.
FORMATS filter_$ (f1.0).
FILTER BY filter_$.
EXECUTE.

```

*Recoding all Treatment Satisfaction Items to one Variable

```

COMPUTE Treatment_Satisfaction=( TH_1_TH_01 + TH_1_TH_06 + TH_3_TH_04 + TH_4_TH_05 + TH_5_TH_07 +
  TH_6_TH_08) / 2.
VARIABLE LABELS Treatment_Satisfaction 'Treatment Satisfaction'.
EXECUTE.

```

*Recoding all Intention to Use Items to one Variable

```

COMPUTE Intention_to_Use=( ITU_00_ITU_01 + ITU_00_ITU_02) / 2.
VARIABLE LABELS Intention_to_Use 'Intention to Use'.
EXECUTE.

```

*Descriptive Table of Methods and ITU

```

CROSSTABS
  /TABLES=METHOD METHOD_other BY ITU_00_ITU_01 ITU_00_ITU_02
  /FORMAT=AVALUE TABLES
  /CELLS=COUNT ROW COLUMN TOTAL
  /COUNT ROUND CELL.

```

***Descriptive Table Gender, Place of Residence, Education, ITU**

```
FREQUENCIES VARIABLES=METHOD Intention_to_Use GEN EDU NAT
/STATISTICS=STDDEV MINIMUM MAXIMUM MEAN SUM
/ORDER=ANALYSIS.
```

***Factor Analysis for ITU and TS**

```
FACTOR
/VARIABLES TH_1_TH_01 TH_1_TH_06 TH_2_TH_02 TH_2_TH_03 TH_3_TH_04 TH_4_TH_05 TH_5_TH_07
  TH_6_TH_08 ITU_00 ITU_01 ITU_00 ITU_02
/MISSING LISTWISE
/ANALYSIS TH_1_TH_01 TH_1_TH_06 TH_2_TH_02 TH_2_TH_03 TH_3_TH_04 TH_4_TH_05 TH_5_TH_07 TH_6_TH_08
  ITU_00 ITU_01 ITU_00 ITU_02
/PRINT UNIVARIATE INITIAL CORRELATION SIG DET KMO INV REPR AIC EXTRACTION ROTATION
/FORMAT SORT BLANK(.10)
/PLOT EIGEN ROTATION
/CRITERIA MINEIGEN(1) ITERATE(25)
/EXTRACTION PC
/CRITERIA ITERATE(25) DELTA(0)
/ROTATION OBLIMIN
/METHOD=CORRELATION.
```

***Cronbach's Alpha TS with All Items**

```
RELIABILITY
/VARIABLES=TH_1_TH_01 TH_1_TH_06 TH_2_TH_02 TH_2_TH_03 TH_3_TH_04 TH_4_TH_05 TH_5_TH_07 TH_6_TH_08
/SCALE('ALL VARIABLES') ALL
/MODEL=ALPHA
/STATISTICS=COV
/SUMMARY=TOTAL.
```

***Cronbach's Alpha of TS without Item 2&3**

```
RELIABILITY
/VARIABLES=TH_1_TH_01 TH_1_TH_06 TH_3_TH_04 TH_4_TH_05 TH_5_TH_07 TH_6_TH_08
/SCALE('ALL VARIABLES') ALL
/MODEL=ALPHA
/STATISTICS=COV
/SUMMARY=TOTAL.
```

***Cronbach's Alpha of ITU**

```
RELIABILITY
/VARIABLES=ITU_00 ITU_01 ITU_00 ITU_02
/SCALE('ALL VARIABLES') ALL
/MODEL=ALPHA
/STATISTICS=COV
/SUMMARY=TOTAL.
*Descriptive tables of age, diaage, use of pump and CGM&pump
DESCRIPTIVES VARIABLES=AGE DIAGAGE INSUP CGMPUMP
/STATISTICS=MEAN SUM STDDEV MIN MAX.
```

***Table Size of Dependent & Independent Variable for Each Treatment**

```
EXAMINE VARIABLES=Treatment_Satisfaction Intention_to_Use BY METHOD
/PLOT BOXPLOT STEMLEAF
/COMPARE GROUPS
/STATISTICS DESCRIPTIVES
/CINTERVAL 95
/MISSING LISTWISE
/NOTOTAL.
```

```
SORT CASES BY METHOD.
SPLIT FILE SEPARATE BY METHOD.
```

***Correlation Table of TS and ITU (Item)**

```
CORRELATIONS
/VARIABLES=TH_1_TH_01 TH_1_TH_06 TH_3_TH_04 TH_4_TH_05 TH_5_TH_07 TH_6_TH_08 ITU_00 ITU_01
ITU_00 ITU_02
/PRINT=ONETAIL NOSIG
/STATISTICS DESCRIPTIVES
/MISSING=PAIRWISE.
```

***Correlation between TS and ITU (Variable)**

```
CORRELATIONS
/VARIABLES=Treatment_Satisfaction Intention_to_Use
/PRINT=ONETAIL NOSIG
/STATISTICS DESCRIPTIVES
/MISSING=PAIRWISE.
```

***Regression for Each TT**

```
REGRESSION
/DESCRIPTIVES MEAN STDDEV CORR SIG N
/MISSING LISTWISE
/STATISTICS COEFF OUTS CI(95) R ANOVA COLLIN TOL CHANGE ZPP
/CRITERIA=PIN(.05) POUT(.10)
/NOORIGIN
/DEPENDENT Intention_to_Use
/METHOD=ENTER Treatment_Satisfaction
/RESIDUALS DURBIN
/CASEWISE PLOT(ZRESID) OUTLIERS(3)
/SAVE PRED ZPRED ADJPRED MAHAL COOK LEVER ZRESID DRESID SDBETA SDFIT.
```

SPLIT FILE OFF.

***Regression of TS on ITU**

```
REGRESSION
/DESCRIPTIVES MEAN STDDEV CORR SIG N
/MISSING LISTWISE
/STATISTICS COEFF OUTS CI(95) R ANOVA COLLIN TOL CHANGE ZPP
/CRITERIA=PIN(.05) POUT(.10)
/NOORIGIN
/DEPENDENT Intention_to_Use
/METHOD=ENTER Treatment_Satisfaction
/RESIDUALS DURBIN
/CASEWISE PLOT(ZRESID) OUTLIERS(3)
/SAVE PRED ZPRED ADJPRED MAHAL COOK LEVER ZRESID DRESID SDBETA SDFIT.
```