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Thesis topic: A review of research techniques for co-creation and an investigation into patient needs and product requirements to study the intention to use of a new medical device to regulate diabetes 1.

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Abstract

Due to the fast moving technology and the increasing demands and needs from customers, companies need to review their products and generate new product ideas to keep up with the increasing needs and to provide a solution to unfulfilled needs of customers. To do so successfully, companies should base their new product development (NPD) projects on the unfulfilled needs of customers. However, identifying unfulfilled needs is difficult, especially when companies rely on traditional market research techniques as the consumer gets minimally involved the NPD process. Therefore, identification of customer needs and usage of external ideas require more customer involvement within the NPD processes of companies. Since traditional market research techniques are inadequate for more customer involvement, other measures are necessary to involve customers and stimulate co-creation. This study focuses on the benefits of co-creation and presents and assesses several techniques that could be used to stimulate customer involvement and co-creation during NPD processes in a medical product context.

A qualitative study was conducted combining two research techniques which enable customer involvement in a pre-purchase stage and during usage (value-in-use) stage to identify patient needs and product requirements for the Artificial pancreas, a new medical device for a new diabetes treatment, and to identify problems, unfulfilled needs and positive aspects that patients encounter during the usage of current diabetes treatments. The aim of the study was to develop an overview of expectations and product requirements for the artificial pancreas. 11 patients were interviewed by using a value-in-use assessment and a customized free eliciting technique to identify product requirements and patient needs for the artificial pancreas. Qualitative analysis has been performed to interpret the input from the interviewees. Results suggested that every participant is satisfied with their current treatment, although minor improvements could be implemented, mostly to stimulate the patient's freedom in its broadest sense. Users of an insulin pump would like to have less items stick to their body (e.g. plasters, infusion wires), whereas users of the insulin pen would like to have more freedom in terms of daily activities, which gets more difficult due to the functioning of the insulin injections and the type of insulin. Specific product requirements for the artificial pancreas range from requests for changes in the product design (e.g. smaller, no sharp corners), safety requirements (e.g. integrated control mechanism to calibrate the glucose monitor) and product performance requirements (e.g. optimal functioning at all times, patches should stick properly and should stay on the body for preferably a week). Although patients still have a lot of questions regarding the functioning of the artificial pancreas and also still have critique on certain aspects of the device, 10 out of 11 participants indicated that they would start using the artificial pancreas as they believe that it relieves the burden of patients and this treatment will be more capable to regulate the glucose levels than other existing treatments that are in use right now.

Keywords: New Product Development, co-creation, customer involvement, value-in-use, pre-usage evaluation, customer needs, artificial pancreas, diabetes, patient

Preface

Enschede, July 2015

A year ago, I finished my courses for my two Master degrees in Business Administration and Communication Studies at the University of Twente. Ariane von Raesfeld approached me to participate in a large research project to support a Medical start-up to market its product, a medical device to treat diabetes, the artificial pancreas. Although not familiar with research in a medical context, I decided to work on the project and started my Master thesis for the degree in Business Administration in November 2014. The main reason to work on this project was the possibility to conduct qualitative research and to deliver results that actually would be used by the start-up company.

Finally, nine months after I started, the research has been completed and the report is here. The process had its ups and downs, and especially in the beginning the differences in focus and perception of the research between the supervisors and myself made it quite challenging for me to get a grisp of the research and the expectations of the company and the academic staff. Yet, due to intensive support of my supervisors Manon Spin, MSc. and Tamara Oukes, PhD candicate, the research was moving ahead and progress was made. I'm glad I finished it, however I found the research extremely fulfilling because of the close contact with diabetes patients and their grateful attitude towards me because they were finally able to let their voice speak and share their experiences and opinions about the disease, the current treatment and the artificial pancreas.

I want to express my gratitude towards my supervisors Manon Spin, Tamara Oukes and Ariane von Raesfeld in the background. Also, I would like to thank the interviewees for their openness, honesty and their willingness to share personal information with me. Furthermore, I would like to thank my parents and friends for their patience and their support during this process.

Laura Klaver

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1. Introduction

1.1 Background

With fast moving technology and the increasing demand and needs from consumers, companies need to review their products and innovate (Brem and Voigt, 2009; Prahalad and Ramaswamy, 2004). To do so successfully, companies within business-to-consumer markets should tune their New Product Development (NPD) processes to market needs and therefore the market success of such businesses get determined by the ability to identify, acquire and use (external) ideas (Brem and Voigt, 2009). Although users always have been integrated in NPD processes via traditional market research, identification, acquisition and usage of external ideas require more customer involvement (Schweitzer, Gassmann and Rau, 2014; Prahalad and Ramaswamy, 2004). Co-involvement, also called co-creation, is the term for more customer involvement within NPD processes next to traditional market research. The main aim of co-involvement is to use the users' knowledge, skills and perspectives for more successful innovation than NPD processes that fully rely on Research and Development (R&D) practices (Schweitzer, Gassmann and Rau, 2014).

To be able to properly introduce new products to the market, the market should be explored first (Anderson and Narus, 1999). Important questions to the supplier company are whether there is a need and what requirements users have for new products. Customer involvement, or co-involvement, could provide insight in these essential issues (Prahalad and Ramaswamy, 2004). Customer feedback regarding current product experiences could identify the need gap and (un)fulfilled value. Collaborating with users to identify their product requirements could result in valuable output for the product design process. Incorporating this source of information into the functioning of new product can result in new ways of competitive advantage, and therefore positively stimulate product performance (Prahalad and Ramaswamy, 2004). Scholars agree that consumer involvement is the new key to a successful product performance, also in business-to-consumer markets (Prahalad and Ramaswamy, 2004; Brem and Voigt, 2009; Schweitzer, Gassmann and Rau, 2014). Therefore, incorporating co-involvement and integrating a user's knowledge and experiences seems to be essential for every NPD process. In this study, co-involvement will be highlighted and by using qualitative tools, participants are asked to share their opinion about current and future treatments. Together with the patient, the manufacturer will be able to come to better solutions for the eventual end user, the patient.

In this particular case, a new treatment for Diabetes is designed and about to be introduced to the market. The occurrence of Diabetes Mellitus has increased significantly, especially in developed countries (Business Insights, 2011). To control the economic burden of Diabetes Mellitus on society as the treatments costs of Diabetes will approach 430 billion dollars in 2030, and also to make a patient's life more comfortable, focus is put on the development of new Diabetes treatments. Most patients, in particular type 1 patients, perceive insulin injections as inconvenient, so patients would rather see a treatment without the need to inject insulin (Atkinson and Eisenbarth, 2001; Peyrot et al., 2005). Type 1 patients are suffering from diabetes caused by malfunctioning of the pancreas as it doesn't produce any insulin (Diabetesfonds, 2015). This means that type 1 patients are fully dependent on insulin injections to be able to control their glucose level. A few years ago, the insulin pump was introduced to the market, which partially took away the need to inject insulin (Facchinetti, 2011). Nowadays, inventors are working on an artificial pancreas and other closed-loop systems which should substitute the malfunctioning pancreas of patients (Business Insights, 2011). Due to the fact that type 1 diabetes patients are dependent on insulin injections, this group of patients would benefit the most from new diabetes treatments. Therefore, this study will invite several type 1 patients to actively participate in the development of the artificial pancreas, a new diabetes treatment, by sharing their thoughts, needs and wishes. Increasing consumer participation, or co-involvement, will help to optimise the product design and functioning.

1.2 Managerial Gap

In general, type 1 patients are diagnosed with Diabetes at an early age (Uncu, 2014), so they have a lot of user experience. Yet, at this moment, very little is known about patient needs, requirements and patient experiences with closed-loop systems such as the artificial pancreas. The number of patient reactions after media attention from the Dutch Diabetes Association and Dutch talk shows on this topic implies that there is a need for new treatments. From literature, patients only appear to want to have less injections (Atkinson and Eisenbarth, 2001; Peyrot et al., 2005) and would like to see incremental changes in current forms of medical support as psychological care and enhancing communication between patients and health care providers (Funnel, 2006). Furthermore, Barnard and colleagues (2015) indicate that patients would like to have continuous, good glucose regulation and improved quality of life. Also, the size and design are important factors for the use of an artificial pancreas. However, Barnard and colleagues (2015) do not make the connection between the artificial pancreas and

patients' experience with current treatments. Also, it is unclear which patient segments could be of interest to the supplier company of the artificial pancreas.

Therefore, this research will contribute to the knowledge about patients needs by focusing on co-creation to assess product evaluations of existing treatment on the one hand, and to gain customer feedback about product requirements and customer needs for new treatment types on the other hand. The outcomes of this research should contribute to the knowledge about patients' evaluations of current treatments, which again can be used as input to optimise the functionality of new medical devices for Diabetes treatment. Also, results will provide explicit product requirements for the product design of the artificial pancreas.

Furthermore, this research is characterised by high levels of a customer-based view and customer involvement. It has been suggested that a customer-based view leads to superior performance due to learning about customers and their changing needs and managing the innovation process accordingly (Slater, 1997). Reaching out to patients and listen to their needs contributes to the relationship between the company and its potential customers and this study shows how customer involvement can be achieved. Therefore, not only the output of this study will be meaningful to the development of an artificial pancreas and a customer-minded company, but also the process of customer involvement research and the actual execution positively affects the level of customer orientation of the company and the relationship between future customers and the supplier company of the artificial pancreas.

1.3 Theoretical Gap

It is unclear which methods for co-creation are suitable in a healthcare setting. Whereas it is important to gather extensive amounts of data for the sake of scientific research, respondents may feel resistant to disclose sensitive information (Bansal, Zahedi and Gefen, 2010; Yang and Wang, 2009). Although much research has been dedicated to the development and assessment of both quantitative and qualitative tools to involve customers in NPD projects, most methods contain the basic assumption that respondents will talk freely and disclose information without any concern (Dicicco-Bloom and Crabtree, 2006). Yet, in case of high level of information sensitivity, this might not be the case (Dicicco-Bloom and Crabtree, 2006). To be able to receive useful information, but at the same time be respectful towards the disclosure threshold of a respondent, it is important to review several existing methods for co-creation and to assess, and perhaps modify, methods to make them appropriate for research in which high levels of personal and sensitive data is involved.

Furthermore, this research is aimed to conduct a pre-usage evaluation as well as a value-in-use, or during usage, evaluation. The methods for co-creation or customer involvement only provide room for one evaluation point (Van Kleef, van Trijp and Luning, 2005). Due to the two points of evaluation as presented in this study, existing methods for co-creation are inadequate in this research context. A new approach to the methods is required to assess both the pre-usage evaluation and the value-in-use evaluation. Therefore, this study provides an assessment of several qualitative methods according to a systematic assessment framework as proposed by Van Kleef, van Trijp and Luning (2005). The information retrieved from this assessment will provide insight in how a method, suitable to this research context with two different evaluation points, can be constructed. This knowledge will contribute to the available literature in the field of co-creation methods as it proposes a combination of qualitative methods which could be used when a product or service evaluation with more stages of evaluation (pre-purchase, during usage, after usage) needs to be conducted.

1.4 Research Questions

To be able to perform this research, the following research questions have been formulated:

1. Which methods of co-creation are suitable for value-in-use measures when highly sensitive information is involved?
2. How can existing methods of co-creation be altered in order to examine two points of evaluation simultaneously?
3. How do type 1 patients value their current Diabetes treatments based on their value-in-use assessment of these current treatments?
4. Which requirements do type 1 patients have for the artificial pancreas to actually start using the treatment?

The first research question sheds light on the theoretical fundament behind a wide range of research methods which could potentially be used in the context of this research. Once it is clear which qualitative method would be the most suitable one for co-involvement and value-in-use assessment as conducted here, this tool can be applied to gather data to answer both research question two and three. The second question a follow-up question of the first research question. However, the point of focus here is to find methods, or a combination of methods, that would enable the researcher to examine several points of evaluation at one interaction moment with a research participant. The third research question highlights patients' evaluations and satisfaction level with their current treatments aiming on identifying

the needs of consumers. Identifying consumer needs from existing treatment evaluation will provide valuable input to the functioning and the design of new Diabetes treatment devices. The fourth research question is more focused on delivering direct design input to optimise the product features of an artificial pancreas. Combining new product requirements with experiences from other treatments will provide the most comprehensive insight of what patients want and need from new Diabetes treatments.

Introducing new products to the market can be tricky, and 50% of all new products fail within the first year (Sivadas and Dwyer, 2000). Meeting customer needs is one of the key predictors of new product performance (Henard and Szymanski, 2001). Performing market research and using co-creation to discover customer needs, therefore, seem highly relevant. The information gathered during this research not only discovers patient evaluations of existing treatments, but also can be used to optimise the new treatment product design. Patient evaluations of existing treatment types should be clarified and affect the level of willingness to use another treatment (Kleijen, Lee & Wetzels, 2009). Besides the practical contribution, this research will provide more insight in Diabetes patient needs and will extend literature in this field. Whereas the DAWN studies (Funnel, 2006) made a start by trying to articulate patients' wishes, this study will go more in-depth and provide an elaborated overview of what patients really value and want from their Diabetes treatment, based on a combination of product experience and future requirements which need to be retrieved from the value proposition. Furthermore, this study mainly focuses on finding the most suitable methods for co-creation for qualitative healthcare-related research. One could argue that healthcare is a personal matter and therefore a tender research subject. Methods therefore should be selected carefully and in compliance with patients' privacy and feelings. Also, this research entails a co-involvement approach to medical product development. In current healthcare marketing literature and diabetes literature, co-involvement has been performed, but mainly to evaluate healthcare services and to assess the relationship between the patient and the healthcare provider (Funnel, 2006; Harris, 2000). Only a few examples of co-involvement for the sake of medical devices are known in literature, and in all cases medical staff (e.g. doctors, nurses) was asked to give input (Lettl, Herstatt and Gemuenden, 2006; Ulwick, 2002) instead of the end-user, the patient. Due to the continuous use of the diabetes treatment, it seems highly important to investigate patient experiences and their thoughts on new treatment types as they have to take along the treatment device permanently.

2. Theoretical Framework

Co-creation, or customer involvement, can be of great value to New Product Development (NPD) processes as the input of the consumer gets integrated into the new product, which leads to a product design that better suits the consumers' wishes and needs and makes the new product more successful as success is dependent on the perceived product value of the consumer (Creusen, 2011; Trott, 2001). Many companies share this opinion and integrating customer needs to reduce the chances of product failure (Van Kleef, van Trijp and Luning, 2005; Trott, 2001; Creusen, 2011). Also, it is important to investigate consumer needs to listen to the voice of the consumer as the true value of the market offering can only be evaluated through the lens of a consumer (Witell et al., 2011).

Although there are many advocates for the inclusion of a market orientation and the customer's voice for the launch of any kind of product, research has shown that a market orientation is less effective for discontinuous product innovations as it gets challenged by the ignorance of consumers (Atuahene-Gima, 1995; Creusen, 2011). Consumers should be able to fully understand the new product in order for marketers to retrieve positive output from customer involvement, yet consumers may have difficulty articulating their needs for new products as they lack user experience with a new product (Cooper and Evans, 2006). Even though these limitations complicate the involvement of customers for discontinuous product innovations, performance of co-creation is essential for the functioning of the new product and the product design process as it still provides valuable information to the design team (Creusen, 2011). Using qualitative tools to stimulate customer involvement is in this case the best option a marketer has to identify consumer needs, requirements and need gaps (Cooper and Evans, 2006). Rather than quantitative tools, qualitative tools offer freedom to speak freely and to alter the research design to the situation (Calder, 1977). This positively affects the stimulation of creative thinking, which is expected to deliver more meaningful input for NPD processes (Dicicco-Bloom and Crabtree, 2006). The question is which qualitative methods there are and which is most suitable in this context.

Yet, to be able to actually identify consumer needs, requirement and possible need gaps, further elaboration on consumer needs is necessary. The following section will discuss consumer, or in this case patient, needs more in depth.

2.1 Patient Needs

Identifying patient needs is highly important but also has become more complex due to the shredded consumer markets and high demands of consumers (Hunt, 2013). Having a clear vision of what patients value and what their specific needs are will positively contribute to new product design when the end-users' input gets integrated into the NPD process by means of co-involvement or co-creation (Creusen, 2011). The usage of co-involvement or co-creation provides a platform for customer interaction and enables customers to share their opinions, thoughts and needs with the supplier company of the new product to enlarge the proposed value of the product (Witell et al., 2011). This implies that the supplier company's knowledge about the end user's needs could be of great importance of the eventual success of a new product (Creusen, 2011; Van Kleef, van Trijp and Luning, 2005; Hoyer et al., 2010).

Consumer needs can be defined as: *"A description, in the customer's own words, of the benefit to be fulfilled by the product or service"* (Griffin and Hauser, 1993). Another definition of consumer needs is: " *A consumer's desire for a product or service specific benefit, whether that be functional or emotional"* (Boundless, 2014), whereas Kotler and Armstrong (2010) identify customer needs as '*a consumer's desire that gets created by internal or external stimul*i'. Internal stimuli would be notifications of our senses whereas external stimuli contain everything external that triggers. In the last two definitions, the desire for and the expression of a certain articulated or latent need depends on the importance of the problem experienced by the consumer and its motivation to solve his issue (Boundless, 2014; Kotler and Armstrong, 2010). Although the definition by Griffin and Hauser (1993) is the most frequently used definition, it fails to include that benefits do not necessarily have to be product features. A product could offer value on all kinds of different levels as product features, but also social motivations (Lynn, 1991; Porter, 1990). Therefore, the definition as proposed by Boundless (2014) seems more complete and will be used as the standard throughout this research.

Needs can be categorised on two different scales, the first one identifies three types of needs; basic needs, articulated needs and exciting needs (Griffin and Hauser, 1993) and the other scale identifies needs based on the source of the need; functional or emotional (Boundless, 2014). Basic needs are the customer's articulation of what they expect a device might do, whereas articulated needs are expressions of customers what they would like to see from the device. Exciting needs are needs that will lead to customer delight when they get fulfilled as these needs are often unspoken and unexpected. Whereas basic needs and articulated needs

are needs that are articulated quite easily, excited needs are more vague and unexpected and therefore can be categorised as latent needs (Griffin and Hauser, 1993). The scale as suggested by Boundless (2014) divides needs in functional and emotional needs. Functional needs are similar to Griffin and Hauser's (1993) basic and articulated needs as functional needs are an expression of the minimal requirements regarding a certain product. This implies that functional needs, just as basic and articulated needs, are easily articulated. Emotional needs refer to needs to satisfy an individual's state of mind, which makes them more difficult to express as they are not clearly linked to certain product features (Boundless, 2014). Indirectly satisfying emotional needs is an unexpected consequence of the usage of a certain product and therefore can be categorised as latent needs. To provide some clarity, the following table has been created to visualize the different scales of needs.

Type of Needs	**Griffin and Hauser (1993)**	**Boundless (2014)**
Articulated needs	Basic needs Articulated needs	Functional needs
Latent needs	Exciting needs	Emotional needs

Table 2.1 Needs categorisation

Customer involvement and the integration of output from customer involvement into NPD processes support the alignment between product and customer needs. This implies that the consumer is expected to perceive the product as more valuable, which will partially determine the success of a product in the market. If there is no compatibility with the consumer's current routines and lifestyle, the product will be perceived as less valuable, which will decrease the chance of success in the market (Van Kleef, van Trijp and Luning, 2005; Hoyer et al., 2010; Rogers, 2003). Also, focusing on and incorporating patient needs would also lead to improved patient safety and improved compliance and health outcomes (Money et al., 2011). Other important factors of market success that are closely related to consumer needs and evaluation are the visualisation of the new product and its value (Kindstrom, Kowalkowski and Nordin, 2012), the speed-to-market of the innovation (Chen, Reilly and Lynn, 2005), yet above all the product quality and the actual value of the new product (Ernst, 2012).

Although the relevance of discovering patient needs is evident, the actual identification of these needs is rather difficult (Trott, 2001; Cooper and Evans, 2006). Product diversification (Ansoff, 1956) challenges imagination and understanding of consumers. Often, consumers are not able to articulate their needs or are not willing to invest time in need articulation (Trott, 2001). Also, understanding new products, without the knowledge of prior experience, can lead to problems when consumers try to articulate their needs (Van Kleef, van Trijp and Luning, 2005). Even though scholars acknowledge the problem of articulating needs, which therefore can imply that consumer needs are of less value to discontinuous innovations (Trott, 2001; Creusen, 2011), they stress that research into consumer needs always results in some output and therefore should be continued to be executed at all times (Trott, 2001; Van Kleef, van Trijp and Luning, 2005). Using creative, pro-active tools for co-creation can stimulate the participant's imagination (Van Kleef, van Trijp and Luning, 2005; Witell et al., 2011). Another solution to overcome this problem is to collaborate with lead users (Witell et al., 2011). Lead users are consumers that can articulate certain needs in a very early stage that will become general in the market place after a while (Von Hippel, 1986). Also, lead users have a high level of motivation to obtain a solution to their unmet needs (Von Hippel, 1986). In other words, lead users have a more creative mind than a 'normal' consumer and therefore could be beneficial to a supplier company because lead users can formulate both articulated and latent needs more easily than a normal end user.

In the case of the closed-loop system sub-market, an upcoming market with devices that combine existing treatments, patients could face problems articulating their needs because of the lack of user experience with these particular devices. Although patients have expert knowledge about the disease and current treatments, they have limited understanding of how a closed-loop system would work and how it will function throughout daily activities. This lack of experience could hinder need articulation, in particular articulated or latent needs (Griffin and Hauser, 1993). However, valuable input could be retrieved from experiences with existing treatments too. Sweeney and Soutar (2001) suggest that a user experience results in a level of satisfaction with the particular product. Due to the experience a consumer has with the product, one could assume that consumers are able to pinpoint the aspects of a certain product that they are particularly satisfied or dissatisfied with. Since dissatisfaction is a product of unmet needs and a result of product experience (Homburg, Koschate-Fischer and Wiegner, 2012), these value-in-use assessments of existing treatments can be highly relevant to uncover needs from patients which could be incorporated in the functioning of new treatments. Also,

to guide consumers through the ambiguity with identifying needs for new products, the value proposition of the new product could have a positive contribution. The value proposition of a new product can be helpful to assess a product beforehand based on a consumer's perceived value prior to purchase or usage (Sweeney and Soutar, 2001). The value proposition is a informative piece of information provided by the supplier company that enriches one's knowledge about a new product. The value proposition is a pre-purchase evaluation, which enables consumers to evaluate a product without having the knowledge from using the product (Gillarza, Gil-Soura and Holbrook, 2011; Sweeney and Soutar, 2001). If the consumer, based on the proposition or the communication of the proposition, concludes that the product offering may lack certain features to completely satisfy the consumer, not all needs are met or communicated. Triggering a consumer with a value proposition enlarges the consumer's understanding of the market offering and stimulates the imagination of consumers which could positively affect the articulation of articulated (basic and articulated needs) and latent needs (exciting needs) (Van Kleef, van Trijp and Luning, 2005; Griffin and Hauser, 1993). Especially with new product offerings, it is quite a challenge to retrieve product information beforehand as there are not many other alternative sources of pre-usage information. A value proposition, although initially a one-way agreement provided by the supplier company (Ballantyne and Varey, 2006), gives consumers more insight in the factual product features, its distinctive factors from other alternatives and the expected added value (Anderson, Narus and van Rossum 2006). Assessing a product based on a value proposition increases the co-creation and offers valuable feedback that could be used in the design process of the product to optimise the offered value by the new product (Payne, Storbacka and Frow, 2008).

However, using the value proposition offered by a company as a pre-purchase measure to introduce potential customers to the product does not automatically leads to success. At first, the development of value propositions is not an easy process as there is no right or wrong way of formulating a proposition (Anderson, Narus and van Rossum, 2006; Cooper, Edgart and Kleinschmidt, 2004). Also, earlier research conducted by Anderson and colleagues (2006) showed that there is no congruence in what content should be included in a value proposition. The only thing that becomes clear is that a proposition needs to be distinctive from the next best alternatives and should persuade the consumer (Anderson, Narus and van Rossum, 2006). Another essential aspect of the value proposition is the communication towards the consumer. Even if a company is able to create a compelling value proposition, the proposition should

become visible (Kindstrom, Kowalkowski and Nordin, 2012). Visualization, or signaling, enables companies to illustrate, demonstrate and communicate the value of their offerings, and involves using strategies to form an understanding of the value before, during and after consumption (Kindstrom, Kowalkowski and Nordin, 2012). So even though a value proposition may be in place, a company needs to undertake quite some additional steps to excite people about the promised value of the new product offering, which could question the effectiveness of the value proposition as a pre-purchase research measure. However, due to lack of other existing sources of information, the value proposition provides the most accurate data and product features of the artificial pancreas and based on this information, patients are properly able to form an initial thought of value of the artificial pancreas.

The initial value proposition of the artificial pancreas, that was used as the pre-purchase piece of information to create a mental picture about the product, contains an informative text about the most distinctive product features and about the functioning of the device. Furthermore, a picture of the current prototype also is included to give patients an idea of the exterior and the size of the device. This value proposition, as provided by the supplier company and already used in previous research (Uncu, 2014), has mainly be communicated to patients during research purposes.

Ballantyne and Varey (2006) argue that value propositions are always two-way, an offering from the company and the evaluation of a consumer that should lead to an actual sale. Whereas the initial value proposition, as offered by the company, could be a good starting point for the development of an understanding of a new product, the final value proposition is based on the value perspectives of two parties, both the supplier company and the value evaluation of the consumer (Ballantyne and Varey, 2006). Therefore, the value-in-use research conducted here and the exchange of thoughts on how patient value gets achieved, are expected to improve the initial value proposition as proposed by the company. So whereas the value proposition is the basis of the value dialog between the company and the consumer, it is also the end result of the value dialog. Incorporating patient thoughts on how needs could be fulfilled will positively affect the value proposition. Recommendations to the initial value proposition, based upon the findings from this study, will be provided in the discussion chapter.

2.2 Identification and assessment of methods for co-creation

Yet the question remains which methods are most suitable for co-involvement. In general, it is argued that qualitative methods are most appropriate for consumer research (Cooper and Evans, 2006; Van Kleef, van Trijp and Luning, 2005). Qualitative research provides an in-depth, if necessarily subjective, understanding of the consumer and its wishes (Calder, 1977). Rather than quantitative research, qualitative research offers freedom to both the researcher and the research participant to speak freely and to alter the method to the situation and the participant (Calder, 1977). This freedom is important to steer the participant if needed and to start a meaningful dialogue to trigger the participant's creativity (Calder, 1977). Creativity can lead to 'thinking outside of the box', an approach that is valuable to innovation processes as it stimulates the articulation of underlying and latent needs (Dicicco-Bloom and Crabtree, 2006).

It is suggested that the stage within the NPD process influences the methods that are suitable. In this research context, the medical device that gets developed, is different from existing devices as it is a combination of several existing treatment types integrated in one system. Therefore, the medical device can be categorised as discontinuous. Although this device serves similar needs as existing products in the market, the functioning of the device is rather innovative. Van Kleef and colleagues (2005) suggest three different qualitative methods that could be used for consumer research for marketing purposes of new products; Free eliciting, Zaltman metaphor and Emphatic design, based on selection criteria as proposed by Eliashberg et al. (1997). The Free eliciting technique seems the most suitable tool in this research context as it enables respondents to share their view on the object. Further elaboration on the free eliciting technique will be presented in the next section.

Yet, the methods suggested by Van Kleef and colleagues (2005) are not the only available qualitative methods that could be suitable to this research context. A well-known qualitative measure from business-to-business markets is field value-in-use interviewing (Anderson and Narus, 1991). Even though mostly applied to research in a business-to-business context, field value-in-use offers a during usage evaluation and therefore could be of interest to discuss customer experience of current diabetes treatment in this particular research context. Also, another frequently used tool for customer involvement is focus group interviewing (Calder, 1977). Focus group interviewing is an interview with a group of participants which can be applied to exchange product experiences or to discuss the expected product value of a new

product. The interaction with a group of respondents at the same time could have positive effects for a respondent's imagination (Calder, 1977).

The eventual selection of the right method will be established by using selection criteria for research methods as proposed by Eliashberg and colleagues (1997). The criteria will be specified in the next section.

2.3 Selection criteria

Eliashberg and colleagues (1997) provided four selection criteria that are necessary to consider when the right method has to be selected. The four selection criteria as proposed by Eliashberg et al. (1997) are the following:

1. Information source for need elicitation
2. Product Familiarity
3. Task Format
4. Need Actionability
5. *Research Context*

A fifth selection criterion, research context, was added to include the fairly unique research context and the consequences of this research context for the selection of the most suitable tool.

2.3.1 Information Source for Need Elicitation

The information source for need elicitation distinguishes the type of stimulus that is used to elicit needs. Within need-driven methods, consumers are asked to express their internal needs without being exposed to a product. The output from this type of research methods are mainly internal needs and personal problems (Van Kleef, van Trijp and Luning, 2005). Product-driven methods intentionally expose participants to a product. This exposure will trigger the needs and problems that come up when seeing or using the test product. Although the latter method limits the imagination and creativity of a consumer, the more predictable results can easily be transferred into a set of product requirements (Van Kleef, van Trijp and Luning, 2005).

2.3.2 Product Familiarity

Another aspect to consider in this first step of selection of the right methods is the level of familiarity with the product (Trott, 2001; Cooper and Evans, 2006; Van Kleef, van Trijp and

Luning, 2005). If the consumer isn't or only a little familiar with the product, it will be more difficult to articulate needs for the product due to the lack of product and user experience (Trott, 2001; Cooper and Evans, 2006). In this research context, the patients are familiar with their current treatment while they are not familiar at all with the artificial pancreas. This means that the method selected should address a during usage assessment of products with high levels of familiarity, whereas a product-driven method is needed to trigger reactions about the non-familiar treatment.

2.3.3 Task Format

The third aspect in determining which consumer research methods are appropriate is task format. Task format implies that preferences are dependent on the specific choice task that has to be made by the consumer and depends on whether the consumer is evaluation one or multiple products at the same time, response type, self-articulated or indirect needs and structure of data collection (Van Kleef, van Trijp and Luning, 2005).

2.3.4 Actionability

The final step is to look at the 'actionability' of results retrieved from a certain method. In the phase of understanding consumer needs, it is essential that the output is concrete and can be used for the technical development of the new product (Van Kleef, van Trijp and Luning, 2005).

In the context of the artificial pancreas, suitable methods need to cover two types of research; a product evaluation analysis of existing treatments as well as a research focused on articulating needs and specific requirements for the new treatment type. Therefore, a research method should facilitate a product-driven approach with the ability to directly explain more about the new treatment due to low senses of familiarity. Also, the method should offer room for product evaluation in which self-articulated needs should be expressed and should provide the researcher the option to discover underlying needs. Furthermore, the method should be straightforward and actionable with output that can be transferred into concrete requirements and needs of patients regarding the new product.

2.3.5 Research Context

This study is aimed at conducting research in a healthcare setting. Participants are asked to share their opinions about their current treatments and are asked to articulate their needs for new medical devices that could become their new diabetes treatment. Due to the healthcare

setting, patients are asked to disclose personal and sensitive medical information. Therefore, it is important that respondents feel comfortable and that the threshold to open up and provide sensitive information is as low as possible.

Also, the research conducted here is focused on during usage as well as pre-usage evaluation of products. A patient's current diabetes treatment will be assessed based on the during usage experience with the device and the treatment, whereas the artificial pancreas, a new medical device, will be assessed based on a pre-usage evaluation. This implies that the technique for customer involvement as used here, should have both a product-driven character and also a need-driven character.

2.4 Selection of suitable research techniques

To be able to select the right tool(s) for customer involvement in this research context, the methods shortly discussed above will be explained in more detail. After the discussion on the tools for customer involvement that could be used, the selection criteria that have been discussed in the previous section will be linked to the qualitative measures. The tools will be assessed and eventually the most suitable tool(s) will be selected based on the selection criteria.

A lot of qualitative techniques have been developed over the years (Anderson and Narus, 1999; Van Kleef, van Trijp and Luning, 2005). The review of qualitative techniques for customer involvement conducted by Van Kleef and colleagues (2005) shows that there are three methods that could be suitable for a market research context in which radical innovation is involved; Zaltman metaphor, Emphatic design and Free eliciting. The Zaltman metaphor and Empathic design methods are not suitable in this research context as observation of product usage is not possible due to the fact that the test product is still under development and also is not suitable for short-term testing. Therefore, continuous observation is impossible. Furthermore, the Zaltman metaphor is aiming to identify personality traits, which is not of relevance in this research context. Therefore, only available option remains; Free Eliciting. Other techniques that have been suggested by respectively Anderson and Narus (1999) and Calder (1977) are field value-in-use and focus group interviewing. The first method, Free Eliciting, is a qualitative method from consumer research in which needs and requirements are triggered by external stimuli (Van Kleef, van Trijp and Luning, 2005). This method seems particularly suitable for the identification of requirements for new treatment

types. The second method, field value-in-use Assessment, is a well-known, straightforward method in qualitative business-market research and offers participants a chance to articulate needs and requirements (Anderson and Narus, 1999). A third frequently mentioned qualitative marketing research method is focus group interviewing (Calder, 1977; Van Kleef, van Trijp and Luning, 2005; Anderson and Narus, 1999).

2.4.1 Free Eliciting

The qualitative method is a semi-structured method that makes use of a stimulus provided by the researcher. The participant is asked to rapidly verbalise what comes to mind when he or she thinks about this particular stimulus (Van Kleef, van Trijp and Luning, 2005). An example would be a photo (stimulus) and the participant has to speak up whatever comes into mind. The results of this technique are mostly aimed at displaying associative knowledge or classifying statements in meaningful categories (Van Kleef, van Trijp and Luning, 2005). Free eliciting can be applied during interviews.

In the context of this research, free eliciting could mostly contribute to meaningful data for the second research question as this technique provides the possibility of a pre-usage evaluation based on the stimulus material. In this method, a stimulus gets presented, which will give the participant some guidance. This may positively contribute to the participant's imagination and memory (Van Kleef, van Trijp and Luning, 2005), which may lead to more concrete product requirements. Using free eliciting as a technique would also contribute to the findings for the pre-purchase evaluation of the fourth research question. Providing a stimulus would generate more responses (Van Kleef, van Trijp and Luning, 2005), yet the question is to what extent these responses lead to well-articulated needs. Even though providing a stimulus to the participant will help to generate requirements for an innovation, due to the low familiarity with new products, a stimulus might not deliver the output a researcher would like to see. It is likely that participants need more background information regarding the new product to be able to provide concrete product requirements.

2.4.2 Field Value-in-use Assessment

In consumer research, an assessment of value-in-use acknowledges the importance of the utilisation of the product as being part of the value proposition (Minkiewicz, Evans and Bridson, 2014). This usage process is susceptible to the costumer's quality assessment (MacDonald et al., 2011) and therefore should be included in research regarding product

evaluation. Since the effectiveness of existing Diabetes treatments is not fully dependent on the product features of the device itself, but on the usability of this device and the medical support process, a value-in-use assessment would be appropriate to uncover needs and expectations during the entire process.

The established value-in-use method, frequently used in business marketing, combined with the acknowledgements regarding value-in-use in consumer markets, could create the most suitable approach for this research. The listing of costs and benefits, or positive and negative points, is very useful to discover consumer needs. Recognising the entire usage process to identify a consumer's needs and to assess the fulfillment of its expectations would cover the complete treatment evaluation. Furthermore, a value-in-use assessment asks for direct articulation of needs by the consumers, meaning that the method is very 'actionable'. The possibilities offered by this method seem particularly suitable for valuable output regarding the during usage evaluation of existing treatments as field value-in-use is executed to get insight into the consumer's experience with the device and the treatment in general.

It seems that value-in-use assessment offers less possibilities to retrieve results for the fourth research question regarding unveiling product requirements for an innovation. A value-in-use assessment is a user experience based evaluation, whereas the fourth research question focuses on perceived value of a conceptual product. Because the device is still under development and has not been marketed yet, patients are not able to provide a during usage evaluation as they haven't used the device before. This implies that a second method may be necessary that focuses on stimulation of a pre-purchase evaluation based on a mental image.

2.4.3 Focus Group Interviewing

According to Calder (1977), qualitative consumer research has become synonymous with focus group interviewing. This technique makes use of a group of 8 to 10 research participants for an open-ended, unstructured discussion about a product (Calder, 1977). The researcher, also called moderator in this technique, makes sure that the discussion stays on track and delivers valuable output. In this type of technique, a potential product offering is shown and participants are asked to provide their opinion and thoughts on this offering (Anderson and Narus, 1999). The distinctive factor of focus group interviewing is the positive stimulation of participants' imagination and thoughts by the group discussion and interaction (Van Kleef, van Trijp and Luning, 2005).

However, the limitation of this method in this particular research setting is that people need to talk about sensitive information. It could be argued that patients are not comfortable talking about their disease and the consequent inconvenience in the presence of other people. This could complicate discussions and may lead to silence. Also, the subjectivity of the technique is concerning (Calder, 1977). Results of the discussion would have been different within a different setting with different respondents and a different moderator. Therefore, focus group research is mostly appropriate as a preliminary research and should always be combined with a quantitative research method to validate the output (Calder, 1977).

Due to the restrictions of the technique and the research setting, it is questionable whether this particular method is the most suitable for the research conducted here. At first, people might not want to talk about their disease and personal issues in public due to the high level of information sensitivity. Furthermore, although qualitative consumer research is always subjective to a certain extent, a technique is preferred that delivers relatively objective output. Also, focus group interviewing is suggested to be more suitable for research into incremental new products instead of radical innovations (Van Kleef, van Trijp and Luning, 2005).

Now that the selection criteria are explained and a thorough elaboration on the different qualitative measures is presented, the following table has been created to give a clear overview of the assessment of the several techniques.

Radical innovation		**Free Eliciting**	**Field value-in-use**	**Focus Groups**	**Zaltman Technique**	**Empathic Design**
Need elicitation source	Need-driven		X	X	X	X
	Product-driven	X		X		
Product Familiarity	High		X	X		-
	Low	X		X	X	-
Task format	Single product	X	X	X	No product evaluation	X
	Multiple products	X	X	X	No product evaluation	X
Actionability	High	X	X		X	
	Low			X		X
Research Context	Suitable	X	X			
	Not Suitable			X	X	X

Table 2.2 Categorisation of research techniques

2.4.5 Assessment of techniques

As becomes visible from the table, free eliciting seems to have significantly different research characteristics than the other two methods, whereas focus group interviewing is the most flexible research method, yet with the less actionable outcomes. In the context of this research, a combination has to be made to reach the final research outcomes. Free eliciting contains the research characteristics for the research to product requirements for the artificial pancreas. Both the field value-in-use and focus group interviewing could be used to cover the during usage assessment. However, focus group interviewing doesn't suit the research context as a group interview would increase the threshold to disclose sensitive information. Therefore, field value-in-use is more suitable in this context.

In search for potential suitable techniques for this particular study, attention has been paid to the research requirements of this research. In this research context, a method should offer the possibility to have both a product-driven and needs-driven approach character for respectively the part of the specific requirements for the artificial pancreas and the assessment of the value-in-use experience with current treatments. Yet current qualitative methods only have a product-driven character or a need-driven character as it is likely that techniques mainly are developed to test one construct (pre-usage, during usage, post usage) at a time. Therefore, a customised approach is mandatory. This is why the value-in-use assessment as proposed by Anderson and Narus (1999) seems to be a suitable method for at least one part of the research; the need-driven aspect. Free eliciting covers the aspect of a product-driven method (Van Kleef, van Trijp and Luning, 2005) and therefore a combination of these two methods might suit the research context. Combining these two methods also would mean that the research covers both pre-purchase and value-in-use evaluation. Another aspect of the research according to the steps as proposed by Van Kleef and colleagues (2005) is the choice to either try to reveal self-articulated or indirect needs. A combination of the two mentioned techniques offers the possibility to participants to both express articulated and latent needs.

2.5 Conclusion

After analysing the three suggested methods, it seems that a customised field value-in-use assessment in combination with free eliciting seems the most suitable option for the analysis of existing treatments. Field value-in-use has a need driven character which enables patients to pinpoint positive and negative aspects of the value of the current treatment device and also provides the possibility to ventilate fulfilled and unfulfilled needs, and the situations in which they occur, of the value created during usage of a certain device. Therefore field value-in-use is suitable to use for a during usage evaluation and patient experience of current treatment types. Free eliciting is a product driven method that stimulates generation of ideas through stimulus material, which is what will be performed during the second part of the interview as stimulus material is used to trigger the participant and provide the participant with more background information to be able to create a mental picture of the future artificial pancreas. Therefore it can be stated that a combination of field value-in-use and free eliciting will be the most convenient research method in this research context as this combination provides the opportunity to have both a product-driven an need-driven character, it enables respondents to present articulated and latent needs and the one-to-one interview setting will lead to a higher

sense of privacy. The next section will provide a more in-depth elaboration on the usage and design of the selected techniques and a detailed description of the research procedure will be presented.

3. Method

The ultimate aim of this study is to develop a suitable technique for customer involvement and to identify patients' needs and requirements for the usage of new diabetes medical treatment devices by using this specific method. In the previous section, three qualitative research methods have been assessed on their suitability for this case. A combination of field value-in-use interviewing and free eliciting seems to be the most appropriate method in this research context and will be used to interview the participants about their needs, expectations and specific product requirements. However, the question remains which patients should be asked to participate in this research and whether patients can be categorised into different patient groups. Identification of different groups is relevant for this research as consumer groups within the market are specific and have their own unique understanding of value (Slater, 1997). Therefore it can be argued that it is likely that there are several types of patients, who all could be interesting to the supplier company of the new medical device, but with different perceptions on how the new product should work in order to fulfill needs and create value for the patient. Identifying different types of consumers can be investigated through a segmentation analysis and a cluster analysis. The first sub-section of this chapter therefore will elaborate on the segmentation analysis that was conducted in the existing market of diabetes patients, where especially type 1 diabetes patients were of interest. Type 1 diabetes patients are completely dependent on insulin injection while they experience pancreatic failure. It is important that this group is the focus consumer group for the artificial pancreas within the existing market of diabetes patients as these patients require frequent insulin injections to replace the normal pancreatic release of insulin (Business Insights, 2011) and therefore it is presumed that these patients could experience a lot of relief by using a treatment as the artificial pancreas because it takes away the majority of the measures a patient has to take to retain a stable glucose level.

Segmentation analysis will lead to consumer groups that are of interest to the supplier company of the artificial pancreas as these groups could become the users of the new device. Another technique to get a better understanding of the different consumer groups within the market is a cluster analysis. A cluster analysis has been performed based on a sample of type 1 patients from a patient database with 398 type 1 patients. The aim of the cluster analysis is to provide a more in-depth understanding of possible sub-segments within the type 1 consumer group. The possible identification of sub-segments will be useful to select suitable

participants for this study. Therefore, this section will move towards an elaboration on the sampling procedure and the selection of participants after the sub-section about the findings of the cluster analysis.

3.1 Segmentation Analysis

The construct of segmentation gained attention due to dissatisfaction with explanations of classical and neoclassical economical theory regarding the market. Classical and neoclassical economic theory include the theory of perfect competition, meaning that both demand and supply side are homogenous (Smith, 1956; Slater, 1997). Yet, diversity and heterogeneity in both supply and demand became the rule instead of the exception in modern markets (Smith, 1956). As a reaction to this heterogeneity, marketers had to adapt their marketing strategies according to the new "rules" of the market and both supply and satisfy different groups of consumers within the market (Smith, 1956).

Market segmentation can be defined as: "*the process of partitioning a market into groupings of customers that have relatively similar requirements and preferences for market offerings*" (Anderson and Narus, 1999, p. 45). The way the segmentation is performed, and the descriptors that are chosen to segment the market, drastically affect the company's understanding and view of the market (Anderson and Narus, 1999). Segmentation being the fundament of proper market research, it is highly relevant for the success of NPD processes and the introduction of innovations to the market (Cooper and Evans, 2006). The need for segmentation is particularly high for the introduction of discontinuous product innovations entering a non-existent market as there is no prior information about consumers and the value that they are looking for. Conducting segmentation analysis in existing markets of substitutes of NPD products could identify possible consumer groups that would be of interest to supplier companies of new products which could replace existing products (Cooper and Evans, 2006).

In general, segmentation starts on a very general level and moves towards more progressive bases of segmentation to clearly pinpoint different consumer groups (Anderson and Narus, 1999), however there is not one right way to perform market research (Kamakura and Russell, 1978). Starting off from an abstract level would have the benefit that every consumer group is included in the eventual outcome of the segmentation. After segmentation is completed, one could strengthen its knowledge about a certain segment by sub-segmenting the group and filter out the sub-segments of interest.). As mentioned earlier, this study will focus on type 1

diabetes patients because of the expected relief they would experience from using an artificial pancreas to substitute their current diabetes treatment. This explains why this study will focus on type 1 patients, which implies that the segmentation analysis is aimed to identify sub-segments within the consumer groups of type 1 patients. Choosing type 1 patients as focus group means that type 2 and other patients are left out of the analysis. Type 2 patients have become insensitive to insulin. Other diabetes patients is a group of patients that are (temporarily) diagnosed with diabetes because of pregnancy or illness as cancer (Business Insights, 2011). Although is it assumed that these groups would also benefit from (temporary) use of the articial pancreas (Inreda B.V., 2014), these patients should be able to control their disease more easily as they still produce insulin themselves and have other solutions to control their insulin shortage (e.g. insulin pastilles, embracing a healthy lifestyle) (Diabetesfonds, 2015).

Within the segment of type 1 patients, it seems that consumers within this group have different types of diabetes treatment (Business Insights, 2011). A distinction can be made between five treatment types which are in use by type 1 patients; regular glucose monitoring devices, continuous glucose monitoring devices, insulin pens, insulin pumps and insulin syringes (Business Insights, 2011). Regular glucose monitoring devices and continuous glucose monitoring devices are products to monitor the glucose levels of the patient, whereas the insulin pen, insulin pump and insulin syringes are devices to manage the injection of insulin. A combination of a glucose monitoring device and injection device always have to be made as there are no closed-loop systems (devices that combine monitoring of glucose levels and inject automatically according the glucose levels) available to patients yet (Business Insights, 2011). The three frequently used combinations within the type 1 patient group are: regular glucose monitoring and insulin pen, insulin pump, continuous glucose monitoring and insulin pump (Uncu, 2014). The fourth injection device, a closed-loop system, will create a fourth sub-segment within the type 1 patient group as these devices aim to better regulate blood glucose levels on a continuous basis and (Business Insights, 2011). This is particularly interesting to type 1 patients as these patients experience pancreatic failure and are fully dependent on insulin via injections (Business Insights, 2011).

3.1.1 Conclusion

A specific selection of the type 1 patient group was already made prior to the segmentation analysis as this group is initially the main focus of the supplier company of the artificial pancreas (Inreda B.V., 2014) due to the severity of the disease and the patients' dependence on external insulin injection. The most frequently used treatments by patients in the Western world are insulin pens in combination with a regular glucose monitoring device or insulin pumps with either a regular or continuous glucose monitoring device (Business Insights, 2011; Uncu, 2014) and patients using these devices represent the majority of the Western market (Business Insights, 2011). As the artificial pancreas intends to substitute both insulin pens, pumps and glucose monitoring devices because it is an 'all in one' system, the patient groups using these existing treatments are of particular interest to the supplier company of the artificial pancreas. Furthermore, these sub-segments in the market entail the majority of the users of a diabetes treatment. Therefore, targeting the sub-segments with users of the insulin pen and the insulin pump, in combination with any kind of glucose monitoring device, would be the most interesting target groups as it is expected that these patients perceive the artificial pancreas as a good substitute for their current treatments. Hence, it is expected that the majority of future customers of the supplier company of the artificial pancreas will belong to one of these consumer groups.

Even though this segmentation is a good start to identify interesting consumer groups, it is expected that not every patient in these consumer groups has the same expectations, needs and characteristics. By conducting a cluster analysis and reviewing consumers within these groups based on more specific characteristics, it is assumed that variance between different consumers will become visible. Exploring this variance is important to get a better understanding of the different sub-groups of consumers and provides more insight in which particular sub-groups would be more of interest to the supplier company. Therefore, the next section will be devoted to the execution of a cluster analysis and the results.

3.2 Cluster analysis

The segmentation analysis conducted earlier represents a starting point of investigating several consumer groups with the type 1 diabetes patients. The segmentation indicated that especially patients who make use of an insulin pen combined with a regular glucose monitoring device or an insulin pump with either a regular or continuous glucose monitoring device are of interest to the supplier company. Although the segmentation provides some clarity about general consumer groups, it is assumed that patients in these groups are not similar and that there will be variance in the way how patients react to the artificial pancreas. By taking a closer look to a combined sample of patients from these particular consumer groups as presented by the segmentation analysis, it is likely that dissimilarities between consumers will become present. To unveil differences between consumers, a cluster analysis can be executed. The cluster analysis also will provide the fundament for the interview protocol for the qualitative research that will be conducted at a later stage.

To conduct a cluster analysis, it is important that a sample of the patients in the right consumer groups is used for analysis. To do so, a database of respondents from a survey conducted by Uncu (2014) to investigate patients' general beliefs of technology on perceived usefulness and intention to use a new medical product (Uncu, 2014) was used to conduct this cluster analysis. The database of respondents from Uncu (2014) was created by a larger patient database which is established by the supplier company of the artificial pancreas with patients using insulin pens or insulin pump therapy. The respondent database included 398 respondents, so this cluster analysis has been performed based on 398 responses to four variables of the survey created by Uncu (2014). This respondent database included patients with several treatment methods, including a treatment with 1) insulin pen and a regular glucose monitoring device, 2) an insulin pump and regular glucose monitoring device and 3) an insulin pump with a continuous glucose monitoring device. Therefore, the suggested segments of interest all are included in the cluster analysis. The cluster analysis eventually got performed by using the combined sample. No further distinction has been made between the three consumer groups as presented in the segmentation analysis. All three consumer groups are of interest, the cluster analysis should show whether there are significant differences visible among all of these patients. Four variables were used as the questionnaire entails questions to address twelve constructs that are somehow related to the intention to use innovative products, ranging from social forces (e.g. subjective norm, social influence) to product characteristics. Four variables were found to be interesting for this research context as

three out of four variables were product aspects of the artificial pancreas, and the fourth was the intention to use the artificial pancreas. Therefore, it can be argued that this cluster analysis has been conducted solely based on aspects of the artificial pancreas that would motivate patients to use this device. This is the reason why a fifth interesting variable, treatment satisfaction (of existing treatments) was left out of the analysis. The four variables that were used for this cluster analysis are: Perceived usefulness, Compatibility, Complexity and Intention to Use. The following table presents four constructs that were used in the questionnaire by Uncu (2014). Per construct, a brief explanation will be provided.

Perceived usefulness	The perceived usefulness of the artificial pancreas. Important to identify product requirements, so relevant to the study presented here.
Compatibility	The degree to which an innovation is perceived as consistent with existing values, past experiences, and needs of potential adopters. Relevant to this study because construct measures whether people think that the AP would suit their life and daily activities. Leads to need identification and product requirements.
Complexity	Focus point in study presented here to identify product requirements regarding design, performance and safety requirements for the product.
Intention to use	Relevant to the study presented here as it indicates whether patients would start using an artificial pancreas.

Table 3.1 Overview of constructs for the cluster analysis

The constructs as presented in table 3.1 give some insight into the constructs that were used in the questionnaire of Uncu (2014). These four constructs were found to be relevant in this research context as these four constructs are solely focused on the artificial pancreas and the usage of the artificial pancreas. Other constructs from the questionnaire are mainly focusing on the level of innovativeness of respondents, external influence from a patient's social network and satisfaction with current treatments. Although the satisfaction with current treatments is interesting to this study too, the decision to exclude this variable from this cluster analysis is caused by the focus of cluster differences solely based on characteristics and usage intention of the artificial pancreas. Therefore, diabetes treatment satisfaction doesn't fit between the four tested constructs as the product focus is different.

To provide a better understanding of the constructs used for this cluster analysis, the variables are discussed below.

3.2.1 Perceived Usefulness

Perceived usefulness, originally introduced by Davis' Technology Acceptance Model, can be defined as: "*the degree to which a person believes that using a particular system would enhance his or her job performance"* (Davis, 1989). Uncu (2014) used this construct to test the perceived usefulness of the artificial pancreas.

3.2.2 Compatibility

The compatibility of a new product can be defined as: *"the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters"* (Rogers, 2003). This implies that innovations should connect to the current lifestyle or routines of the patients, otherwise the innovation will be perceived as inconvenient and not be useful to the potential user (Uncu, 2014).

3.3.3 Complexity

Besides compatibility, the complexity of the new product also affects whether the product is perceived as useful to the patient. Complexity is the degree to which an innovation is perceived as relatively difficult to understand and use (Rogers, 2003). If a patient finds the new product difficult to understand and to use, someone's perception of product usefulness is lower and therefore someone might be not as willing to use the product (Uncu, 2014).

3.3.4 Intention to Use

The intention to use can be defined as the degree to which a person has formulated conscious plans to perform or not perform some specified future behaviour (Venkatesh and Davis, 2000). In this particular case, it implies the conscious plans patients create to start using the artificial pancreas.

These variables, characteristics of the artificial pancreas, were selected to identify differences in product usage between type 1 patients. Finding clusters based upon perceived usefulness, compatibility and complexity and intention to use might unveil different groups of patients with different needs and expectations.

After running a hierarchical cluster analysis on the data from the participants, two clusters were found based on these four variables. One cluster however, only contained one case, which is rather remarkable and indicates that this case is significantly different from all other cases. One could argue whether the data of this specific case is accurate. The significant differences between the two original clusters, one cluster with one case, and the other cluster with the remaining of the cases could jeopardize the understanding of the differences between

the remaining cases. Therefore, this particular case was excluded from a second cluster analysis, which was executed to see whether differences would occur between the remaining cases that were categorised in the second cluster. The second cluster analysis resulted in two clusters, dividing the remaining cases from the second cluster of the initial cluster analysis. This implies that differences could be found in the initial second cluster but that these differences were too marginal in comparison to the differences from the outlier case in the first cluster of the initial cluster analysis. The results from the second cluster analysis were more meaningful, and probably more realistic, than the results from the first cluster analysis. This line of reasoning led to the exclusion of the first cluster analysis and the outlier case and has advocated for the use of the second cluster analysis. During the second cluster analysis, A K-means cluster analysis identified that one third of the respondents is grouped in cluster one and the rest of the respondents in cluster two. Below, the results of the cluster analysis and the differences between the clusters are discussed.

3.3.5 Results

The cluster analysis conducted resulted in two cluster groups. Besides the actual cluster analysis, a demographical analysis was executed to see whether the differences between the clusters could be explained by demographical factors. Appendix 7.2 contains the SPSS output. Below, the tables with the cluster centers are presented.

Initial Cluster Centers

	Cluster	
	1	2
Compatibility	3,33	7,00
Complexity	4,00	1,00
PerceivedUsefulness	4,50	7,00
IntentiontoUse	2,00	7,00

Number of Cases in each Cluster

Cluster	1	120,000
	2	277,000
Valid		397,000
Missing		,000

Table 3.2 SPSS Output Cluster Analysis

From the results of the cluster analysis, it can be argued that there are significant differences in the perception regarding the product aspects of the artificial pancreas of patients in cluster 1 and patients in cluster 2. Whereas patients in cluster 1 have a more moderate view about the compatibility, complexity, and perceived usefulness of the device, and a rather low intention to use the new product, the scores for the variables in cluster 2 are high. This implies that

patients in cluster 2 are more positive about the new device than patients in cluster 1. The variable ‘complexity’ is scored reversely, meaning that a score of 1 indicates that people don’t perceive the new device as complex and therefore a score of 1 is the most positive score that could be retrieved. The results from this cluster analysis, and the analysis of these four variables, provide the basis for the interviews that were conducted. Questions asked during the interviews cover all four variables that were used in this cluster analysis to see whether interview respondents assess the artificial pancreas similarly to the findings of the cluster analysis. If so, the findings from the interviews are expected to provide more insight into the scores of the cluster analysis and especially into the underlying reasoning why these scores were appointed to the tested variables. The discussion chapter will elaborate on the findings from both the cluster analysis and the interviews and the (dis)similarities between them.

Besides an analysis of the cluster centers and the four variables, a demographic analysis was also executed to investigate potential differences between the clusters based on demographical aspects. Cluster II, which is the biggest cluster, contains 277 patients with a mean age of 40 years, slightly more women (54,8%) than men (45,2%) and 47% is highly educated (either HBO or WO level). Furthermore, the mean age of the patients when they got diagnosed with Diabetes is 21,7 years. The majority of this cluster uses an insulin pump (44,6%) or an insulin pump with a continuous glucose monitor (CGM) (15,9%). Cluster I contains 120 patients with a mean age of 37,8 years, more female participants (58,3%), yet less educated than participants from Cluster II. 38,3% finished a HBO programme or has an academic degree. Furthermore, the mean age of patients when they got diagnosed with Diabetes is 19,7 years old. 60,5% of the patients in Cluster I uses a insulin pump or insulin pump and CGM. The data is collected in the following overview.

	Cluster I	Cluster II
Number of patients in cluster	120	277
Mean age	37.8 years	40 years
Gender	Male – 45,2% Female – 54,8%	Male – 41,7% Female – 58,3%
Education level	HBO/WO – 47%	HBO/WO – 38,3%
Treatment type	Insulin Pump/CGM + Pump – 60,5%	Insulin pump/CGM + pump – 60.5%
Diagnosis age	19.7 years	21,7 years

Table 3.3 Descriptive statistics of clusters

Based on these analyses, it can be argued that significant differences are evident between the clusters, both on the assessment of the four variables tested and demographical differences. The results from the cluster analysis show that patients in cluster 2 assess the artificial pancreas in a more positive way than patients from cluster 1. It can be argued that cluster 2 represents the group of patients that would very much like to start using the artificial pancreas once it becomes available to them. Cluster 1 seems to be a representation of the patients that have more reservations about the artificial pancreas and need more convincing before they would start use the artificial pancreas. From the demographical analysis, one could conclude that demographic differences between clusters are mostly among educational level and gender. This might explain the variation in perceived usage of the artificial pancreas, and it would therefore be interesting to select interview participants based on these clusters and based on educational level and gender.

3.4. Sampling Procedure

The unit of analysis of this qualitative study are type 1 diabetes patients. The choice to collaborate with type 1 patients was made by the supplier company because this group of patients will be the first target group of the supplier company once the artificial pancreas will be introduced to the market. The ideal number of research participants is 15, yet this number is not fixed and depends on the theoretical saturation of the output of the research participants.

To select the research participants that eventually participated in this study, a purposive sampling procedure was chosen. Using a purposive sampling strategy is rather common when

conducting qualitative research (Mack et al., 2005). This strategy groups potential research participants according to pre-selected criteria. In this research context, the pre-selected criterion that was set in advance by the supplier company of the artificial pancreas, was type 1 diabetes patients. The pre-selection of potential research participants, which was performed by the supplier company, only contained type 1 patients. Another selection criterion that was used for this initial list of potential participants was their geographical location. Based on type of diabetes and the geographical location, a list of patients who could be approached for this research got developed by the supplier company and was sent to the researcher. This list of patients contained individuals with all kinds of different characteristics. Therefore, a multi-stage sampling strategy was necessary to approach a number of patients with various demographical characteristics. Attention was paid to an overall equal amount of female and male participants and differences in age. The following sub-chapter will go more in depth about the approached patients that actually collaborated in this research.

3.5 Participants

The type 1 patients that were invited to participate in this research are selected from a the patient database of the supplier company based on the patient's geographical location. This database is the same database from which Uncu (2014) got contact details to submit his only survey to diabetes type 1 patients. An invitation was being sent to 59 patients, 11 recipients were not reached by invalid e-mail addresses, so a total of 48 patients was contacted to participate in the study. 15 of these recipients replied positively and were willing to cooperate in the study. Eventually, 11 interviews were conducted, as four patients cancelled their interview and did not respond to an invitation to re-schedule the interview. The ideal number of interviews conducted for this research was15 interviews, only 11 were conducted. The sample was too small to trace valid differences between the segments, but this research gives some insight into the needs and requirements from patients in the segments; 1) the insulin pen combined with a regular glucose monitoring device and 2) the segment with users of the insulin pump combined with regular glucose monitoring devices. It turns out that continuous glucose monitoring devices are too expensive in use to switch from a regular glucose monitoring device to a continuous glucose monitoring device as indicated by 3 participants and 2 participants state that the continuous glucose monitoring devices don't work properly yet.

Due to the lack of information regarding educational level and treatment type and the marginal response rate, it was not possible to select patients according to the findings of the

cluster analysis and no distinction could be made based upon the tested variables. Although the response rate was still 31%, the rate was expected to be higher as the people contacted were selected from a database of people who left contact details to participate in research projects for the development of the artificial pancreas. As the sign up process for this database is voluntary and patients need to reach out to the contact form themselves, it was expected that more patients would reply to the invitation. Therefore the potential variation as presented by the cluster analysis, could not be demonstrated with this sample of patients. Although it wasn't able to select participants based upon the differences in clusters as presented by the cluster analysis, the cluster analysis could be meaningful indirectly as it is expected that the group of interviewees could be categorised into the two clusters. Potential differences between the participants then could be compared to the differences between the clusters and ideally could back up the results and findings of the cluster analysis. A further elaboration on the combination of the data retrieved from the cluster analysis and the interviews will be presented during the discussion chapter.

The age of the participants rages from 27 till 70 years old. Due to the limited number of respondents willing to cooperate in the research, only three women were interviewed, whereas the other eight interviews were conducted with male patients. Although it wasn't able to select participants based on educational level, the sample included participants from all kinds of educational backgrounds. Yet, the treatment type wasn't distributed equally, which resulted in 4 insulin pump users and 7 insulin pen users. Even though the treatment type wasn't distributed equally, this may be representative to the population as there are still more insulin pen users than insulin pump users due to the higher expenses of the insulin pump (Business Insights, 2011). Also, from their input in the interviews, an overall sentiment of how the participants scored, based upon the four variables tested in the cluster analysis, could be developed. The cluster analysis was based on output from quantitative research. Because this research has a qualitative character, no hard numbers could be appointed to the sentiment of the participants regarding the four variables. Therefore, the four variables out of the cluster analysis were scored 'low', 'moderate' and 'high' based upon the conversation and the input from the participants. The following tables present the characteristics of the interviewees and the descriptive statistics of the interviewees.

Patient	Gender	Age	Education	Patient since age of	Patient for	Treatment	Belongs to cluster
1	M	30	MBO	26	4 years	Pen	2
2	M	70	MBO	25	45 years	Pen	1 / 2
3	F	61	MBO	21	40 years	Pen	2
4	F	46	MBO	13	32 years	Pump	2
5	F	38	MBO	10	28 years	Pump	1 / 2
6	M	27	WO	25	2 years	Pen	2
7	M	30	HBO	20	10 years	Pump	2
8	M	49	HBO	26	23 years	Pump	1 / 2
9	M	68	MBO	18	50 years	Pen	2
10	M	45	HBO	18	27 years	Pen	1
11	M	30	HBO	13	17 years	Pen	1 / 2

Table 3.4 Characteristics of interviewees

Gender	Male: 73%	Female: 27%
Age	Mean: 44 years	
Education	Intermediate vocational education (MBO): 54%	Higher vocational education (HBO/WO): 46%
Patient since age of	Mean: 19,5 years	
Patient for	Mean: 25 years	
Treatment	Pen: 64%	Pump: 36%

Table 3.5 Descriptive statistics of interviewee sample

3.6 Focus of the research: user value of the Artificial Pancreas for diabetes 1 patients

The initial idea for the development of the artificial pancreas (AP) by Inreda came from the inconvenience of current treatment options as experienced by the inventor who suffers from diabetes himself (Inreda B.V., 2014). His aim was to combine all steps of treatment into one device. The AP takes over the function of the pancreas automatically, with the injection of both the insulin and glucagon hormone. This results in a better regulation of the blood glucose level and prevents the patients from experiencing hypoglycaemia (hypo) and hyperglycaemia

(hyper), almost without the need for a patient to intervene in the process. Previous treatments consisted of two devices; a monitoring device and a device for the dispense of the insulin. These treatments fully rely on the discipline and knowledge of patients and put the patients in charge of the regulation of hypo's and hypers.

The device consists of seven components; the artificial pancreas, two sensors, two injection patches, a accelerometer, and optionally a heart rate monitor in case of extreme physical exercise (e.g. cardio training). Furthermore, the AP needs to be filled with an insulin ampoule as well as a glucagon ampoule.

The AP distinguishes itself from other treatments on several aspects. The most important aspect is that the AP enables the patient to live a nearly-to-normal life without the need for continuous monitoring. The AP is self-regulatory in the sense that is measures the glucose level in the patient's blood and automatically adapts the dispense of insulin and glucagon. Therefore patients are no longer required to monitor their glucose level closely and calculate how much insulin or glucagon they need to inject to stabilize the glucose level. Furthermore, the presence of two sensors is a distinctive aspect compared to the insulin pump. The sensors are needed to monitor the glucose level and normally take half a day to measure properly. Having two sensors guarantees safety and continuity in the measurement process. Other beneficial aspects of the AP are the fine-tuned detection mechanism for obstruction of the injection needle and the possibility to track data from the AP on distance.

To optimise the product characteristics, the research that will be conducted is of major importance to the development of the AP's safety, functional and performance requirements. Creating a good understanding of patient needs, the advantages and disadvantages of current products (value in use evaluation) and the customer's perceived value of the AP based on its value proposition will help to modify safety, functional and performance requirements to live up to patient standards.

3.7 Interview protocol

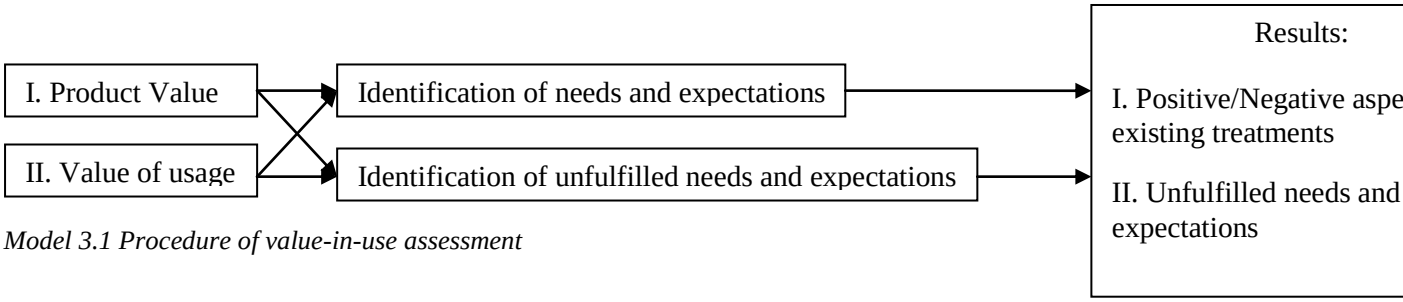
During the interviews that will be conducted with several type 1 patients, it is essential that the protocol entails a set of semi-structured, actionable questions to assess the value-in-use of existing treatments, but also contains a set of questions regarding necessary product requirements in order to identify product requirements for the usage of the artificial pancreas. This part of the protocol will be discussed after the presentation of a prototype of the artificial pancreas and additional information regarding its functioning. A semi-structured approach is

important as it provides both the interviewer and interviewee with freedom to adapt the interview to the situation and to allow the interviewer to elaborate on issues which seem important to the interviewee. By doing so, the interview will get more depth and it will stimulate the creative mind of the interviewee (Calder, 1977), which is needed if one is interested in latent needs (Dicicco-Bloom and Crabtree, 2006).

To ensure that participants feel comfortable, which is assumed to have a positive effect on the disclosure of personal information, an off-record introductory conversation, prior to the actual interview questions, was initiated by the researcher. All interviews started off with a short introduction from both parties in which the researcher tried to find some common grounds with the interviewee and in which interest was shown for the disease of the respondent. Also, a clear explanation was given about the interview procedure and anonymity of the patients was stressed as well. The researcher perceived this introductory dialogue as pleasant and important to release participants from any tension or anxiety in relation to the interview and the expectations.

3.7.1 Value-in-use assessment

Value-in-use assessment basically covers two aspects; value offered by the product and value offered by the usage process (MacDonald et al., 2011). The extent to which the product fulfils the consumer's expectations determines whether consumers are satisfied or dissatisfied with the product usage (Homburg, Koschate-Fischer and Wiegner, 2012). Questions should therefore consider both components of value-in-use and focus on the fulfillment of expectations and patient needs. The questions asked should lead to input about the positive/negative aspects of existing treatments and also should give insight into unfulfilled needs and expectations. These unfulfilled needs and expectations and the situations in which they occur as well as positive/negative aspects of the current treatment could be used as valuable input to get a better understanding of what the consumer is looking for when choosing a treatment. Both the unsatisfied needs and expectations and the positive and negative aspects of a current treatment should be detected and listed in order to get an overview of the experiences of using a particular existing treatment and the gap with the patient's expectations and needs. The knowledge gained from these gaps could be used to optimise new products as the artificial pancreas. The following model briefly explains the procedure for the value-in-use assessment.



Model 3.1 Procedure of value-in-use assessment

3.7.2.Pre-usage evaluation

For the second part of the interview, participants will be asked to provide feedback regarding product requirements, mainly in the field of performance, safety and functionality. Functional requirements relate to the functions that the medical device incorporates. Performance requirements determine how long or how well functional requirements should last or perform. Finally, safety requirements relate to certain requirements to ensure a safe operating of the medical device. Furthermore, participants are free to share other types of requirements and needs they have. The second part of the interview will consist of straightforward questions to get clear answers regarding these requirement issues of consumers.

The stimulus material in this research context will be the value proposition provided by the supplier company of the medical device that will be introduced to the interviewee. It contains a brief explanation and a short overview of the most distinctive product features of the artificial pancreas. It is suggested that this piece of information provides the respondent with sufficient information to form a mental image of the future treatment. The stimulus material has been disclosed in Appendix 7.3. The model below briefly explains the procedure of the free eliciting technique for the identification of the product requirements of the artificial pancreas.

Model 3.2 Procedure of free eliciting technique

3.8 Data Collection and Analysis

The initial interview protocol was executed at all interviews, although slight changes were made during the interviews to connect the protocol to the actual conversation between the interviewer and interviewee. An example would be that the interview was re-arranged when certain questions already got included into other questions, or new questions came up as a

consequence of the story that the participant was telling. The question about diabetes during childhood (see appendix 7.1) was developed after listening to a story of a participant, this question was also asked during the following interviews with participants who were diagnosed at a young age. For non-diabetics it is difficult to imagine the burden of diabetes on daily life, especially at a young age when patients have to cope with their diagnosis and adapt life accordingly. Asking about pre- and post-diabetic life unveils valuable information about the changes patients had to make and what they had to give up. This could uncover underlying needs as it provides input about inconvenient aspects of diabetes that cannot be solved by existing treatments. Overall, the questions included in the interview protocol were created for need identification, need categorization and product requirements, in which the three out of four variables (complexity, compatibility and perceived usefulness) were reviewed implicitly. Also, a direct question was asked about the intention to use the artificial pancreas.

The duration of the interview ranges between 20 minutes and 50 minutes, depending on the patient's experience and willingness to disclose information. One of the participants was diagnosed a few years ago, meaning that he only enhanced his understanding about his own treatment. Therefore, it was more difficult for this participant to link his current treatment to another one and to think of (unmet) patient needs besides the standard requirements.

All interviews that were conducted have been audio recorded to secure the accuracy of the data and to enable the interview to completely focus on the interviewee and the conversation between the interviewer and interviewee. The data has been transcribed precisely and the qualitative analysis tool, Atlas, was used to analyse, code and label the data and to unveil the patient needs. Eventually, seven codes were used to categorise the data from the interviews.

From the first part of the interview, with questions concerning product requirements of existing diabetes treatments, two codes were established; product requirements pen and product requirements insulin pump. The second part of the interview, regarding value-in-use evaluation of the current treatment type, resulted in three codes. Interviewees disclosed meaningful information about the consequences of living with diabetes, which resulted in a code 'consequences of diabetes'. Furthermore, two codes were created for the value-in-use evaluation of the usage of the insulin pump and the value-in-use evaluation of the usage of the insulin pen.

The third part of the interview in which interviewees were asked to give a pre-usage evaluation of a new diabetes treatment by using an artificial pancreas, resulted in two codes.

At first, participants disclosed information about why they either would be willing or not willing to use an artificial pancreas. This information also identified certain needs or requirements concerning the artificial pancreas, or shortcomings in their current treatments. Therefore a code was created labelled 'switch to AP'. Also, in the third section of the interview, interviewees were asked to express product requirements that should be fulfilled before they would use the artificial pancreas. These direct product requirements for the artificial pancreas resulted in the final code, 'product requirements AP'.

Together, the information gathered in these codes either expressed direct (unmet) product requirements for the existing treatments and the new diabetes treatment. However, indirect and latent needs were also captured, mainly disclosed in the consequences of living with diabetes and the participant's willingness to switch to the new treatment. No questions were asked about the evaluation of the current glucose monitoring devices of patients. This has been a respective choice as all participants used a regular glucose monitoring device, so the differences were expected to be small. Furthermore, there are many regular glucose monitoring devices available. Although they all work according to the same principle, their particular functioning differs per device. Since there are so many different devices available, it was impossible for the researcher to know all devices and the consequent device characteristics. Even though no direct questions were asked about the glucose monitor, participants did speak about their experience with monitoring blood glucose levels, this mainly was discussed in the value-in-use section of the interview.

After coding, the quotes were interpreted and, possibly, combined manually. This resulted in a list of frequently mentioned aspects and product requirements. This list has been further specified and categorised into sub-fields as design aspects, functional aspects, wishes and negative aspects to get a better understanding of patient needs. The results section will go more in depth into the findings of the interviews.

3.9 Conclusion

This chapter has aimed to explain the method used and the choices made during this study every step in the way. The segmentation analysis and the cluster analysis contributed to the knowledge about the consumer and developed more insight in the differences between consumers in such a way that these preparing techniques prior to the actual research have led to considerate selection of certain research participants according to their treatment type.

Furthermore, the results from the cluster analysis in particular have been a fundament for the interviews as it predicts the movements there are in the consumer market. Also, the results from the interviews, which will be discussed in the next chapter, are expected to qualitatively back up the findings from the cluster analysis. The interviews could offer a line of reasoning or explanation why some patients evaluate the compatibility, complexity, perceived usefulness and the intention to use the artificial pancreas differently.

Having this knowledge about consumer differences, the interview protocol was created to firstly ventilate the value-in-use of the existing treatments to see whether these differences were also recognised in the present study and to get an understanding of positive and negative aspects of existing treatments and potential additional (unmet) needs. The second part of the internet protocol has been completely dedicated to the articulation of product requirements for the artificial pancreas after presenting stimulus material to the interviewee.

The interviews were audio recorded and were precisely transcribed to be able to analyse the data. The qualitative data was labelled and coded by the qualitative research programme Atlas, from where the quotes that were coded got interpreted, and possibly combined, manually. This has resulted in a list of frequently mentioned aspects and product requirements of both existing treatments and the artificial pancreas, which will be discussed in more depth in the following chapter.

4. Results

The Results chapter entails the findings of the cluster analysis, the qualitative research and the combination of these two study methods that have been conducted in this research. Before findings are discussed and interpreted, a recall of the demographic characteristics of the research participants is presented.

After the demographics, this chapter will move towards the different components of the study. First, the outcomes of the cluster analysis will be discussed in more detail. From there, this chapter will move towards the findings of the interviews. Firstly, attention will be paid to results as categorised as consequences of living with diabetes. The consequences of living with diabetes were found to be very meaningful to formulate patient needs and product requirements as it clearly illustrates the difference between life without having diabetes and a life with diabetes. Comparing these differences could lead to the identification of unmet, and possibly latent, needs. Following the consequences of living with diabetes, two tables with labels that were created by combining similar quotes about positive and negative product aspects and value-in-use experience of patients is presented for the insulin pen. The same tables with positive and negative product aspects and value-in-use experience for the insulin pump are presented secondly. No distinction has been made between a regular glucose monitoring device and a continuous glucose monitoring device as all participants in this study use a regular glucose monitoring device. As the glucose monitoring device is integrated into the diabetes treatment, no distinctive tables are presented for the glucose monitoring device. Experiences from patients regarding the glucose monitoring device, as part of their overall treatment, are included in the value-in-use experience tables from both the insulin pen and insulin pump. These tables provide the basis for interpretation and discussion of the findings regarding existing treatments. The second part of the interview has resulted in information about product requirements and usage of the artificial pancreas. Two tables with information about these matters are included to provide input for further discussion and reflection of the information provided by the interviewees.

Once all results from the interviews have been presented, a comparison between the cluster analysis and the output from the interviews will be made to see how findings from both techniques relate and whether they can explain each other.

4.1 Demographics and Cluster Analysis

To investigate the needs and product requirements of existing treatment types and future treatments for diabetes patients, eleven interviews were conducted. Three women were interviewed, whereas the other interviews were conducted with male participants. Six out of 11 interviewees is educated on a secondary vocational education (MBO) level. Five participants were higher educated (HBO/WO). Furthermore, 7 interviewees use insulin pen treatment, whereas the other 4 interviewees have an insulin pump therapy. The mean age of the participants is 44 years old and on average, the interviewees have suffered from diabetes for 25 years now.

The cluster analysis, as explained in the method chapter, has resulted in two consumer groups that were found after analysis of 397 patients. Cluster 1 is the smallest cluster with 120 patients with a more moderate sentiment about the artificial pancreas in comparison to cluster 2. The second cluster comprises of the remaining 277 patients with a very positive sentiment about the artificial pancreas. Whereas the scores for compatibility, complexity and perceived usefulness were moderate in cluster 1, and the intention to use the artificial pancreas was rather low in this cluster, patients in the second cluster assess the compatibility, complexity and perceived usefulness as very positive, which makes the intention to use the artificial pancreas also very high.

The interviews conducted with the research participants also entailed implicit and explicit information about the four variables tested during the cluster analysis. Although qualitative research doesn't result in numbers, based upon the information exchange of the research participants, patients' perceptions were categorised by the researcher as being 'low', 'moderate' or 'high'. The following table provides more insights into the scores of the participants on the variables compatibility, complexity, perceived usefulness and intention to use.

Participant	Compatibility	Complexity	Per. Use.	Int. to. Use	Cluster
1	High	Low	High	High	2
2	High	High	High	High	1 / 2
3	High	Low	High	High	2
4	High	Low	High	High	2
5	High	Low	High	Moderate	1 / 2
6	High	Low	High	High	2
7	High	Low	High	Moderate	1 / 2
8	Moderate	Low	High	High	1 / 2
9	High	Low	High	High	2
10	High	Low	High	Low	1
11	High	Low	High	Moderate	1 / 2

Table 4.1 Participant per Cluster

Five out of 11 patients score identical towards the four variables from the cluster analysis as patients categorised in cluster 2. Five patients seem to fall in between cluster 1 and cluster 2 as these patients score differently from cluster on one or more variables. However, the intention to use the artificial pancreas is still moderate to high, so therefore these patients seem to have more in common with the second cluster than the first cluster. Only one out of 11 patients scores low on the intention to use the artificial pancreas, which reconciles with the characteristics from cluster 1. Although this patient scores similarly on compatibility, complexity and perceived usefulness, the intention to use is significantly different from the indication of intention to use in cluster 2 as presented in the cluster analysis. As the intention to use is perceived as highly important, this patient has been categorised to have more similarities to cluster 1. Without an intention to use, the artificial pancreas will not be sold to these patients, which could jeopardize the success of the new device.

After analysing the sentiment of the patients towards the four tested product aspects of the artificial pancreas, it can be concluded that, overall, this group of patients seems to have similar understanding towards these product aspects in comparison to the sentiment from the cases from the cluster analysis. A more in-depth elaboration on the findings of the cluster analysis in combination with the findings from the interviews will be presented later on in this chapter.

4.2 Value-in-Use assessment

4.2.1 Consequences of living with diabetes

During the interviews, it became clear that participants were willing to share a lot information regarding the consequences of diabetes on their daily lives and choices that they have made in the past based upon the diagnosis. Although the consequences of living with diabetes initially wasn't a point of focus of this research and no direct questions were included in the interview protocol, the information provided by the participants gives an idea how diabetes patients live and what deliberate decisions they make in order to stabilise their disease. The protocol was slightly altered to get an idea of the consequences of diabetes by including a question about diabetes and childhood and how daily life for the participant looks like, yet the majority of the information about the consequences of living with diabetes came organically as a result of the dialogue between the interviewer and interviewee. Furthermore, consequences of diabetes became also evident while answering questions about the expectations and positive and negative aspects of the current treatments. These sources of information combined has resulted in meaningful additions to the value-in-use experiences of the participants.

The consequences of living with diabetes were found to be very meaningful to formulate patient needs and product requirements as it clearly illustrates the difference between life without having diabetes and a life with diabetes. The following table presents a list of consequences of living with diabetes.

Consequences of diabetes	Count
I'm afraid of needles and now I have to inject myself	2
Limitation to social life	4
Limits the way you live life and the freedom	4
Always the same breakfast and lunch	3
Diabetes is always on your mind	1
You always have to carry around a lot of equipment	2
Diabetes caused accidents due to fluctuating glucose levels	1
A lot of scars	2
Feeling unwell	2
Diabetes makes you feel dependent on others	2
Different lifestyle if I wasn't diagnosed with diabetes	1
Doubts about having children	1
Sensitive skin, especially of the fingers	3
All kinds of medical statements necessary when travelling	1

Table 4.2 Consequences of living with diabetes

Table 4.2 gives an overview of the consequences that patients face due to their diagnosis with diabetes. 4 out of 11 participants feel restricted in life and find diabetes to be a '*social obstruction that you just need to accept'.* They mention that they need to adapt their habits and that they feel insecure about how the body is reacting to the insulin. Especially all participants who use an insulin pen indicate that the functioning of the diabetes is never '*according to plan'* and the glucose levels are dependent on so many different factors that it is difficult to stabilise the glucose levels on a short term. Also, 3 participants that have been diagnosed for a long period now indicate that it gets more painful to measure glucose levels as the skin is so sensitive and full of scar tissue. Another aspect that is explicitly mentioned by 3 interviewees is that a diabetes patient always has a standard meal (especially for breakfast and lunch) at a standard time. Although not directly expressed, it becomes clear that diabetes patients live very structured and restricted to keep glucose levels as stable as possible. Patients may not perceive it as inconvenient, however, this structure is quite different from people without diabetes. Another consequence of the disease is that one participant caused several accidents due to low glucose levels. Also, a female participant indicated that she deliberately

thought of whether or not to have children as the risk of complications during pregnancy is higher for diabetes patients. She ended up being in a coma during her pregnancy as a consequence of her disease. In general, it seems that they are quite some restrictions to life of diabetes patients and that the disease even could threaten the patient's health and well-being.

4.2.2 Value-in-Use assessment Insulin Pen

The interviews conducted in this study have resulted in qualitative data regarding needs, expectations and positive and negative aspects of diabetes treatment through the usage of the insulin pen. The important quotes and findings from the interview transcripts have been listed to function as a basis for further interpretation and uncovering of patient needs, expectations and product requirements. Below, the lists with labels and the associated counts are presented.

Product aspects of the insulin pen	**Count**
Positive aspects	
Compact	4
Easy to use	7
Simplicity of device	7
Precise	5
Nothing stick to the body	5
Patient in control of insulin injections	1
Functions properly	4
Sharp, sterile needles	2
Short needles	4
Easy to carry around	1
Negative aspects	
Needles are inconvenient	1
Device could be forgotten to take with you	1

Table 4.3 Positive and Negative aspects of the insulin pen

Value-in-Use experience Pen	**Count**
Diabetes is well regulated while using a pen	2
Experiencing extreme glucose levels while using a pen	2
Using a pen increases the sense of freedom	1
Pricking causes damages spots on the skin (e.g. scar tissue)	2
Afraid of needles	2
While using a pen, you always have to bring along a bag	1
Using several colours to differentiate functions of the pen	1
Insulin bumps when insulin gets injected incorrectly	1
A busy life could lead to forgetting to measure, eat and inject	1
Using is a pen is inconvenient in public areas	2
A patient needs to have knowledge about the functioning of insulin	4
While injecting insulin, I feel the insulin rushing through the body	2
Short functioning insulin is unpredictable	3
Long lasting insulin limits the daily activities and planning	4
You should have understanding about your disease	3
Monitoring blood glucose levels is inconvenient	3
Glucose levels are dependent on various factors and therefore frequently pricking is needed to monitor the glucose levels	7
Competence of diabetes nurse is insufficient	3
Diabetes nurse is important	2

Table 4.4 User experience of the insulin pen

Table 4.3 presents the information interviewees shared about the positive and negative aspects of the insulin pen. In general, users of the insulin pen seem very satisfied with their treatment. 7 out of 7 participants indicated that they value the insulin pen because of its simplicity and because it is easy to use. 5 out of 7 interviewees find it positive that the device is very precise as it is possible to inject insulin per unit, and like that there is nothing attached to the body, however some patients that injecting insulin per unit is not precise enough. Whereas the dosage is precise when using a pen, two patients indicate that it should be possible to inject insulin in smaller quantities as they feel unwell when injecting insulin. Other frequently mentioned positive aspects of the insulin pen are the fact that the device is compact, that the needles which are used are short and therefore less painful and that the device works properly without any defects. Less positive aspects of the insulin pen which were mentioned by 1 out

of 7 participants are the usage of needles and the fact that a patient is able to forget the device while a patient leaves home.

Table 4.4 provides positive and negative aspects of usage of the artificial pancreas in specific situations. Whereas 2 out of 7 patients indicate that the insulin pen enables them to regulate their diabetes properly and that they expect relatively stable glucose levels on the long run, also 2 out of 7 patients find themselves to have extreme glucose levels on a regular basis while using the insulin pen. This could be explained by the belief of 4 out 7 patients that it is essential to understand diabetes and the functioning of the insulin and that all insulin pen users who participated in this research have difficulty to regulate glucose levels because the functioning of the insulin and the amount of insulin needed depend on various factors (e.g. stress, exercise, pain etc.). Therefore, it seems that patients have more difficulty with the insulin that they need to inject rather than the insulin pen itself. One participant indicated: '*Insulin is very complex'*, Another participant says: "*The disadvantage of the insulin pen is not so much the pen itself, but the insulin that needs to be injected".* Injecting 'per unity', as is the case with the insulin pen, is not accurate enough. Also, 2 out of the 7 interviewees think that injecting a couple of units at the same time cannot be good. These interviewees indicate that they can feel the insulin flow through the body once it is injected, they especially complain about headaches and a feeling of being unwell in general. Another drawback of the insulin, as indicated by 4 out of 7 participants, is the long-lasting insulin as it limits the patient's flexibility in daily life. One of the participants states: *"You never can do things without consideration, you always have to be careful".*

Although it seems that most discomfort from patients gets caused by the functioning of the insulin, there are some drawbacks to the insulin pen as well in certain situations. One disadvantage mentioned by 2 of the interviewees is the inconvenience people experience when they have to inject in public. Patients don't like to inject in public as it 'reveals' the disease to others. Yet, they also don't want to go somewhere private every time they have to inject (e.g. bathroom). Patients perceive this as unpleasant and 2 of the patients state that this withholds them from public dining and other social activities. Another negative aspect of insulin pen therapy, as proposed by two older participants in this research, is the fact that the large amount of injections over the years has caused scar tissue, which complicates injecting and makes the injections more painful. A remarkable aspect is that, especially patients who have been diagnosed a long time ago, don't go to the diabetes nurse. One participant stated:

"I'm not going to the diabetes nurse, I can tell her more about the disease than she can tell me".

Despite the fact that participants are not very content about the functioning of the insulin, they would not be willing to start using an insulin pump. 5 of the pen users like the fact that they don't have anything on their body and 2 pen users find that carrying a pump would limit the perceived freedom of the patient. Also, they believe that the pump won't lead to better regulation of the glucose levels and the diabetes in comparison to the results achieved by using the insulin pen.

The insulin pen could be improved by building in an alarm to remind the patient of injecting. A young patient with a busy life indicates that he sometimes forget to inject because he loses track of time due to his busy schedule. The patient currently solves this problem by setting an alarm on a mobile phone, yet it is more convenient to integrate an alarm function on the pen (or monitoring device) itself. Also, 2 users of the insulin pen would like to see one device with an injecting function and the possibility to measure glucose levels as well.

4.2.3 Value-in-Use assessment insulin pump

Similar to the value-in-use assessment of the insulin pen, the value-in-use assessment of the insulin pump also consist of two aspects; positive and negative aspects of the insulin pump and positive and negative aspects of the insulin pump during usage and in specific situations. The following two tables give a short overview of the findings of the interviews.

Product aspects of the insulin pump	**Count**
Positive aspects	
Not so much equipment to take with you	1
Functions properly	4
Wear on different spots of the body	1
Wireless	2
Less measures to take	3
Precise (per 1/10 unity)	2
Light	1
Calculates for you	2
Simplicity	2
Negative aspects	
No Continuous Glucose Monitor (CGM)	3
Technical defects	3
Difficult device in the beginning of usage	3
Complex additional software	1
Device always in the way	4
Starting pump therapy only possible when you have a stable lifestyle	1
Difficult to obtain due to the health insurance companies	2

Table 4.5 Positive and negative aspects of the insulin pump

Value in Use experience insulin pump	Count
Provides freedom while using the insulin pump	*3*
Control still in patient's hands while using the pump	*1*
Needs to stay in place, also when the skin is more humid	*3*
More convenient in use in public areas	*1*
A patient should understand its disease to use the pump properly	*2*
Scar tissue could lead to pump defects	*2*
The 'automatic pilot' leads to a decline in stable glucose levels	*2*
Pump could be adjusted more precisely	*1*
Inconvenient to replace pump while patches are still in place and no skin irritation has occurred yet	*1*
Inconvenient while travelling	*1*
Pump is very visible, people are looking	*2*
Glucose monitoring is inconvenient	*2*
Needles are uncomfortable	*1*
The competence of the diabetes nurse is insufficient	*1*
Diabetes nurse is important in introductory stage of pump use	*2*

Table 4.6 User experience of the insulin pump

Table 4.5 and 4.6 present information on how pump users perceive the product and how they experience the use of the insulin pump. Starting off with table 4.4, in which positive and negative aspects of the insulin pump are listed, it seems that pump users are quite satisfied with the device. All participants indicate that their pumps function properly and they are able to regulate the glucose levels. 3 out of 4 participants also value the fact that using an insulin pump requires less actions that should be taken to regulate diabetes as the device regulates the insulin injection and calculates the amount of insulin needed. 2 participants also find it beneficial that the pump is very precise as it can inject insulin per tenth of a unity. Also, dependent on which insulin pump is in use, positive aspects are the light weight of the device and the simplicity of the operating system of the device.

Although there are many positive aspects, it becomes evident that the insulin pump also has negative features, more than the insulin pen. The biggest issue with the insulin pump, as indicated by all insulin pump users, is the fact that the device or patches are always in the way. Furthermore, 3 of the 4 pump users also perceive it as negative that they don't have a

continuous glucose monitoring device and that the pump may be difficult in usage, especially in the beginning. Also, 3 of the 4 users have experienced technical defects. Negative aspects as indicated by an insulin pen user who was interested in starting pump therapy, is the complexity of getting an insulin pump from healthcare insurance companies and that the pump needs to be set properly which is only possible when a new user of the pump experiences a stable lifestyle for a longer period in time.

Table 4.6 provides an overview of positive and negative aspects during the usage of the treatment. One major advantage as indicated by 3 out of 4 pump users is that it gives them more flexibility in usage during the day. Using a pump will decrease the number of actions a patient needs to undertake. A patient indicates that: *"It provides freedom because you do not longer have to inject yourself, so there are far less actions to undertake than when I used an insulin pen".* So even though people feel that the device or patches are inconvenient as you always have to carry it with you, the perceived freedom in daily life and activities increases. Taking less actions also has a drawback as 2 out of the 4 pump users indicate that they *trust on the 'automatic pilot',* which has minor negative implications for the glucose levels. Also, once you know the device, the pump is very easy in usage and using an insulin pump is more convenient for regulation of diabetes in public areas as indicated by one of the participants. Although the pump may be more convenient in public areas as pump users don't have to inject insulin publicly, 2 other participants experience discomfort from 'being looked at' because of the visibility of the pump. One of the pump users stated: *"With the insulin pump on your body, you constantly brandishing your diabetes".* Therefore, every interviewee who uses an insulin pump only wants to have a cordless insulin pump. Although they are not ashamed of their diabetes, they don't like to be constantly subjected to questions from strangers. Also, pump users feel that their freedom gets limited by a normal insulin pump because you always need to carry around a device. This is the main reason for insulin pen users not to start using an insulin pump. Another remarkable aspect, similar to experiences from pen users, is that one pump user, who has been diagnosed for 23 years now, doesn't see the relevance of a diabetes nurse due to the knowledge of the nurse about the disease. 3 out of 4 pump users acknowledge the value of the nurse during the introductory stage of pump usage as the diabetes nurse is the first person to approach when experiencing defects or when there are questions about the device.

From the value in use experience of pump users, it appears that there are still some unmet needs. 3 out of 4 interviewees that use an insulin pump would like to have a continuous glucose monitoring (CGM) device as monitoring the glucose levels is perceived as inconvenient and painful. Furthermore, three out of four users also indicate that the pump should properly stick to the body, also when the skin is humid, which could be the case in situations of exercise, summer, or when users find themselves in humid areas (e.g. bathroom). Once the plaster doesn't stick properly anymore, users run the risk that the pump will come off from the skin and this may jeopardize the functioning of the pump.

4.2.4 Conclusion value-in-use assessment

Even though patients have to live according to strict rules and schedules, 8 out of 11 patients indicate that they are quite satisfied with their current diabetes treatment. Patients' product requirements for the insulin pen and insulin pomp are similar to a certain extent. In any case, 8 out of 11 patients expect that the use of both the pen and pump should result in stable glucose levels on the short and long run. Furthermore, both devices should be simple in usage, easily understandable for every user and as compact as possible. Another remarkable aspect is that 3 patients who have been diagnosed a long time ago, don't or seldom make use of the diabetes nurse. They feel that the majority of the nurses is not skilled enough to learn them something new about the disease or the regulation of the disease.

Besides the general requirements, 2 out of 7 users of the insulin pen would like to see the pen and monitoring device to be integrated into one device. All users of the insulin pump prefer to have a cordless, light weighted pump without technical defects. Also, 3 out of 4 pump users find it important that the device stays in place, also during sports and when the skin is damped. However, one pump user indicate that when the plaster needs to come off, it should go smoothly and as painless as possible.

4.3. Pre-usage evaluation Artificial Pancreas

4.3.1 Switch to Artificial Pancreas

8 out of 11 participants of this study seem all quite satisfied with their current treatments, so the question remains whether they would be willing to switch to the use of the artificial pancreas. The following table presents the motivations for switching to the artificial pancreas.

Switch to AP	**Count**
Motivation to switch from current treatment to AP	
I can live life like a healthy person	5
Continuous glucose monitor	2
Improve glucose levels and regulate diabetes even better	5
A lot of complications (hypo's)	1
No more pricking and injecting	6
First step to curing diabetes	2
No more calculation of carbohydrates	1
Improves independence	1
You don't have to think of your disease on a continuous basis anymore	2
Motivation why patients would not switch to AP treatment	
The device is too big	2
Too many things (cords, patches, device) on the body	2

Table 4.7 Switch to artificial pancreas

10 out of 11 participants would switch immediately if they would have the possibility to do so. 5 participants believe that the artificial pancreas is better capable of regulating diabetes than the insulin pen and insulin pump are. This is the main reason to switch to the artificial pancreas. Furthermore, 6 interviewees would switch to diabetes treatment by using the artificial pancreas because they no longer have to measure glucose levels, which means that they don't have to prick anymore. Another motivation as indicated by 5 participants is that they expect to live life like a 'normal' healthy person without diabetes. One participant states: *"To me, it seems just perfect to do things without any consideration, something spontaneous. Especially with long-lasting insulin this was not possible anymore, you always have to wait to see how my body reacts to the insulin"*. Furthermore, 2 interviewees indicate that they would

switch immediately because of the continuous glucose monitoring integrated in the device. This implies that patients do not longer need to monitor their glucose levels separately, which would spare them a lot of inconvenience and pain. One patient indicates: *"Monitoring the glucose levels is a bigger punishment than injecting insulin. I only prick in my little finger, that one is the least sensitive. The sensitivity is a consequence of the diabetes".* In general, patients expect that the artificial pancreas will provide them freedom in life.

There are also 2 participants that would like to switch to the artificial pancreas, yet they see it as a semi-solution. A transplantation of the islets of Langerhans is their ultimate goal as they would like to be cured from diabetes permanently.

The only reason for one of the participants to not switch to the artificial pancreas is because of its size, the expected weight of the device and the fact that it is not cordless at this moment.

Similar to the findings of the cluster analysis, the lower educated participants were more willing to switch directly from their current diabetes treatment to the use of an artificial pancreas, whereas the higher educated participants had more reservations and were found to be more critical about the device and the design of the product. One explanation to these findings could be the difference in number of years lower educated participants have been diagnosed with diabetes compared to higher educated participants. On average, lower educated participants have been diagnosed with diabetes for 33.2 years now, whereas higher educated participants have been diagnosed with diabetes for 15.8 years. As the number of years is double in the group with lower educated participants, it could be argued that they are more in need of a new diabetes treatment that would relieve them from inconvenience and painful finger prick compared to patients that have been diagnosed with the disease for a shorter period.

4.3.2 Product requirements Artificial pancreas

Previously it has been established that patients are enthusiastic about the artificial pancreas and want to switch from their current treatment to the usage of an artificial pancreas to regulate their diabetes. From the interviews conducted with diabetes patients, a list of product requirements has been developed which need to be in place before patients would be completely satisfied with the use of the artificial pancreas. The list of requirements has been divided into three components; design requirements, functional/performance requirements and safety requirements. The table with design requirements will be presented first.

4.3.2.1 Design Requirements

Design requirements AP	**Counts**
As compact as possible	10
Not too heavy	2
Internal	5
Less visible	3
Cordless	4
Simple	6
Portable	4
Water resistant	5
Should not be a physical burden	5
Less patches	2
Plasters should come off easily when they have to be replaced	1
Design has a strange shape	1
Corners of the device are too sharp	1
Just an on/off button	1
Use colours to differentiate buttons and functions	1
Cords are too short to put the device in a pocket of back pocket	1
Design should be less medical and more aesthetical	2
Nice additional accessories	2
Financially accessible to every diabetes patient	1

Table 4.8 Design requirements for the artificial pancreas

Design wise, patients have some comments on the current prototype of the device. 10 out of 11 participants would like to see that the eventual device that will be marketed, is more compact than the current prototype. Furthermore, especially the female participants in this study would like to see the device to look less 'medical'. Two female participants would like to have a more aesthetic design and that aesthetic accessories are available to wear the device properly. One of the female participant remarks: *"the appearance does matter, don't make it a medical product".* This is in line with the reasoning of another participant who states: *"As long as you see the device, you get constantly reminded of your disease".* So perhaps a device that looks less medical could take away the feeling of being ill. Also, one of the participants stated: *"The corners of the device are sharp and the device itself has a strange shape, this could lead to discomfort during usage".* Especially the corners could cut into your skin, which would lead to an unpleasant feeling while wearing the device. Furthermore, the device should be simple according to 7 participants so that the device is understandable for patients from all ages. During the interviews, it was suggested by one participant to just give the device an on/off switch to make it as simple as possible. Also, the touch screen and the navigation buttons on the device itself should also be properly visible for diabetes patients with limited visual capacity as indicated by one participant who experiences limited visual capacity as a consequence of diabetes.

Suggestions for further development of the artificial pancreas contained the remark that was mentioned by 4 interviewees to make the device cordless. Furthermore, two participants would like to see less patches on the body, one of the participants suggest to develop one patch to cover all needles and sensors that are necessary for the functioning of the device. Another frequently mentioned wish, as stated by 5 from the 11 participants, is that they would like to have an internal artificial pancreas.

4.3.2.2 Functional and Performance requirements

The next table presented below gives an overview of the product requirements regarding the functioning and performance of the artificial pancreas.

Functional and Performance requirements	Counts
Stable performance and good glucose levels	3
All functions should be automatically and smoothly	2
Patient should be able to fully rely on the functioning of the device	5
Quick reaction of the device to changes in glucose levels	1
Easy in use	6
Good self-regulating algorithm	1
Exercising should be possible	2
Wear on different spots on the body	2
Simple software to analyse data from AP	2
Establish a connection between a mobile phone and the AP for reading data overview of glucose levels	1

Table 4.9 Functional and Performance requirements for the artificial pancreas

When it comes to the functioning of the device, 8 patients demand stable performance of the device, a device that functions automatically and smoothly and on which patients can rely. Also, the device must be as simple in use as possible as indicated by 6 participants and one interviewee would like to see that the device reacts quickly to changes in glucose levels. Furthermore, two patients indicate that exercising should be possible when wearing the device and should not negatively impact the performance of the artificial pancreas. Also, as experienced by two pump users, it is convenient to wear a device (either a pump or artificial pancreas) on different spots on the body to avoid the development of scar tissue on the skin.

Two participants also would like to be able to easily retrieve the data concerning their diabetes regulation from the device. A participant indicated: *"We as diabetes patients are used to be in control, being able to retrieve the data about the regulation from the device would be comforting".* Establishing a connection between a mobile phone, tablet or pc and the device to present the regulation data on other electronic devices would be easy for patients according to one of the patients.

4.3.2.3 Safety Requirements Artificial Pancreas

The last table with requirements for the artificial pancreas provides an overview of the safety measures that patients would like to have integrated into the artificial pancreas. The table is presented below.

Safety Requirements for AP	Count
Device should not be fragile	6
Early alert when something is wrong	2
Less defects as possible	2
Defects should be easily solvable by the patient	3
Build-in security measure to compare integrated monitor measure with external blood glucose monitor device	1
Self-cleaning mechanism for cords	1
Helpdesk support from supplier company	1

Table 4.10 Safety Requirements for the artificial pancreas

Table 4.10 presents the safety requirements that were mentioned by the participants in this study. One aspect that was found to be very important, as it was indicated by six participants, it that the device should not be fragile and functioning of the device should not be jeopardized when a situation occurs in which the artificial pancreas gets dislocated from its original position. Furthermore, two patients indicate that they value an early alert when something is wrong and that the defects should be easily solvable by the patient itself. One participant states: *"I should be alarmed on time when something is wrong, and I should able to intervene when something goes wrong, so that I can fix the situation myself. The defect may never be so complex that I cannot solve it myself".* From this statement it becomes clear that the patient really want a good-working alarming mechanism, and the device should be not too complex to solve. Another participant, a pump user, values the good communication with his supplier of the pump. In case of defects to the artificial pancreas, a helpdesk should be in place too.

Another control aspect as suggested by another participant is an integrated control mechanism that every once in a while requires patients to test their glucose levels with an external device. This empowers the patient and is an immediate check to see whether the glucose levels of the artificial pancreas are similar to the indicated level to the external device. Also, a self-cleaning mechanism is proposed by one of the interviewees to keep the cords and needles clean and to avoid defects.

4.3.3 Conclusion pre-usage evaluation Artificial Pancreas

Patients are welcoming the developments regarding the creation of an artificial pancreas and 10 out 11 patients would immediately switch to a diabetes treatment through an artificial pancreas for the sake of stability of their diabetes. 6 participants indicate that they would switch to the artificial pancreas to avoid the finger pricking to measure glucose levels. Also, 5 interviewees would switch to the artificial pancreas to live life like a normal person.

Although almost all participants would directly choose to start using the artificial pancreas, they have still a lot of remarks on the current prototype of the artificial pancreas.10 out of 11 participants of this study would be more willing to use the artificial pancreas if the design gets smaller than the current prototype. Also four interviewees prefer a cordless artificial pancreas. And the ultimate aim should be an internal design according to 5 participants. Concerning the functional and performance requirements, 8 out of 11 patients prioritise the stability and performance of the device and that they can completely rely on the performance of the artificial pancreas. Furthermore, 6 patients highlight the importance of the simplicity of the device so that it is easy to use. Also, two participants would like to see that they could wear the artificial pancreas without having to worry about the performance during sport activities. Finally, the safety requirements mentioned by the interviewees indicate that 6 patients find it important that the device is not fragile and could take a hit. Also, 2 participants indicate that they expect on time alerts when something goes wrong and the defects should be solvable by the patient itself according to three interviewees.

4.3 Review of Findings

The cluster analysis resulted in two clusters with patients who appear to have different perceptions regarding the compatibility, complexity, perceived usefulness and the intention to use the artificial pancreas. To get a better understanding about the underlying reasoning for these differences, interviews have been conducted to see whether the differences that were revealed in the cluster analysis are also visible during interviews and to provide qualitative argumentation for the differences in patient perceptions.

The cluster analysis unveils two types of consumers; type 1 is more reserved about the artificial pancreas and the several product aspects that were tested, whereas type 2 is positive about the artificial pancreas and its product aspects, and intends to use the artificial pancreas

once it becomes available to them. A demographical analysis showed that the group of patients within the two clusters are not that different from each other. One remarkable aspect that became apparent was the difference in educational level between the two clusters. Whereas cluster 1 mainly contained people that are higher educated (HBO/WO), the majority of patients within cluster 2 are lower educated (MBO). Therefore, it could be argued that the level of education relates with the evaluation of the artificial pancreas and seems to negatively affect the scores of patients.

Overall, it can be argued that the cluster analysis has identified two clear groups of patients with different views on the compatibility, complexity, perceived usefulness and the intention to use regarding the artificial pancreas. Whereas the biggest cluster, cluster 2, contains two-third of the 397 participants, it is expected that the majority of the group with interviewees will also fall within this cluster. This implies that most interviewees would be very positive towards the artificial pancreas and would like to have one when it becomes available to the market.

The interviews that were conducted to get more insight into patient needs, product requirements for the artificial pancreas and the general sentiment towards the compatibility, complexity, perceived usefulness and intention to use the device, revealed an overall positive sentiment towards the artificial pancreas for most interview participants. Although there are still doubts and questions about the current design and the actual functioning of the device, 10 out of 11 patients indicate that they would try treatment through an artificial pancreas as they believe it will simplify the treatment and provide more freedom to the patient's life and activities. From the conversations with the participants, five out of 11 patients had similar views towards the four product aspects as the patients within cluster 2. Only one out of 11 patients indicated that he would not be willing to start using the artificial pancreas as it is right now, mainly because of the design. The low usage intention is in line with the findings from cluster 1, and therefore this participant seems to have more in common with the sentiment from the first cluster than the second cluster. The remaining five interviewees, although they mainly correspond with the sentiment from cluster 2, they also show dissimilarities with both cluster 1 and cluster 2. Therefore, these patients seem to be somewhere in between these clusters, although they tend to better correspond with the second cluster. This means that 10 out of 11 interview participants are in line with the second cluster, whereas one participants seems to have more similarities with the first cluster.

As expected, the number of participants that would relate with the sentiment from cluster 2 is larger than the number of patients corresponding with cluster 1. Similar to the findings from the cluster analysis, the only participant that stated not to want to use the artificial pancreas, is higher educated. A negative trend between educational level and sentiment regarding the four product aspects was expressed before, and also in this research a higher educated participant is the only patient that has a low usage intention. Moreover, the higher educated interview participants in this study were more critical towards the artificial pancreas and asked more questions about the product and its functioning during the interview. Also, three out of five participants that are categorised not to be typically according to cluster 2 are higher educated. This implies that, in this research, it seems that higher educated participants have a more moderate sentiment than lower educated research participants.

Explanations on differences in compatibility mainly are caused by the current design of the prototype. Some participants doubt the functioning of a rather big device with cords on their body when performing physical activities. Although 10 out of 11 interviewees indicated that they expect the artificial pancreas to be simple in use, age and the number of complications as a consequence of diabetes could be factors affecting the level of complexity of the device. The only participant who expects to have difficulties in learning to use the artificial pancreas is one of the oldest participants and has limited visual capacity as a consequence of the disease. Furthermore, all research participants indicate that the artificial pancreas is perceived as highly useful. They are convinced about the performance of the artificial pancreas and have the feeling that this device will provide them with more freedom and less burden as a consequence of diabetes. Lastly, the patients that score moderate or low on use intention of the artificial pancreas are mainly concerned with the current design, the size, the amount of plasters on the body and the cords.

Therefore, it can be concluded that the product becomes more interesting to a wider range of patients if the current design gets modified. It is expect that the research participants that are in between cluster 1 and 2, or in cluster 1, will move towards cluster 2 if their concerns regarding the design are tackled.

5. Discussion

This study investigated the patient experiences, needs and product requirements of diabetes patients towards existing treatment types and a new diabetes treatment by means of using an artificial pancreas. These findings were the result of a literature review of existing research techniques for co-creation to construct a suitable method for this particular context with high levels of information sensitivity and two points of evaluation, a pre-purchase evaluation and a value-in-use evaluation. The research has aimed to contribute both theoretically by reviewing methods to for stimulation of customer involvement on a pre-purchase stage and during usage stage by constructing a customised research technique, and practically by offering more insight in product requirements, patient needs and wishes regarding several diabetes treatments.

To recapitulate, the research questions as presented in the introduction chapters were:

1. Which methods of co-creation are suitable for value-in-use measures when highly sensitive information is involved?
2. How can existing methods of co-creation be altered in order to examine two points of evaluation simultaneously?
3. How do type 1 patients value their current Diabetes treatments based on their value-in-use assessment of these current treatments?
4. Which requirements do type 1 patients have for the artificial pancreas to actually start using the treatment?

In order to provide answers to the central questions of this research, this study consisted out of two phases. The first phase was a literature review dedicated to present an overview and an assessment of several qualitative techniques for co-creation, whereas the second phase of this study was a qualitative, more practical, research into the patient evaluations, needs and product requirements for existing diabetes treatments and a new diabetes treatment. From the literature review, it became evident that the required type of qualitative measure depends on the degree of innovativeness of the new product (Van Kleef, van Trijp and Luning, 2005). However, since also an evaluation of existing products was included into this research, five techniques for co-creation were presented to be assessed according to the suitability to this research. A combined approach a field value-in-use assessment for evaluation of existing treatments, and a free eliciting method for the pre-usage evaluation of a new treatment was

found to be the most suitable to this research context. Application of this customised approach resulted in meaningful output about existing treatment and product requirements for a new treatment. Both sources of information led to the development of understanding what patients seek and want for new treatment types, yet also what they have missed in their existing treatment. This knowledge is helpful in need formulation and formulation of product requirements.

A further elaboration on the presented research questions will follow in the sub-sections of this chapter. Yet, before moving to answering the research questions, a more in-depth view on the participants of this research and the link with the segmentation analysis as well as the cluster analysis will be provided first.

5.1 Participants

The segmentation analysis and the cluster analysis conducted in this research prior to the selection of the participants contributed to the understanding of the potential consumer groups of interest to the supplier company of the artificial pancreas. Whereas the segmentation analysis indicated that the consumer groups with the highest potential are patients using an insulin pen with a regular glucose monitoring device, patients using an insulin pump with a regular glucose monitoring device and patients using an insulin pump with a continuous glucose monitoring device. The subsequent cluster analysis indicated that two clusters of consumer groups could be found and that the main demographical variance was detected on the educational level of patients. However, once the participants for this research were selected, it turned out that no prior information was provided regarding educational level from the supplier company patient database , which implied that the findings from the cluster analysis could not be integrated in the participant selection for the research. Even though the findings of the cluster analysis could not be used initially for the selection, the findings of the interviews can now be linked to the cluster analysis to see whether the interviews provide a qualitative, more detailed reasoning for the findings from the cluster analysis.

All participants of the research are expected to score moderately to high on compatibility of the artificial pancreas. This implies that no major changes to the current life of the patient is required before the patient can use the artificial pancreas properly as they all live regular lives. Patients scoring moderate on compatibility have situational exceptions in which proper functioning of the existing treatment, so perhaps also the artificial pancreas, cannot completely be guaranteed. One of the participants travels a lot, which brings along risk for the quality of the insulin.

A few situational exceptions would be a participant that travels a lot and a participants that like to exercise should perhaps be more careful than with the current treatment. Furthermore, the interviewees, with the exception of the older interviewees, score low on complexity indicating that they do not perceive the artificial pancreas as being difficult to use. Based on the motivations to switch to the usage of an artificial pancreas, it can be expected that the perceived usefulness of the device is high and that the intention to use is high as well. Only 1 interviewee indicated that he would not use this device at this point in time because of the size. This means, according to the scores of the group of interviewees on the four variables of the cluster analysis, that they would likely to fit in the second cluster, which also entailed 70% of the respondents from the online questionnaire of Uncu (2014).

As proposed by the findings of the cluster analysis, the educational level could explain some of the variance in relation to the four variables tested. 47% of Cluster 1 was higher educated (HBO/WO), whereas only 38,3% was higher educated in Cluster 2. The scores for the four variables are more moderate in Cluster 1 in comparison to Cluster 2. This could imply that higher educated people are more reserved about the four variables and have scored the items more moderately. This movement is also visible in the research conducted here. The five higher educated participants asked more questions about the functioning of the device after the presentation of the stimulus material and were more critical regarding the perceived usefulness, especially the functioning of the algorithm and the design of the product. Also, the only interviewee that would not use the artificial pancreas directly is higher educated. Therefore, although the group of participants of this research would most likely fit in Cluster 2, it is remarkable to see that there is a negative trend between educational level and the scores for these four variables.

To conclude, it can be argued that the possibilities for selection of the research participants for this study was rather limited due to the lack of prior background knowledge and to the little number of people who were willing to collaborate. However, it seems that this small sample of patients fit into the bigger picture and it could be argued that this provides evidence of ‘regular cases’ which would imply that the answers given by the respondents are in line with the thoughts of the general patient population.

5.2 Methods of co-creation

Due to the intimate character of both the field value-in-use assessment and the free eliciting technique as both techniques should be executed one-to-one, plus the fact that these techniques combined provide a possibility to research two evaluation points, this combination seemed to be the most suitable for this research and this particular research context. The decision made to use a combination of a field value-in-use assessment and a free eliciting method resulted in output similar to expectations formulated in academic literature.

Both techniques used in this research context are too much consumer-oriented with a focus on both articulated needs and latent needs to fit in with the responsive traditional marketing rationale (Witell et al., 2011) and therefore can be considered to be different from traditional marketing research methods. Traditional marketing techniques are mostly focused on consumer's articulated needs and a backward evaluation which a company could satisfy rather easily (Witell et al., 2011). A more proactive market orientation and subsequent research techniques have a consumer-driven focus to unveil latent needs and to co-create value together with the end user (Witell et al., 2011).

5.2.1 Field value-in-use technique

Accordingly to stated in literature, it appeared to be difficult for participants to articulate their needs (Trott, 2001; Cooper and Evans, 2006; Van Kleef, Van Trijp and Luning, 2005). Participants were able to express the positive and negative product and treatment aspects, but need articulation was implicit and only visible 'between the lines'. The value-in-use assessment resulted in positive and negative aspects based upon experience, just as proposed by Anderson and Narus (1999). Participants described the positive and negative experiences they had with the existing treatment mainly based upon situations in which the interviewee encountered problems with the device or the treatment in general. The fact that mainly negative aspects were the result of the during usage evaluation was not mentioned in literature. Negative information is given more weight than positive information and leads to a stronger psychological response (Mittal, Ross and Baldasar, 1998). This might explain why particularly negative experiences are recalled. Whereas the negative points of insulin pumps are clearly stated, users of the insulin pen were rather positive. Even though negative information is expressed more often, users of the insulin pen did not formulate that many negative aspects. This could mean that, overall, the insulin pen functions properly and that users of the insulin pen have less negative experiences with the use of the insulin pen in comparison to users of the insulin pump. All in all, the two parts of the value-in-use

assessment (product value and value during usage), delivered a considerate amount of output on both positive and negative product aspects and negative experiences during usage to develop sufficient understanding of what patients value in existing treatments and which needs are unmet.

5.2.2 Free eliciting technique

The output from the free eliciting technique to understand product requirements for the artificial pancreas was positively affected by the value proposition and photo presented to the patients prior to the interview questions about the artificial pancreas. This is in line with literature as the value proposition should trigger one's imagination, which will lead to more valuable output (Sweeney and Soutar, 2001; Griffin and Hauser, 1993; Van Kleef, Van Trijp and Luning, 2005). Although 10 out 11 participants had some background information about the artificial pancreas due to personal interest and research, the questions asked after the presentation of the stimulus material indicated that the prior knowledge about the new product would not be sufficient to answer the interview questions properly. This could imply that the general awareness of the new treatment is rather low at this point in time. Even though the product is still under development, it is suggested to start informing diabetes patients about the device and the functioning of the device to take away questions and doubts and to create a need for the artificial pancreas prior to product launch. Furthermore, although three creative participants articulated interesting thoughts and suggestions for the artificial pancreas, the output of the majority of the participants was rather obvious due to the low product familiarity. Van Kleef and colleagues (2005) acknowledge that this is one of the major drawbacks of the free eliciting technique. Therefore, it proves to be challenging to deliver valuable results as input for the development of innovative products (Trott, 2001; Creusen, 2011) and it is questionable whether a value proposition is sufficient to create a mental picture of a new product in order to provide a pre-purchase evaluation. In this research context, it might have been more valuable to use the clinical trial group to test the device, not only for the performance and the regulation of the diabetes, but also to provide positive and negative aspects of the artificial pancreas based on user experiences. Based on the results from the value-in-use assessment, user experiences seem more meaningful and creative to the supplier company and therefore may be more valuable. Another solution to overcome the occurrence of this problem is to have used a different technique for this research purpose, perhaps one that does not rely on the value proposition. Another way of uncovering latent needs is taking a more general, projective approach than direct questions regarding specific product

requirements for a certain product. Using a Kelly Repetory Grid technique or a Photosort technique would bypass the verbal route and may stimulate one's imagination (Downs and Adrian, 2004), which is expected to lead to expression to more underlying thoughts. Although the choice of using a value proposition did have drawbacks, projective techniques as a repertory grid or a photosort may be more suitable for the articulation of underlying thoughts and needs, but the difficulty of analysis is a major disadvantage of these techniques (Downs and Adrians, 2004).

5.3 Points of evaluation

During this research, a distinction has been made between a pre-purchase evaluation and during usage (value-in-use) evaluation. It has been suggested by literature that a consumer in a pre-purchase stage lacks user experience, mainly with innovative, or new products (Gillarza, Gil-Soura and Holbrook, 2011), whereas it is expected that consumer that have user experience have a better understanding of the product and therefore should be better able to evaluate a product (Sweeney and Soutar, 2001). Due to the fact that the artificial pancreas has not been marketed yet, interested patients base their initial evaluation of the new device based upon information provided by the supplier company, the media and diabetes institutions as the Dutch Diabetes Foundation. Therefore, it can be argued that the current view of patients regarding the artificial pancreas is rather conceptual and the research technique that is used to interview the participants should enrich a patient's understanding of the artificial pancreas so that patients are enabled to articulate needs more easily. In this research setting, the initial value proposition of the artificial pancreas, created by the supplier company, has been used as stimulus material to trigger participant's imagination and current knowledge about the device. However, simultaneously, this research requires the participants to provide an evaluation of the patient's current treatment. As patients have extensive user experience with their current treatment, it is expected that patients provide a more in-depth evaluation. Therefore it can be suggested that significant differences are visible between a pre-purchase evaluation and a post-purchase evaluation, which demand different research approaches.

From the assessment of several research techniques for co-creation, it becomes clear that techniques are focused on solely one evaluation point (Van Kleef, Trijp and Luning, 2005), meaning that a combination of several techniques is required to create a suitable research design for a context in which more than one evaluation is required from research participants. Pre-usage evaluation of a product requires a projective technique or a technique in which stimuli get presented to create a better understanding of a potential user's perception of the

product and to trigger the creative mind of a consumer to get access to the underlying thoughts and the articulation of needs (Trott, 2001). A value-in-use evaluation is an evaluation based upon the satisfaction level of a user, which is the outcome of the reflection of positive and negative product and product usage aspects (Sweeney and Soutar, 2001; Hoburg, Koschate-Fischer and Wiegner, 2012). Therefore, it can be concluded that traditional value-in-use evaluation techniques are not suitable for pre-purchase evaluation due to the lack of user experience. On the other hand, using techniques that are suitable for pre-purchase evaluation for value-in-use evaluation would be possible, however it is presumed that these techniques don't cover the user experience from the actual usage of the product. Therefore, using pre-purchase techniques would result in a partial evaluation and a researcher would miss out on the meaningful contributions of participants regarding the usage of the product. Hence, it can be argued that it seems more logical to work with different techniques for research with more than one point of evaluation. A combination should be made to address both evaluation points properly.

5.4 Value-in-use assessment existing treatments

The third research question presented in the introduction chapter, aims to investigate what patients value in their current diabetes treatment. From the research conducted it appears that all patients are rather satisfied with their current treatment, yet they would immediately switch to a better alternative when this becomes available. Whereas pen users value the compactness and the simplicity of the device, pump users are satisfied because of the accuracy of the pump, less actions that need to be taken and the freedom they perceive. Yet, both pen and pump users would prefer a continuous glucose monitor to avoid the many finger pricks that are involved with the measurement of glucose levels. Literature dedicated to diabetes, also acknowledge this wish from patients (Atkinson and Eisenbarth, 2001; Barnard, 2015). Furthermore, Funnel and colleagues (2006), who performed the DAWN studies, also indicate that patients would like to see incremental changes to existing medical support that is combined with current treatments. A similar view is presented by the older participants of this study, who have been diagnosed for many years now. They indicate that diabetes nurses, although specialised in the disease, don't enrich the knowledge about diabetes and treatment of diabetes of patients who have been diagnosed for a long time. The knowledge patients gain from their experience with the disease extends the knowledge a diabetes nurse can be taught. Therefore, visiting the diabetes nurse may not have added value for patients who have lived with diabetes for many years. Therefore, there seems to be room for improvement of the

medical support offered to diabetes patients. To conclude, the findings from the value-in-use assessment are in line with the expected results based on the literature. Yet, especially the value-in-use evaluation of patients provide a more extensive list of situations of unmet needs than is presented in current diabetes literature. The list of value-in-use aspects of insulin pens and insulin pumps are quite similar in terms of sub-topics. In both lists, comments are made about the regulation of the disease, the inconvenience from glucose monitoring and the physical consequences of the pricking and injecting. Furthermore, both groups of participants discuss the perceived freedom and the importance of having knowledge of diabetes and the functioning of insulin. Also, the diabetes nurse leads to comments. Although there is quite some overlap in sub-topics as mentioned by insulin pen users and insulin pump users, there are differences in opinion, sentiment and meaning of the topic. Especially the perceived freedom as experienced by both insulin pen users and insulin pump users is based on different motivations. Furthermore, another distinctive factor is the amount of negative statements regarding the usage of insulin pumps in comparison to the amount of negative quotes regarding the insulin pen. Pump users either are more critical or have more negative experiences with the pump than insulin pen users have with the insulin pen.

5.5 Product Requirements Artificial Pancreas

Diabetes treatment through an artificial pancreas is a new method, but already raises the interest and the expectations from diabetes patients. The interviews indicated that almost every interviewee is likely to switch to a treatment by using the artificial pancreas. The main reasons to use an artificial pancreas are no more injecting to measure blood glucose levels, a better regulation of the disease and improved quality of life. Research focused on the artificial pancreas conducted by Barnard (2015) substantiate the motivations provided by the participants of this study. Barnard (2015) also indicates that a continuous glucose monitor, stable glucose regulation and improved quality of life are main reasons to start using the artificial pancreas.

Although they all seem very willing to start using the artificial pancreas, patients are not convinced about the look and feel of the current prototype. Product requirements that are frequently mentioned critiques are the size and the cords and patches of the current prototype. Findings by Barnard (2015) also indicate that size and design are very important decision factors for the actual usage of the artificial pancreas. Due to the size and the fact that the artificial pancreas contains cords and patches, it is remarkable that all pen users intend to use

the artificial pancreas as 5 out of 7 participants highlight the fact that they value that there is nothing on their body. Intention to use is not the same as actual usage, so because of the contrary findings for insulin pen users, it will be interesting to see how many users actually would shift to the usage of an artificial pancreas.

5.6 Theoretical Implications

This study has aimed to contribute to existing literature in a few ways.

At first, this research has combined two different techniques for customer involvement to measure both a pre-usage product perception and a during usage evaluation. The results from the created 'method' indicate that combination of two techniques is desired when different stages of evaluation need to be assessed. Also, the execution of the combined method demonstrates that pre-usage product perception requires more background information than only a value proposition as suggested in literature (Sweeney and Soutar, 2001; Griffin and Hauser, 1993). The question then remains how pre-purchase product evaluation has to be studied. The combined method also has shown the added value of consumer experience, so pre-purchase evaluation requires more active, participatory methods in which some kind of experience can be gained by the consumer in order to get meaningful information that could complement the NPD project. One example for a more participatory method would be a trial period in which participants can 'play around' with the new device and can gain knowledge about the device and probably create a better understanding of the device. Having used the device increases the experience of the user, which enables them to provide more input for a NPD project as the artificial pancreas.

Furthermore, to stimulate the articulation of latent needs, it is suggested to review the methods used in this research context and perhaps choose an alternative technique for the pre-usage evaluation as the flow of latent needs was rather marginal in this part of the research. The free eliciting technique used in this context did not deliver the desired output as expected by the researcher, especially in the field of latent needs. Therefore, based on this study, it can be argued that this technique lacks possibilities to uncover latent needs and other techniques should be used in order to trigger latent needs. An interesting technique to do so is the a laddering technique, a type of repertory grid (Downs and Evans, 2004). A laddering technique enables the researcher to link participant's emotional benefits with product features. However, the line of questioning of a laddering technique requires some interviewing expertise from the

researcher as emotional benefits only can be uncovered when the right questions and follow-up questions are asked (Downs and Evans, 2004). Another technique to unveil latent needs is a projective technique as Photosort. A collection of photos with all kinds of items should be presented to the participant and photos that seem to connect with the research object (e.g. the artificial pancreas) according to the participant will be selected from the collection (Downs and Evans, 2004). Subsequently, the participant has to share its thoughts on why he selects those particular photos. Both the laddering technique and the Photosort are more creative forms of consumer research methods that will access less rational, intuitive judgments (Downs and Evans, 2004). Therefore it is suggested that methods like these will contribute to the understanding of consumer latent needs. However, as the method becomes less rational, it is expected that the analysis will also become more difficult as there is less logic involved.

Also, the search in literature for more information about diabetes and patient needs implied that there is limited knowledge about the patients that have to cope with this disease every day. As these patients are the end user of medical devices and the medical support system, they are an important source of information to optimise service and products in the future. Therefore, this research contributes to the understanding of the end user in and provides detailed information on patient needs which can complement the limited existing literature on diabetes patients.

Lastly, this research contributes to the evidence of the functioning of co-creation. Involving the patient, or the consumer, has provided interesting qualitative data and created goodwill with the patients as someone was ‘finally’ listening to them. Both aspects are essential components for a better relationship between healthcare providers and the patients.

5.7 Managerial implications

Besides theoretical implications, there are also managerial implications.

At first, the segmentation and cluster analysis have indicated some consumer groups of interest that could be willing to start using the artificial pancreas. Therefore, the chances on success of the new device in the market are likely to be largest when these consumer groups will be the main target of the supplier company.

Furthermore, this study shed light on the patient opinions about existing treatments and revealed the points of improvement of existing treatments. The points of improvement are indicators of unmet needs, so when the supplier company would take into account these improvement points, the artificial pancreas would increase the need fulfillment, which would

have positive implications on the perceived usefulness and the intention to use the artificial pancreas. The overview of the product requirements for the new device and the reasons why people would (not) switch to the artificial pancreas are also of major interest to the supplier company and could add value to the product when this information is taken into account and integrated into the product. This will not only positively affect the design and development of the product, but also will provide input for a modification of the value proposition based upon the opinions of the consumer. The value proposition should be based on the value perspectives of two parties (Ballantyne and Varey, 2006), however the current value proposition, that was also used as stimulus material in this research, is created by the company without validation of the consumer. Especially the more critical participants asked a lot of questions regarding the product after reading the value proposition. This means that not all important information is captured in the current proposition. Therefore, it is suggested that the lists of product requirements for the artificial pancreas and the reason why patients would switch to the usage of the artificial pancreas should be reviewed to include the most distinctive characteristics of the device into the value proposition. Furthermore, the value-in-use assessment of existing treatments sheds light on the positive and negative user experiences of these treatments. Using this knowledge within the value proposition to differentiate the artificial pancreas from other alternative treatments would stress the unique selling points of this device and reveals the added value of the product.

Lastly, this research shows that value-in-use and customer involvement can deliver additional value to a new project as the artificial pancreas. Customer involvement, or co-creation, builds a close relationship to the end user and the supplier company, whereas value-in-use evaluations are very meaningful and go beyond regular input from solely product requirements.

5.8 Suggestions for future research

To properly investigate consumer needs and to support new product development and information gathering for NPD projects, more research should be conducted on how to study pre-purchase product perceptions. Using the value proposition as basis for a dialogue with a consumer might be not sufficient as the creation of a mental image of the product is challenging, which means that participants cannot create an opinion about a new product. Research is necessary to see how this problem can be solved in the future as innovation and NPD project happen continuously in many organisations.

Also, although there is a lot of specialised literature generated by the diabetes industry itself, scientific healthcare literature, especially focused on research methods is quite limited. In this research, a very general approach was taken to form a solid theoretical framework around the concept. Unfortunately there was not enough scientific medical literature in place to create a theoretical foundation for this research. Therefore, it may be worthwhile to investigate NPD processes, radical innovations and marketing problems within a healthcare setting more in depth. Also, more research could be conducted about co-involvement within a medical context.

Furthermore, there is a lack of examples of co-involvement studies within healthcare industries. The only forms of co-involvement were mainly conducted with medical professionals instead of the actual patients. Besides the fact that opinions of patients matter, these kind of studies gives them the feeling that they are being heard by the industry and manufacturers of devices that they have to live with every day. This creates mutual understanding between the two parties and takes the products to a higher level.

5.9 Limitations

The research conducted during this study consisted of a set of interviews. The first limitation to the research was the low response rate. This had negative implications for the variation within the sample. Due to the low response rate, the researcher was not able to select cases based on different demographics as education level and gender, and the type of treatment that patients use. Furthermore, the chance of having lead users in this small sample of participants is very small. Lead users can be recognised by their ability to present needs that will become general in the market months or years in the future (Von Hippel, 1986). There is no evidence that participants from this research could be categorised of being a lead user. Also the level of creativity and the possibility to think ‘outside the box’ from the research participants was marginal, which would be an essential characteristic of a lead user (Von Hippel, 1986). As a consequence, the majority of the participants mainly could think of obvious product requirements and need articulation, especially latent needs, was found to be very difficult (Trott, 2001; Cooper and Evans, 2006). Another explanation for the lack of latent needs could be the use of these particular research techniques, as it turned out that the free eliciting techniques and the stimulus material inspired the patients too little. It became evident that they lack user product experience and that it is difficult to imagine how such a device would work.

Another limitation to the usage of interviews, and in this case a free eliciting approach with stimulus material, is that older patients may experience limitations in hearing and vision and that diabetes patients in particular experience more limited visual capacity as it is a consequence of the disease. The stimulus material led to some problems with two older participants since they have been subjected to the consequences of the disease for a very long time, which negatively affects someone's well-being and health. They were unable to read the text or the fully comprehend the photo of the prototype. This could have negatively affect one's understanding of the device and therefore could have biased the third part of the interview.

Also, the limited knowledge about diabetes, the existing treatments and the artificial pancreas made the researcher a limitation as well. Even though the supplier company provided the researcher with a presentation about the device and the researcher conducted some self-study to get more feeling with the disease, it was challenging to level with the knowledge of long-time diabetes patients. This may have affected the first interviews as a lot of new information was transferred to the researcher. This could have had negative implications for the line of questioning during the first interviews.

Lastly, the participants of this research were selected from a patient database of the supplier company of the artificial pancreas. This database is the result of a sign-up form on the website of the supplier company to collect interested patients for research purposes. Because of the fact that patients have to sign up themselves, it could be assumed that these patients are very interested in the development of the artificial pancreas. Therefore, the patients that have been selected for this research could be slightly biased in favour of the artificial pancreas, which jeopardize the neutrality of the research.

5.10 Conclusion

Conducting research in environments with highly sensitive information requires a different approach. Participants need to feel comfortable before they will disclose personal information, yet their view and personal experience are of great importance to suppliers and manufactures and therefore this kind of research, even though more complex, is very meaningful. With the input of these patients, treatments can be optimised and quality of life of the patient will improve.

6. References

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7. Appendix

7.1 Interview Protocol

General questions:

1. Name
2. Educational level
3. Current treatment
4. Age of diagnosis
5. If young age of diagnosis, how did you experience diabetes when you were young?

Device Evaluation – product value

1. Which diabetes treatment do you use right now?
2. Did you also use other diabetes treatment(s) in the past?
3. What needs do you have regarding your Diabetes treatment?
    a. In what way does your current treatment differ from previous diabetes treatments?
    b. *Need identification and categorisation*
4. Which expectations did you have about the device (Pen / CMG) itself prior to first usage?
    a. *Identification expectations*
5. Which aspects of the device do you consider to be positive and which aspects do you consider to be negative?
    a. What are the positive aspects of this device in comparison to your previous treatment?
        i. *Need identification*
    b. Would you be more satisfied if you would use a different treatment? If yes, which treatment do you prefer? Why would you be more satisfied with this treatment?
        i. *Need identification*
6. Does this device fulfil all your needs regarding your personal Diabetes treatment? If yes, why?
    a. *Need identification*
7. Why do you prefer your treatment over another treatment (e.g. pen or pump)?
    a. *Need identification*

Treatment Evaluation – Value in use

1. Was your diabetes ‘normal’ yesterday?
2. What are you doing on a normal day?
    a. Give a description of how you use your device on a normal day.

    b. *Compatibility*
3. Which personal needs should be fulfilled by this treatment in order to be satisfied by it?
    a. *Need identification & Need categorisation*
4. Does this treatment require a lot of expertise and skills of the patient? – Please explain which skills are needed. *Complexity*
    a. If you compare this device to other treatment devices, do you think there are other devices available which are more easy to use? If yes, which and which aspects make it more easy to use? *Complexity*
5. Which aspects of the device usage do you consider to be positive and which aspects of the device usage do you consider to be negative?
    a. *Perceived Usefulness*

- Part II -
    - Introduction to Artificial Pancreas
        - Background information / Value proposition
        - Photo prototype artificial pancreas

1. Do you understand the information about the artificial pancreas you just read?
2. Please summarize shortly what the artificial pancreas is and how it works according to your perception.

Product Requirements – Artificial Pancreas

1. According to your opinion, what would be the most perfect and ideal Diabetes treatment?
    a. *Need identification*
2. What would make you consider to switch from your current Diabetes treatment to usage of the artificial pancreas?
    a. *Intention to Use*
3. What are the reasons why you would (not) start using the artificial pancreas if you compare it to your current treatment?
    a. *Intention to Use / Compatibility / Complexity / Perceived usefulness*
4. According to you, what should the artificial pancreas do?
    a. *Perceived usefulness*
5. Under which circumstances in your daily life should the artificial pancreas function normally? *Compatibility*
    a. Are there any circumstances in daily life and activities in which your current treatment doesn't live up to your standards and doesn't function well enough?
6. To guarantee your safety, which requirements do you have for the artificial pancreas?
    a. How satisfied are you with the level of safety and security offered by your current treatment?

7. Are there any other product requirements that you have for the artificial pancreas before you would decide to switch to this Diabetes treatment.
    a. *Compatibility / Complexity / Perceived usefulness*
    b. What do you miss in your current treatment?
8. Finally, if you would be able to forward one last message to the supplier company of the artificial pancreas, what would it be?

7.2 SPSS output Cluster analysis

Cluster I

Cluster II

Gender

Geslacht

Cluster Number of Case			Frequency	Percent	Valid Percent	Cumulative Percent
1	Valid	Female	70	58,3	58,3	58,3
		Male	50	41,7	41,7	100,0
		Total	120	100,0	100,0	

Geslacht

		Frequency	Percent	Valid Percent	Cum Per
Valid	Female	150	54,2	54,2	
	Male	127	45,8	45,8	
	Total	277	100,0	100,0	

Age

Statistics

Leeftijd

1	N	Valid	119
		Missing	1
	Mean		37,75
	Minimum		8
	Maximum		85
	Percentiles	25	24,00
		50	36,00
		75	50,00

Statistics

Leeftijd

N	Valid	276
	Missing	1
Mean		39,89
Minimum		3
Maximum		74
Percentiles	25	26,00
	50	40,00
	75	52,75

Educational level

Wat is uw hoogstgenoten opleiding waarvan u een diploma heeft behaald?

Cluster Number of Case			Frequency	Percent	Valid Percent	Cumulative Percent
1	Valid	Basisonderwijs (groep 1-8)	9	7,5	7,5	7,5
		Voortgezet onderwijs (VMBO, HAVO, VWO)	28	23,3	23,3	30,8
		Middelbaar Beroepsonderwijs (MBO)	37	30,8	30,8	61,7
		Hoger Beroepsonderwijs (HBO)	36	30,0	30,0	91,7
		Wetenschappelijk onderwijs (WO) of hoger	10	8,3	8,3	100,0
		Total	120	100,0	100,0	

Wat is uw hoogstgenoten opleiding waarvan u een diplom

		Frequency	Percent	Vali
Valid	Basisonderwijs (groep 1-8)	14	5,1	
	Voortgezet onderwijs (VMBO, HAVO, VWO)	62	22,4	
	Middelbaar Beroepsonderwijs (MBO)	71	25,6	
	Hoger Beroepsonderwijs (HBO)	96	34,7	
	Wetenschappelijk onderwijs (WO) of hoger	34	12,3	
	Total	277	100,0	

Cluster I

Cluster II

Diagnosis Age

Statistics

Hoe oud was u toen u de diagnose diabetes kreeg?

1	N	Valid	119
		Missing	1
	Mean		19,74
	Minimum		1
	Maximum		69
	Percentiles	25	11,00
		50	16,00
		75	27,00

Statistics

Hoe oud was u toen u de diagnose diabetes kreeg?

N	Valid	277
	Missing	0
Mean		21,70
Minimum		1
Maximum		64
Percentiles	25	10,50
	50	20,00
	75	31,00

Treatment Type

Welke methode gebruikt u op dit moment om uw diabetes te behandelen?

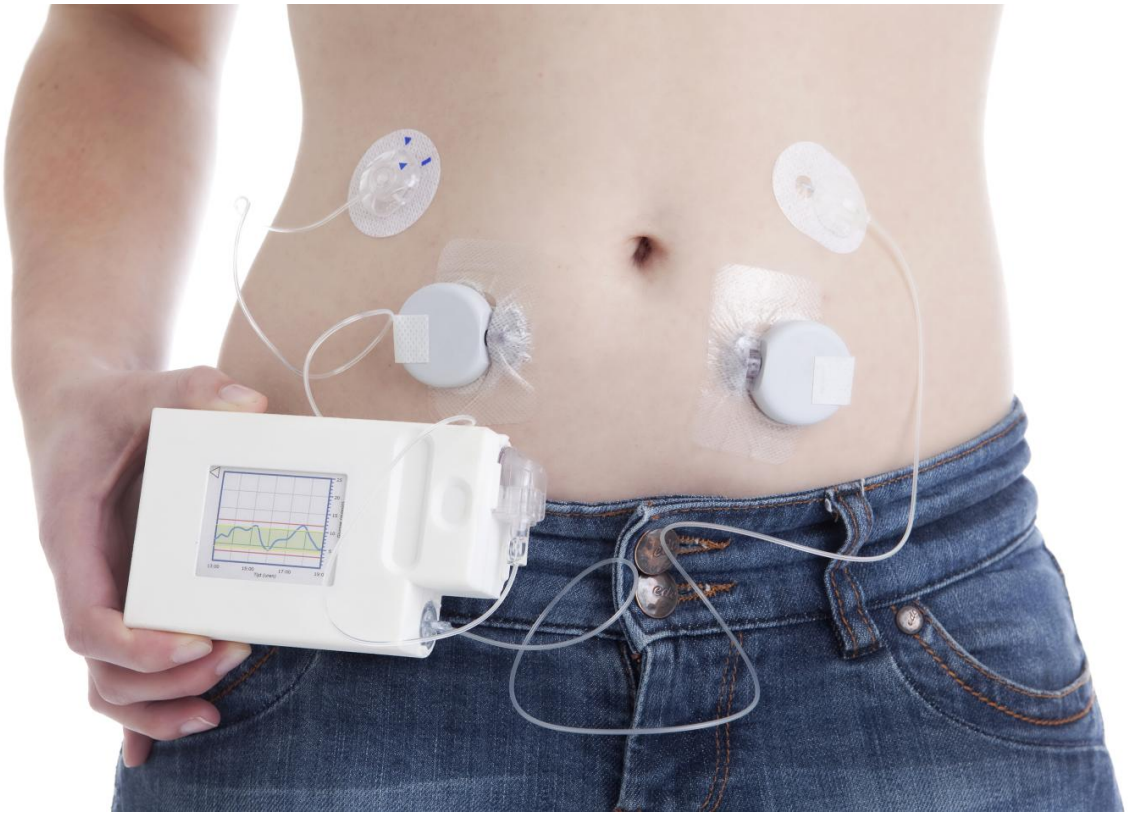
Cluster Number of Case			Frequency	Percent	Valid Percent	Cumulative Percent
1	Valid	Insuline pen	47	39,2	39,5	39,5
		Insuline pomp	62	51,7	52,1	91,6
		Insuline pomp en CGM (Continue Glucose Monitor)	10	8,3	8,4	100,0
		Total	119	99,2	100,0	
	Missing	System	1	,8		
	Total		120	100,0		

Welke methode gebruikt u op dit moment om uw diabetes te beha

		Frequency	Percent	Valid Perce
Valid	Insuline pen	107	38,6	39
	Insuline pomp	121	43,7	44
	Insuline pomp en CGM (Continue Glucose Monitor)	43	15,5	15
	Total	271	97,8	100
Missing	System	6	2,2	
Total		277	100,0	

7.3 Stimulus Material

Photo prototype artificial pancreas



Explanation/value proposition artificial pancreas:

Op bovenstaande foto ziet u de kunstmatige alvleesklier. De kunstmatige alvleesklier bevat twee pompsystemen, één voor insuline en één voor glucagon (om de bloedsuikerspiegel te verhogen), met beiden een aansluiting op een eigen infuus. Door gebruik te maken van een continue glucosemeting met twee sensoren, kan de kunstmatige alvleesklier actief blijven bij het vervangen van een sensor en zijn de metingen nauwkeuriger. Hierdoor kan de juiste hoeveelheid insuline of glucagon worden bepaald en afgegeven. De kunstmatige alvleesklier functioneert op twee AA batterijen en zorgt elke 24 uur voor een verzending van de gegevens naar de database.

De kunstmatige alvleesklier maakt gebruik van een regeling die bepaalt wanneer en hoeveel insuline of glucagon toegediend moet worden. Uit wetenschappelijk onderzoek blijkt dat door gebruik te maken van twee hormonen een betere regulatie van uw bloedsuikerwaarde mogelijk is en dat deze tussen de reguliere waardes van 4 en 11 mmol/l blijft.
De glucoseregeling verloopt geheel automatisch waardoor u bijvoorbeeld niet hoeft aan te geven of u gaat eten of sporten. Interne veiligheidsmaatregelen zorgen er voor dat er nooit teveel toegediend wordt of dat er ongemerkt dingen fout gaan, hoorbare alarmen waarschuwen als u iets moet doen of controleren. M.b.v. de scrol balk (1) en de bevestigingsknop (2) kunt u de kunstmatige alvleesklier bedienen.

7.4 Contact details research participants

Patient	Gender	Age	Education	Patient for	Treatment	Compatibility	Complexity	Perceived usefulness	
1	M	30	MBO	4 years	Pen	High	High	High	
2	M	70	MBO	45 years	Pen	High	Low	High	
3	F	61	MBO	40 years	Pen	High	Low	High	
4	F	46	MBO	32 years	Pump	High	Low	High	
5	F	38	MBO	28 years	Pump	High	Low	High	
6	M	27	WO	2 years	Pen	Moderate	Low	High	
7	M	30	HBO	10 years	Pump	High	Low	High	
8	M	49	HBO	23 years	Pump	Moderate	Low	High	
9	M	68	MBO	50 years	Pen	High	Low	High	
10	M	45	HBO	27 years	Pen	High	Low	High	
11	M	30	HBO	17 years	Pen	High	Low	High	

7.5. Transcripts of interviews

Interview 1

Man:
30, jaar
MBO

Wat gebruik je? Ik gebruik een prikpen.

Geen andere diabetesbehandelingen gehad.

1. Welke eisen stel je aan het apparaat? Belangrijk dat het makkelijk is, draagbaar is, simpel prikje en verder ben ik er dan vanaf Vind je die prikjes vervelend? Prikjes zijn niet lastig of vervelend

2. Verwachtingen van het apparaat: weinig verwachtingen, ik moest er mee leren omgaan. Aanwennen om te spuiten wanneer ik ging eten. Ik verwachtte dat de suiker dan gelijk in orde was, maar je moet er toch wel een beetje inkomen.

3. Over welke behandelaspecten ben je tevreden: handig alleen voor het eten even prikken, en geen apparaat aan mijn lichaam. Bijv. sauna, geen last van een apparaat aan je lijf.

4. Negatieve behandelaspecten: dat je hem niet moet vergeten.

5. Zou je meer tevreden zijn met een pomp? Of reden voor een pen te kiezen: omdat ik niets aan mijn lichaam wil hebben

6. Maakt de pen je verwachtingen waar? Ja, diabetes goed onder controle. Ik kan snel iets bijspuiten als ik iets te hoog zit.

7. Wat zou je van de pomp vinden? – Pomp werkt niet anders dan een pen, je krijgt alleen insuline toegediend en dat is ook het nadeel van de prikpen. De hoeveelheid insuline kan te veel zijn.

V-I-U:

8. Kun je een omschrijving geven van dagelijks gebruik van je pen: ’s morgens eet ik in principe altijd een beetje hetzelfde, zodat ik weet wat ik moet spuiten, 4 eenheden in de morgen. Om de twee uur eet ik even wat, anders wordt de suiker te laag. ‘S middags gewoon een boterham, 4 eenheden, 2uur later weer een stuk fruit. ’s Avonds avondeten, ligt eraan wat je gaat eten. Eventueel bijsturen, 6 of 8 eenheden.

9. Wat zijn de gebruikseisen aan je pen behandeling: het moet simpel zijn.

10. Vergt het apparaat kennis en vaardigheden: ja, je moet wel opletten wat je gaat eten, want je injecteert snel te veel of te weinig. suiker goed blijven meten en dat is wel eennadeel.

11. Vind je de pen gebruiksvriendelijk?: ja, voordeel van de pen. Heel simpel, als je een apparaat aan je lichaam hebt moet je helemaal instellen en die bepaalt hoeveel insuline je krijgt. Met een pen is dat heel anders, je kunt het zelf in de gaten houden en prik je hoeveel je nodig hebt.

- Arts en verpleegkundigen meer dan tevreden, lange termijn waardes zijn heel erg goed. Goed onder controle.

Kunstmatige alvleesklier

12. Waarom zou je willen switchen naar een AP?: omdat ik wel eens last heb van hypo's, dat is erg vervelend. Je prikt snel te veel, vooral met sporten, altijd in je achterhoofd hoe veel ik nou moet spuiten. Het zou handig zijn als je een apparaat hebt wat dat zelf in de gaten houdt.

13. Wat zou je de meest ideale diabetes behandeling: dat ik nergens meer omkijken naar heb, dat alles automatisch geregeld wordt. Qua design: het liefst inwendig.

14. Welke gebruikseisen stel je aan AP: echt goed draagbaar is, op de riem klippen bijvoorbeeld. Niet dat ik bang hoeft te zijn dat ik de naalden uit mijn lichaam trek bij een verkeerde beweging of 's nachts. Een band om de buik, dat ik in ieder geval geen rekening hoeft te houden met die draadjes.

15. Wat doe je zoal in het dagelijks leven: hobby's: fietsen, internet, zingen, hardlopen.

16. Onder welke omstandigheden zou de AP moeten blijven functioneren: sauna gaan, hardlopen, fietsen. Waterdicht zijn.

17. Zijn er momenten in het dagelijks leven dat de pen tekortschiet: altijd een tas bij me dragen, alles moet je meenemen. Moeilijk om de glucosewaarden constant te houden.

18. Als je de AP gaat gebruiken, welke eisen stel je dan aan het apparaat en je veiligheid: volledig moet kunnen vertrouwen dat die voldoende insuline inbrengt, niet dat ie verstopt gaat zitten. Dat ie zichzelf misschien verschoont, of de leidingen schoon houdt.

19. Andere eisen: simpel in gebruik ook met het verwisselen van de naalden.

20. Laatste wat je mee wil geven aan het ontwerp team: niet te veel naalden in het lichaam, niet dat de bedrading in de knoop kan gaan zitten, moet echt gewoon draagbaar zijn (riem, in de zakken). Huidige formaat oke? Dit komt aardig in de buurt, zal ik wel willen dragen. Niet te vaak willen verschonen. Software zou moet simpel zijn, het beste zou zijn alleen een 'aan en uit' knop.

Interview 2

Man:
70 jaar
Lagere school

Later etaleur in Zuid-Nederland en België.

Schilderdemonstraties gegeven in België.

Oorzaak diabetes: ongeluk op de weg na het werk, gunde geen tijd om te slapen. Bij Evergem in België reed ik tegen een stilstaande vrachtwagen op, einde van de etaleurs carrière. Alvleesklier verwijderd, vandaar diabetes patiënt. Later werkzaam geweest bij een sociale werkplaats. Begin van het einde vanwege schommelende bloedsuikers en ongelukken hierdoor. Pijnstillers, hoe meer pijn je hebt hoe meer insuline je nodig hebt.

Ik gebruik een pen.

Product:

- 1. Heeft u andere apparaten gehad? Altijd een pen, vroeger een gewone spuit. Moest je zelf nog uitkoken en naalden moest je zelf betalen. Naaldjes uit Dld, daar waren ze goedkoper en uitkoken in gedestilleerd water. Daarna wegwerpspuiten.

- 2. Sinds wanneer een pen? Al wel 15 a 20 jaar.

- 3. Eisen stelt u aan de pen: bloedsuiker dus de goede waarden houden.

- 4. Is dat makkelijker met de pen dan vroeger met de naalden? Dit is veel makkelijker, je draait aan die pen en je hebt de hoeveelheid. Vroeger had je het flesje en moest je zelf de naald vullen. Omdat u zo slank ben kunt u wel met de kortere naaldjes overweg, maar omdat je al zo lang spuit heb je langere naalden nodig.

- 5. Gebruik van een pen minder pijnlijk? Ja, dat klopt. Maar als je al bijna 50 jaar spuit wordt het steeds gevoeliger, op zoek naar een plek zonder littekens en met een adertje. De ziekte wordt heel erg onderschat. Veel sneller een depressie.

- 6. Voordat u met de pen begon, wat had u voor een verwachtingen? Dat het makkelijk was, het is allemaal wat makkelijker. En altijd een scherpe naald, dat is ook wat waard. Dunnere naalden.

- 7. Kunt u aangeven welke behandelaspecten positief zijn: geen antwoord op geven. Meneer is tevreden. Ik streef naar beter, maar over de pen bent u tevreden.

- 8. Heeft u overwogen om naar een pomp over te stappen: wel eens naar geïnformeerd, maar is afgeraden. Omdat ik geen pancreas meer heb ben ik makkelijker in te stellen. Een

pomp heb je altijd in de weg zitten, in je werk, in alles wat je doet. Sterk afgeraden, mocht er wel over denken of doe het toch maar, maar heb het advies wel opgevolgd. Fijn dat die pen niet aan het lichaam zit.

V-I-U

- 9. Gisteren normaal ziektebeeld? Gisteren op visite geweest, gistermiddag behoorlijk lage bloedsuiker tegen 15u, wazig zien en kan ik niet meer helder denken. Dan is je verstand van slag. Altijd een flesje zoete drank waar veel suiker in zit. Gewoon suiker duurt langer voordat het opgenomen is in het bloed, binnen 5 minuten merk je dat vloeibare suiker werkt.

- 10. Hoe gebruikt u uw pen op een normale dag? Op een normale dag, gebruik: 3x5 kortwerkend en 1x10 langwerkend.

- 11. Denkt u dat het gebruik van de pen veel kennis vereist: Nee. Het is makkelijker geworden, vroeg moest je echt schuin insteken en deze kun je recht insteken. Pen die je moest terugtrekken en op een knopje moest drukken om te spuiten. Huidige pennen zijn allemaal makkelijker geworden.

- 12. Heeft de patiënt kennis nodig van het aanvoelen van zijn bloedsuiker: ja, maar is niet altijd aan te voelen.

- 13. Hoe vaak meet u de bloedsuiker: ook wel eens een dag helemaal niet, maar ook wel eens 4x per dag.

- 14. Wat maakt de pen makkelijk? Draaien voor het aantal eenheden, de manier van insteken, steeds een nieuw, scherp naaldje (altijd steriel). Geen luchtbellen meer.

AP:

- 15. Waarom zou u willen overstappen op de kunstmatige alvleesklier? Niet meer te prikken om te monitoren, dat is een grotere straf dan het spuiten van de insuline. Hij heeft zo'n pijn in de handen en vingers. Ik prik het laatste jaar alleen in de pink, dat is het minst gevoelig. De gevoeligheid is een gevolg van diabetes. Voor mensen met inwendige problemen is het prettig dat het een uitwendig apparaat is. Ja, dan ben ik van het prikken af. Spuiten is nog niet zo erg, maar het meten is zo pijnlijk. Ik knoei en knutsel graag met de handen, en daar word ik in belemmerd door de pijn in de vingers van het prikken.

- 16. Meest ideale behandeling: niet meer hoeven spuiten, geen bloedsuikers prikken, je bent altijd afhankelijk, lange autoritten doe ik ook niet meer. Door de suikerziekte. Als ik zo'n pomp heb kan dat misschien wel weer. Het beperkt heel erg.

- 17. Waarom zou u de AP kiezen in vergelijking tot de pen? je kunt weer meedoen met alles. Ook als je uit eten gaat. We kunnen nooit om 7u uit eten gaan. Ik doe vrijwilligerswerk en daar heb ik volgende maand een diner van, ik kan niet eerder spuiten dan wanneer ik het

eten voor me heb. Wanneer het eten op tafel staat moet ik nog spuiten. Ik schaam me daar niet erg voor, het moet, maar een ander is al aan het eten en ik ben nog aan het spuiten. Lage bloedsuiker of schommelingen in de bloedsuiker hebben geleid tot ongelukken. Daar kun je je erg naar over maken (ook als echtgenote). Het is meerdere malen gebeurd. Je hebt liever dat je dat niet overkomt, als ouder iemand maar ook als vader van de kinderen. Voor jezelf is dat erg vervelend, in mijn werk was dat net zo.

- 18. Zou u de hele dag een kastje met u mee willen dragen? Er komen riemen, tasjes etc. om het apparaat te vervoeren. Dat zijn al hele mooie dingen dat die worden geleverd. Ik zou bereid zijn om het zo te gaan gebruiken.

- 18. Veiligheidseisen: hoeft niet per sé waterdicht. Ik wandel met demente bejaarden, een 20 jaar oudere man. Uiteindelijk door een lage bloedsuiker moest die 20 jaar oudere man je weer terugbrengen. Dat voelt vernederend. Constante en goede metingen.

- 19. Wat wil u meegeven aan het ontwerpteam: Prettige manier om het apparaat te kunnen dragen, dat hij niet aan de buitenwereld wordt getoond. Dat ie een beetje bedekt is. Ik heb altijd mee willen draaien met gewone mensen, met mensen die geen weet hadden van mijn suikerziekte, en mijn suikerziekte geheim willen houden.

Interview 3

Vrouw
61 jaar
MBO

Product:

- 1. Wat gebruikt u nu? Ik gebruik novorapid, kortwerkend en lantus, langwerkend. Met de novopen.

- 2. Heeft u nog andere behandelingen gehad? De eerste langwerkende insuline, direct spuiten. Ben begonnen met de metalen spuit, lange naalden (18mm) en nu met 5mm naalden. De pen die ik nu heb is een hele vooruitgang.

- 3. Welke eisen stelt u aan uw diabetesbehandeling: goede begeleiding, informatie, dat er naar je geluisterd wordt. Het lichaam reageert niet volgens het boekje en dat is het lastige van de diabetes. Je krijgt wel handvatten en daar probeer je naar te leven, maar het is niet makkelijk.

- 4. Welke eisen stelt u aan het apparaat: makkelijk te bedienen, simpel, niet te groot, nauwkeurig in te stellen. Geen wisselwerking laag naar hoge bloedsuikers. Lage bloedsuikers zijn erg vervelend, naarmate je ouder wordt en hoe lang je diabetes het heeft invloed op je en hoe je lage bloedsuiker aanvoelt. Met de jaren steeds lastiger, steeds voorzichtiger om extreme glucose tegen te gaan.

- 5. Heeft u wel eens overwogen om een pomp te gaan gebruiken? Wel eens overwogen een pomp te nemen, maar ik zie de meerwaarde er niet van in. Als ik het zo om me heen hoor, heeft dat niet veel meerwaarde door technische problemen, het spuiten op zich is geen probleem.

- 6. Welke verwachtingen had u van de pen? Veel makkelijker om mee te nemen, niet meer naalden uitkoken. Dat was echt niet leuk, dan is dit een hele vooruitgang.

- 7. Wat is positief van de pen ten opzicht van de pomp: dat je niet continu met iets aan je lichaam loopt. Het verwisselen van de naaldjes geeft nog wel eens problemen, omdat ik het spuiten op zich geen probleem vind en makkelijk mee te nemen is en minder storinggevoelig is dan zo'n insuline pomp.

- 8. Maakt uw huidige behandeling uw verwachtingen waar? (pen+behandeling): werking insuline vind ik heel complex. Heel erg moeten wennen om van langwerkend naar kortwerkende insuline te gaan. Insuline werkt soms heel agressief, ik voel wanneer de insuline begint te werken en dat voelt niet lekker. Het ligt meer aan de vloeistoffen dan aan het apparaat. Met name in het hoofd voelt het erg vervelend. Ene keer werkt het heel snel, en soms zit je in een keer heel hoog. Het is zo onvoorspelbaar, dat vind ik het vervelende van de kortwerkende insuline. Bijregelen is wel makkelijker, en dat je niet meer met die tussendoortjes zit en dat je het eten makkelijker kunt aanpassen. Je bent veel flexibeler dan met langwerkende insuline.

V-I-U

- 9. Hoe gebruikt u uw pen op een normale dag? 'S ochtends, meten en spuiten (9 eenheden novorapid), tussendoor (gegeten), lunch: brood (meten), 's avonds (meten, eten). Minimaal 4x per dag meten, maar als ik me niet lekker voel meet ik vaker. Vind het vervelend dat ik zo vaak moet meten. Het liefst zou ik iets willen hebben dat vlot gereageerd op het lichaam, CGM meet trager dan de lichaamwaarden. Hoge bloedsuiker heeft soms hetzelfde gevoel als een lage bloedsuiker, dus altijd meten door de onzekerheid. Dat vind ik belastend.

- 10.Activiteiten: doordeweeks: 's ochtends opstaan, gesport, dinsdag en woensdagen werk ik, wat huishoudelijk werk. Op het kleinkind passen eens in de week.

- 11. Welke gebruikeisen stelt u aan uw pen+behandeling: pen is heel simpel, clickstar en novo 4. Andere pennen hadden een draaimechanisme dat ik niet vertrouwde.

- 12. Gaat u nog vaak naar het ziekenhuis? 2x per jaar naar de internist. Internist die gespecialiseerd is in diabetes. Oude internist luisterde niet zo en had geen affiniteit met diabetes. Hele fijne diabetesverpleegkundige, goed contact mee, zie ik 2x per jaar.

- 13. Vergt de pen kennis: Nee, de pen zelf niet. Die is erg makkelijk. Wel moet je kennis hebben over de insuline, de werking, hoe om te gaan met koolhydraten en gevoel hoge en lage bloedsuikers. Moet je je als patiënt echt in verdiepen, je kunt niet zomaar 'wat doen'.

Zeker met het beeld van de complicaties ga je er niet onzorgvuldig mee om. Diabetesverpleegkundige ondersteunt in de kennis over de insuline en de werking van de insuline in het lichaam en in jouw lichaam persoonlijk. Echte, persoonlijke begeleiding is beter bij de diabetesverpleegkundige.

- 14. Denk je dat er naast de pen een makkelijkere methode is? Pen is niet zo moeilijk, maar het effect moet beter op elkaar afgestemd kunnen worden.

- Vrijdag een documentaire of transplantatie van stamcellen, patiënt af zijn zou nog mooier zijn. Diabetes is er altijd, 24u per dag, je hebt nooit vakantie. Je kunt dingen niet onbevangen doen en dat maakt het zo lastig.

- 15. Heeft diabetes u geremd in het leven? Als ik geen diabetes had zou ik heel andere dingen doen en anders in het leven staan als ik nu sta, het is nu altijd oppassen geblazen.

AP:

- 16. Wat zou volgens u de meest ideale diabetesbehandeling zijn?: als het zou kunnen zou ik gaan voor de transplantatie van de eilandjes van Langehans. Maar dit is al een enorme vooruitgang, de AP is de tussenstap.

- 17. Bent u bereid te switchen naar de AP? Ja, als ik de mogelijkheid krijg. Om toch eens te kijken hoe het weer is om onbevangen dingen weer te doen. Spontane acties te kunnen doen. Vooral met langwerkende insuline kon dat niet, heb al gespoten en gegeten. En dan doe je het toch niet zo makkelijk. Het lijkt me zo heerlijk om daar geen rekening mee te hoeven houden. Altijd maar afwachten hoe de insuline reageert. Soms sport je en dan keldert de insuline, en de andere keer heb je hetzelfde gedaan en dan zit je huizenhoog en dan denk je ; hoe kan dat nou? Koolhydraten tellen is helemaal geen probleem, nooit moeite mee gehad. Maar het lijkt me wel lekker dat je geen koolhydraten te hoeven tellen en eerst te kijken hoe je ze zit. Het biedt vrijheid. Zwangerschappen ook erg veel last gehad; zelfs in coma geraakt.

- 18. Waarom zou u voor de AP kiezen in plaats van uw huidige behandeling? door de werking ervan. Hij biedt vrijheid.

- 19. Gebruikeisen AP? Makkelijk te bedienen, hij moet gewoon heel makkelijk zijn. Voor jong en oud, ongeacht de leeftijd moet ie voor iedereen makkelijk zijn.

- 20. Onder welke omstandigheden moet de AP normaal blijven functioneren?: ik zwem, dus hij moet waterdicht zijn. Tegen een stootje kunnen.

- 21. Waar schiet de pen tekort? dat het toch lastig inschatten is, met name met sporten, hoe het lichaam gaat reageren op de insuline. Is niet te voorspellen. De ene keer denk je voldoende gegeten, minder gespoten en dan gaat het toch mis. Dat is heel lastig.

- 22. Welke veiligheidseisen: dat het apparaat niet kwetsbaar is in de dingen die je doet. Met de kleinkinderen stoeien, hoe zit zo'n ding aan het lichaam, hoe werkt ie dan? Hij moet goed blijven werken en goed blijven zitten.

- 23. Andere gebruikseisen: hoe compacter, hoe mooier.

- Je belooft iemand gouden bergen, was het maar zo. Buitenwereld denkt vaak het is toch allemaal niet zo moeilijk en erg, je kunt toch spuiten en koolhydraten tellen. Zo simpel is het allemaal niet. Was het maar waar. Het lichaam is heel complex.

- Wat zou het laatste zijn dat u het ontwerpteam wil meegeven? Een beetje vaart erachter. Niet lange termijn en nog 10 jaar duurt.

- Lantus insuline was al een hele vooruitgang, geeft geen insuline pieken meer.

- Overwogen om aan kinderen te beginnen; kunnen we het aan, kunnen we niet aan. Ik zou het heel erg vinden als een van mijn kleinkinderen diabetes zou krijgen. Babies en kleine kinderen, is het vreselijk om diabetes te hebben.

- Je wil graag onafhankelijk blijven, niet aangewezen te zijn op je partner.

- Hoe compacter, hoe beter: inwendig eventueel? Dat zou nog mooier zijn.

Interview 4

Vrouw
46 jaar
MBO

Product:

- 1.Nu gebruik de insuline pomp. In het verleden de normale insuline met een pen.

- 2. Eisen die je aan de pomp stelt? dat je het makkelijker kunt reguleren en stabiel kunt houden. Hij berekent de bolus, dus dat is een stuk handiger, dus ik hoeft niet zelf te rekenen.

- 3. Verwachtingen pomp? zag er eerst tegenop, maar valt 100% mee. Je draagt altijd wat bij je, dat vond ik wel lastig. Uiteindelijk niet lastig, je raakt er steeds meer aan gewend, af en toe stoot je er nog tegenaan.

- 4. Welke behandelaspecten positief: alles is erg positief.

- 5. Geen technische mankementen? Soms, vaak met de insuline inspuiten, dan gaat het mis. Dat ik ergens iets niet goed doe, dat ie een foutmelding aangeeft. 1x verstopte naalden gehad.

- 6. Meer tevreden met pomp dan met pen? Ja, heeft te maken met de goede waarden van de suiker. Met de pen was ik vrij laks, suikers zijn nu stabiel en daar voel je je fijner door.

V-I-U:

- 7. Normale dagactiviteit: huishouden, wassen, strijken. Met de hond wandelen. Geen sport door een wond.

- 8. Gisteren een normaal ziektebeeld, hoe gebruikt u de pomp?: met de maaltijden de suiker meten. De pomp meet, het aantal koolhydraten invoeren die ik ga nemen en hij berekent de bolus die ik dan nodig heb. Dan spuit ik. Voorheen was het altijd een gok, zit ik wel goed, veel hypo’s.

- 9.Vergt de pomp kennis en vaardigheden? in het begin wel, vooral technische dingen. Ik ben stap voor stap met de diabetesverpleegkundige begonnen om de pomp te leren kennen. Inmiddels al een half jaar bezig. Nu wel makkelijk in gebruik, nu je het kent. Ik zie de verpleegkunde wekelijks.

- 10. Apparaat makkelijker dan de pen? Je moet het apparaat even leren kennen, maar daarna is het een stuk makkelijker.

- 11. Pomp gebruiksvriendelijk? Ja, nu wel. Je moet het even leren kennen, maar nu je het kent is ie makkelijk in gebruik en makkelijk te besturen.

- 12. Wat zou nog makkelijker zijn volgens u? AP. Die automatisch berekent wat je bloedsuikers zijn, dat bloedprikken is het vervelende. Je vingers zijn gevoelig, daar heb je last van.

- 13. Welke aspecten van de pomp zijn positief: makkelijk, het kastje en doet de bolus. Ook in openbare ruimtes in het makkelijker. Met de pen ga je meestal naar het toilet, voel je je net als een junkie.

- 14. Pen belemmerd in je leven? Nee, dat niet. Wel vervelend in het openbaar.

AP:

- 15.Wat zou volgens u de meest ideale behandeling zijn?: richting een AP, dat je er niet meer continu mee bezig hoeft te zijn. Hoeveel ga ik eten, heb ik ook echt zoveel trek. Het lijkt me ideaal dat je hier geen rekening meer mee hoeft te houden, kunt doen en laten wat je wil zonder er bij na te denken.

- 16. Bent u bereid om te switchen naar de AP?: Ja, het lijkt veel makkelijker. Alleen al vanwege het bloedprikken.

- 17. Gebruikseisen voor de AP: makkelijk in te stellen, moet tegen een stootje kunnen (ik ben nogal eens onhandig), dat ie goed op je lichaam blijft zitten. Waterdicht is makkelijk en belangrijk. Afkoppelen is lastig.

- 18. Veiligheidseisen: materiaal om hem goed af te plakken, of waterdicht.

- 19. Wat zou je het team nog willen meegeven: een leuk tasje waar die in kan. Hij is nog niet draadloos. Pomp is al wel draadloos, zou wel wenselijk zijn. Daarvoor heb ik voor deze pomp gekozen. Ik kan het kastje wegleggen. Maar dit zou de keuze niet aanpassen, is minder storend dan het meten.

Interview 5

Vrouw
38 jaar
MBO

Product:

1. Andere behandeling naast de pomp: met spuit begonnen, daarna de pen en uiteindelijk overgestapt op de pomp

2. Gebruikseisen pomp: draadloos. Hele grote pre bij mezelf. Ik heb een pompje geplakt op mijn buik, daar zit de insuline in en stel je voor. Daarnaast een apparaatje dat draadloos met de pomp in verbinding staat en waarmee je de bolus kunt geven.

3. Verschil pomp/pen: scheelt heel veel prikken, vond ik heel erg belangrijk. Ik vind het zelf makkelijker, niet zoveel spullen bij je, één etuitje met alle dingen. Ik voel me vrijer.

4. Verwachtingen van pomp bij begin?: gewoon dat ik me vrijer zou voelen. Pen naar pomp gaf al een stuk heel stuk vrijheid door geen injecties, infuus bleef langer zitten. Bij wat ik nu heb is na 72u is de batterij hierbij leeg en moet ik hem vervangen. Dus veel minder handelingen.

V-I-U:

1. Wat doe je op een normale dag: huismoeder, heel erg druk met m'n dochter. Hobby's: geen sport, foto's maken en thuis werken achter de computer.

2. Was Gisteren een normale dag? Ja.

3. Hoe gebruik je de pomp op een normale dag? Zodra ik wakker wordt begin ik met bloedprikken, als de waarde hoger is dan streefwaarde geef ik de bolus erbij. Ik prik tussen de 8 of 10 keer per dag, reageer ik door extra te eten of bij te bolussen. Bloedprikken? Erg lastig, vervelend. Ik stop er liever vandaag dan morgen nog mee.

4. Gebruikseisen: dat ie doet wat ie moet doen. Allerlei techniek zit erin, ik heb zeker op mijn armen nog wat littekenweefsel en daar reageert hij op. Dus het zou fijn zijn als de pomp op meerdere plekken gedragen kan worden. Littekenweefsel blokkeert de doorgang van de insuline.

5. Kennis en vaardigheden? Je moet wel weten waar je mee bezig. Automatisch wordt alles berekend, maar je moet je hoofd er bij houden met de activiteiten die je gaat doen, en komt het overeen met je diabetes plan en je bolussen. Je moet er wel verstand van hebben.

6. Gebruiksvriendelijk? Ja, makkelijk te besturen.

7. Denk je dat er nog een andere makkelijkere behandeling is? Er is een sensor die het bloed meet waardoor je niet meer hoeft te prikken, maar wordt nog niet vergoed.

8. Positieve punten pomp: draadloos

9. Negatieve punten: ik kan niet zelf bepalen of ik het pompje langer of korter kan dragen. Ik kan hem ook laten zitten zonder nare huidreacties, maar ik moet hem elke 72u afkoppelen vanwege de batterij.

AP:

1. Ideale behandeling: de AP.

2. Bereid te switchen? Ja. Ondanks dat draadloos voor mij het ideale is streef ik meer naar minder schommelingen in mijn bloedwaarden om mijn complicaties te verkleinen. Op dit moment heb ik veel schommelingen en moet ik zo vaak bloedprikken.

3. Gebruikseisen?: dat ie doet waarvoor die gemaakt is. Dat wanneer een lage bloedwaarde geeft dat ie glucagon geeft, en dat wanneer de waarde te hoog is dat die insuline afgeeft. Hij moet tegen een stootje kunnen, mijn dochter raakt mijn pompje nu ook regelmatig en die blijft netjes zitten dus er moet een goede plaklaag onder zitten.

4. Veiligheidseisen?: als er een verstopping is dat ie dan meteen een alarm afgeeft en dat je hem ook zelf kan vervangen.

5. Andere gebruikseisen?: uitlezen. Het pompje meet alles, we zijn als diabetes patiënten allemaal gewend om controle te hebben. En nu moet je de controle laten gaan. En het zou dus fijn zijn om hem zelf uit te kunnen lezen om hem te kunnen controleren.

6. Laatste ding meegeven dat je de ontwerpers wil meegeven?: het oog wil ook wat. Maak er geen echt medisch product van, een kleurtje of een plakkertje. Het is geschikt voor kinderen tot volwassenen en mensen vinden het leuk.

7. Zoals je hem nu ziet, zou je hem willen dragen? Ja, wel wat aan de grote kant maar mijn complicaties staan op de eerste plek.

Interview 6

Man
27 jaar
WO

Product:

1. Wat gebruik je nu? Pen. Novorapid, 5/6x daags, levimeer 1x daags. Ik was bezig om naar een pomp te werken, maar dat is allemaal wat lastiger en gecompliceerder proces. Stressvolle situatie achter de rug, en dus geen stabiele balans om de pomp op te laten inmeten.

2. Gebruikseisen pen: niet zoveel keuze, ik volg blindelings mijn verpleegkundige. Meest belangrijkste voor mij dat ik erg dunne naaldjes had ivm mijn angst voor naalden. Er moet insuline in, als er een betere manier is neem ik het gelijk. Pillen waren niet sterk genoeg. Pen doet het prima.

3. Verwachtingen van je pen: ik dacht dat ik door een hel ging, dat ik een naald in mezelf moest steken wat ik niet kende. Er was niks wat me hier op voor kon bereiden. Het heeft de eerste keer 1.5uur geduurd om een naald in mijn been te drukken. De barrière om dit te overkomen was het moeilijkste. Het heeft lang geduurd voordat ik een pen in me kon steken.

4. Positieve punten pen: geen plakkertje of apparaatje aan mijn lichaam. Straks komt de zomer eraan, ik zit er niet op te wachten met zo'n apparaat op mijn lichaam. Ik kan gaan doen en laten wat ik wil, nadeel is dat ik me 5x moet prikken. Ik vind het erg vervelend dat ik bulten op mijn been krijg als ik niet goed spuit. Ik moet oppassen voor blauwe plekken en insuline verhardingen. Ik ben wel bereid om iets aan mijn lichaam te plakken, ik heb bijna geen symptomen van diabetes. Mijn waarden reguleren is erg belangrijk. Hoge waarden leiden bij mij tot een kort lontje en woorden die ik niet meen. Die pomp zorgt voor meer constantere waarden en dan voel ik me veel beter. Gezondheid gaat voor mijn subjectieve belangen.

5. Pen maakt verwachting waar? Ik geloofde niet dat ik insuline nodig had omdat ik me lekker voelde, maar toen ik eenmaal de insuline begon te gebruiken begon ik effecten te merken van normalere bloedwaardes. Ja, de pen en de insuline werken en ik had nooit verwacht dat ik me beter zou kunnen voelen.

V-I-U

1. Wat doe je op een normale dag?: sta op, ga werken (8-17), ga ik naar huis, 's avonds iets ondernemen met vrienden en dan slapen. Wat straks gaat gebeuren is dat ik 3 of 4x per week weer sporten, wel onder begeleiding van een diëtist. In de weekenden ga ik vaak met vrienden wat doen, of mijn vriendin komt. We houden het allemaal lekker rustig.

2. Gisteren dag met normaal ziektebeeld? Ja, want ik was vrij.

3. Hoe gebruik je de pen dan? Standaard ontbijt, lunch en diner. Drie momenten dat ik standaard moet spuiten. Sinds kort spuit ik na mijn maaltijd ipv voor mijn maaltijd. Tussen 3 en 7 eet ik een boterham om een hypo te voorkomen, tenzij ik honger krijg, dan spuit ik me. Ongeveer 22u krijg ik honger en spuit ik me licht in. Lichaam reageert wisselend op die laatste spuit.

4. Kennis en vaardigheden behandeling? Ja, achteraf wel. Je moet je eigen lichaam snappen en weten hoe je eetpatroon en insuline werken. Elke diabetespatiënt die niks van z'n eigen diabetes afweet moet zich echt gaan verdiepen om complicaties en kwalen te voorkomen. Je moet eerst je ziekte begrijpen voordat je ook goed je insuline kunt inspuiten.

5. Kennis en vaardigheden nodig voor het gebruik van de pen?: in het begin wel. Ik ben erg nieuwsgierig en ik moet overtuigd zijn over zo'n pen. Dus in het begin had ik veel vragen maar nu niet meer. Ze heeft me alles uitgelegd, werking van de ziekte tot aan de werking van de pen. Ik snapte het allemaal niet.

6. Pomp makkelijker in gebruik? Nee, dat denk ik niet. Misschien aan het einde, maar in het begin niet. Er zijn verschillende pompen en zorgverzekeraars doen moeilijk om zo'n ding te krijgen. Nu weet ik hoeveel ik moet spuiten voor 2 boterhammen met kaas. Na al die tijd ben ik helemaal gewend wat wat doet en om zo'n pomp te mogen gebruiken moet ik wegen, wat het eten inhoudt, mijn plakje kaas moet ik wegen. Delen door 2, aantal koolhydraten die moet ik invoeren in het apparaat, en uiteindelijk gaat hij me vertellen hoeveel ik moet inspuiten en daar moet ik dan maar op vertrouwen. En dit is alleen maar voor een broodje kaas. Dus in het begin is dat veel moeilijker.

7. Ga je vertrouwen? Ja, wanneer die mij heeft overtuigd. Ik heb liever een sensor die mij vertelt wanneer ik een hypo krijg, dan een meter die mij waarden geeft. Als die sensor accuraat is vind ik het niet belangrijk hoe mijn waarden verder zijn, zo gauw ik maar bericht krijg zodra ik een hypo (of hyper) krijg.

8. Pen gebruiksvriendelijk? Ja, kind kan de was doen, maar het kan niet goed zijn dat ik 10 eenheden insuline in één keer spuit. Ik voelde in het begin de insuline echt door m'n lichaam gaan.

AP:

1. Wat zou je ideale behandeling zijn? Meerdere. Ik heb me neergelegd bij een semi en complete oplossing. Er komt een spuit over 10 jaar, een vaccin, waardoor je patient-af bent doordat de kunstmatige alvleesklier weer geactiveerd wordt. Ik ga dat ook wel meemaken, maar dat is lange termijn. Daarnaast stamceltherapie, geloof ik ook wel in, maar duurt ook lang en moet goed zijn uitgetest. De AP is veel dichterbij, maar dit is een meer een droom (vanwege de kosten). Laatste tussenoptie is een priknaald in mijn arm waar ik mijn telefoon langs houd en waardoor je waarden als het ware gescand worden. Als ik mijn hypo/hypers maar kan wegnemen, dat is alles wat ik op dit moment zou willen.

2. Bereid te switchen? Ja, absoluut. Geen twijfel. Ik heb mijn hele leven zonder diabetes geleid, en dat waardeerde ik minder. Ik ben nu begonnen met een gezonde levensstijl. Het zou fijn zijn dat ik even weer diabetes af ben en niet hoef te prikken. Ik moet wel overtuigd worden dus ik blijf wel in mijn vingers prikken.

3. Gebruikseisen AP: geen naalden. Ik snap dat er allerlei plakkertjes bijkomen en een apparaatje bij hoor. Ik heb weinig eisen. Nee, ik ben juist gestopt met MMA om zo eventueel een insulinepomp te krijgen. Ik doe verder geen gekke dingen. Geen specifieke eisen. Ik moet me normaal kunnen bewegen. Het zou fijn zijn dat mijn shirt er overheen kan of dat hij achter bij mijn riem kan.

4. Schiet je pen ergens tekort? Ja, maar dat heeft te maken met een stukje discipline. Als je druk bent vergeet je gewoon te eten, meten en te spuiten. Dat kan meerdere keren voorkomen in een week, ik probeer me er altijd aan te houden, maar door de stress en drukte vliegen mijn waarden alle kanten op. Met stress heb je meer of minder insuline nodig, en dan zit je nog aan je hyper/hypo. Die situaties zijn niet fijn en niet te reguleren door het gebruik met de pen.

5. Wat zou het laatste zijn dat je zou willen meegeven aan de ontwerpers van de AP? Ga zo door, maak het rendabel. Zorg dat het zo toegankelijk mogelijk wordt voor iedere diabetes patiënt.

Interview 7

Man
30 jaar
HBO

Product:

- 1. Diabetesbehandeling: pomp

- 2. Heb je ook andere behandelingen gehad?: Tot laat vorig jaar insuline gespoten, daarvoor al een keer geïnformeerd naar een pomp maar een pomp zou volgens de internist niet leiden tot een aanzienlijke verbetering. Eind 2013 in gaan verdiepen en sinds maart 2014 heb ik een pomp. Ik wou dat ik er 10 jaar geleden aan was begonnen. Tijdens voetballen stijgt mijn bloedsuiker door de spanning, ik zou dus een pomp willen dragen tijdens een wedstrijd, en er was één draadloze pomp op de markt en die ben ik gaan dragen en dat bevalt heel goed.

- 3. Gebruikseisen pomp? Draadloos, ik moet er verder geen last van hebben in het gebruik. Normaal mogelijk kunnen leven en alles kunnen doen (zwemmen, douchen). Hij is ook waterdicht en kan 3 dagen lang op je lichaam blijven zitten.

- 4. Verschil pomp / pen?: ik spoot lantus en novorapid, op het moment dat je die langwerkende insuline in je hebt blijft ie ook zitten. Als je dag er dan toch anders uit gaat zien kun je geen correcties meer aanbrengen, en dat kan met de pomp wel. Insuline pen is per eenheid en bij de pomp kun je met een tiende insuline toedienen, dus de pomp is een stuk nauwkeuriger en kan afgestemd worden op je dagelijkse behoefte. Resultaten waren in het begin een heel stuk beter, maar door de automatische piloot werden de resultaten iets minder.

- 5. Wat waren je verwachtingen van de pomp?: ik wilde flexibeler zijn. Ik had redelijk vaak uitschieters, die leidde naar een andere uitschieter. Dat was de voornaamste aanleiding om te beginnen met de pomp.

- 6. Positieve aspecten pomp? flexibel, nauwkeurigheid, minder vaak te spuiten. Vervelend van het spuiten; ik ga nog wel eens uit eten voor mijn werk en dan moet je toch spuiten aan tafel, nu kun je het met een kastje doen. Nu eenmaal in de drie dagen een prikje. Naalden zijn toch ongemakkelijk.

- 7. Negatief? geen CGM, ik meet minimaal 4x per dag. Het is niet pijnlijk, maar wel vervelend; je moet eraan denken en plannen om je activiteiten heen, het maakt je onbewust onzekerder. Je bent iedere keer op zoek naar de bevestiging.

- 8. Controle uit handen geven met pomp? Nee, vind ik meevallen. Ik bedien de pomp helemaal zelf. Ik heb niet het idee dat ik geen controle meer heb.

- 9. Betrouwbaarheid en technische mankementen? Nee. In het begin had ik vaak een pompstoring, maar dat kwam meer door mijn onwetendheid. Korte lijntjes met de leverancier. 2x een storing gehad die niet aan mij lag. Het heeft vooral met je eigen gedrag te maken. Als je eenmaal goed weet hoe je ermee om moet gaan kan er weinig misgaan.

- 10. Beperkingen pomp?: grootste beperking. Ik voetbal, dus een keer worden er grappen over gemaakt. Mensen blijven kijken door die pomp. Eigenlijk doet het me niks, maar je ziet mensen kijken en dat vind ik wel het meest vervelend. Inwendige behandeling zou beter zijn. Het is niet zwaar, je hoeft je echt niet zielig te voelen, maar je hebt toch wel een beperking. Er zitten beperkingen aan je leven en dan moet je dat maar accepteren.

- 11. Nog een betere behandeling beschikbaar op de huidige markt? Pomp met continu meting. Daar kom ik niet voor in aanmerking, daarvoor gaat het nog te goed met me.

V-I-U

1. Was het gisteren een normale dag met een normaal ziektebeeld? Nee, door toneel spelen te veel spanning dus een te hoge waarde.

2. Normale dag gebruik pomp: 's ochtends word ik wakker, even meten, goede waarde. Ontbijt, altijd hetzelfde aantal koolhydraten (is vast ingesteld in de pomp). Dan ga ik naar het werk, 10.00: koffie + mueslireep, 12.30: lunch (vaste aantal koolhydraten). Middag een moment dat suiker gaat stijgen, te veel koekjes en snoepjes op kantoor. 15/15.30: fruit, bolus ik ook. 's Avonds 17.30/18: bolus verschillend, afhankelijk van het eten en hoe hoog ik zit. Voor de maaltijd meet ik ook. Overdag meet ik alleen als ik een afspraak ergens heb. 's Avonds sport ik of speel ik toneel, voordat ik naar bed ga meet ik ook altijd. 3 vaste meetmomenten, plus 2 flexibele momenten.

3. Wat zijn je gebruikseisen voor de pomp? belangrijkste vind ik dat ik er fysiek geen ongemak van heb. Hij is niet zwaar en je bent eraan gewend. Het liefst zo pijnloos mogelijk, hij moet goed blijven zitten. Als je huid klammer is blijft de pleister niet goed zitten, met zweten wil die ook nog wel eens loslaten. Als ik hem eraf trek moet ie niet te veel pijn geven. Zo min mogelijk zichtbaar, draadloos is echt heel belangrijk. Ik zou niet kunnen voorstellen dat ik een pomp heb die met draden aan de patches zit.

4. Vergt het apparaat veel kennis/vaardigheden? Nee. De fabrikant is bij mij thuis geweest om hem uit te leggen. Eerst een paar dagen uitgetest met een zoutoplossing en daarna met echte insuline. De software is was complex en te uitgebreid. Software is niet alleen voor de insulinepomp maar ook voor andere apparaten. Het programma kan veel simpeler. Je hebt helemaal niet zo heel veel dingen nodig, de kunst is om het simpel te houden.

5. Pomp gebruik meer kennis van eigen ziekte dan met pen? Ja, absoluut. Je moet precies het aantal koolhydraten inschatten. Dat is bij het pomp veel langer dan wanneer je insuline spuit. Je leert veel beter naar je lichaam luisteren door je diabetes en je laat je pomp daarop anticiperen. Het eist bewustwording. Ik kan me ook niet voorstellen dat er geen stukje bewustwording in zou zitten. Misschien is het wel heel goed om eerst te gaan spuiten, dan pomp en dan de AP. Belangrijk voor de behandeling.

6. Behandeling suikerziekte is niet alleen 2x per jaar verpleegkundige en 2x per jaar internist. Ook voeding, lectuur, zelfeducatie.

7. Hoe was het om diabetes te hebben in je jeugd jaren? Ik had de klassieke symptomen maar je hebt niet het idee dat je iets mankeert. Ik was heel ziek maar was me er zelf niet bewust van. Direct geaccepteerd en nooit als een probleem gezien. Ik ben wel heel blij dat ik de puberteit heb overgeslagen met mijn diabetes. Ik kan me voorstellen dat de puberteit en het bijbehorende gedrag negatief zou zijn voor je diabetes en het ziektebeeld. Het uitgaansgedrag veranderde toch na mijn twintigste, voor suikerpatiënten is hetzelfde patroon elke dag het meest ideaal. Daar paste uitgaan niet echt in. Ik was nooit erg uitbundig dus het was niet zo lastig om mijn leven erop aan te passen. Je moet er wel aan denken en je spullen meenemen als je met je vrienden ergens naartoe gaat. Altijd dextro bij je hebben, dus een jas met veel zakken of een tas nodig. Als je uitgaat en je bent veel aan het bewegen dan daalt je suiker ook sterk, dus je moet altijd kunnen anticiperen.

AP:

1. Wat zou de meest ideale behandeling voor je zijn?: de AP. Of de alvleesklier weer aan de praat krijgen en dus patient-af zijn.

2. Ben je bereid te switchen? Het is allemaal nog wel vrij veel, maar het zou mooier zijn als die vier pleisters in één ding zouden zitten, en draadloos. Weet niet of het nu al tijd is om te switchen, het draadloze aspect van de pomp is erg positief en of je dat al op wil geven is lastig.

3. Waarom zou je wel voor de AP kiezen? continue gemeten worden, nu beïnvloed ik het functioneren van mijn lichaam, de AP vloeit samen met mijn lichaam. Puur om de behandeling zou ik direct ja zeggen. Uiteindelijk gaat de gezondheid voor, als je bloedsuiker waarden naar beneden gaan leef je beter en daar gaat het uiteindelijk om.

4. Waarom zou je niet voor de AP kiezen? visuele aspect, dat ie nogal aanwezig is. Het valt me 100% mee. Kan ik hiermee voetballen bijvoorbeeld? Kan ik zwemmen met m'n dochter?

5. Gebruikseisen: contactsporten kunnen blijven doen, kunnen zwemmen, visueel zo min mogelijk zichtbaar. Al die vier patches in één grotere pleister, lichamelijke inspanning in zijn algemeenheid. Vooral met zweten, de pleisters moeten goed blijven zitten. Als je timmerman bent moeten die pleisters wel blijven zitten als je transpireert. Als ik slaap, hoe ik ook leg of waar ik ook lig, dat moet goed blijven zitten. Het mag de bewegingsvrijheid niet te beperken. Dragen op meerdere plekken, ook ivm littekenweefsel, verdikking etc. Op het moment dat je het kastje zelf niet zitten ben je er minder mee bezig en ben je je er ook minder bewust van dat anderen naar je kijken.

6. Veiligheidseisen: Standaard inbouwen, signaal om extra meetmoment in te lassen om de meetapparatuur in de AP te controleren.

7. Laatste ding meegeven aan productteam: hou het simpel, in gebruik, in uitlezen, in verschijningsvorm, in grootte. In de breedste zin van het woord.

Interview 8

Man
48 jaar
HBO

Product:

1. Wat gebruik je? Pomp + apart meetapparatuur

2. Heb je ook andere behandelingen gehad? Hiervoor een pen gehad, 10 jaar geleden. In het begin met losse spuiten en losse naalden.

3. Wat vind je het voordeel ten opzichte van de pen? Gemak. Niet elke dag injecteren, basale hoeveelheid die ingesteld is. Het scheelt wat handelingen en minder fluctuaties.

4. Gebruikseisen voor de pomp?: gemak om makkelijk bij te vullen, katheter te zetten. Dat je dat allemaal niet handmatig hoeft te doen. Aantal jaren geleden meegedaan aan een onderzoek voor de meetapparatuur, maar die was te traag en daar ben ik van afgestapt. Dus toch overgestapt op aparte meetapparatuur. Makkelijk aan te passen aan verschillende tijdzones en makkelijk af te koppelen (niet waterdicht).

5. Wat waren je verwachtingen van de pomp toen je ermee begon?: verwacht dat mijn waarden lager zouden zijn, het is wel beter geworden maar niet wat ik in het begin had verwacht. Maar ik heb er veel meer vrijheid door gekregen, en daardoor ga je vaker op de automatische piloot.

6. Wat zijn de negatieve aspecten van de pomp?: niet gebruiksklaar, alles zelf vullen, oppassen luchtbellen etc. Niet handig als je op reis bent.

7. Zou je meer tevreden zijn als je een andere behandeling zou gebruiken?: nee.

8. Geen technische problemen en geen verstopte naalden.

V-I-U

1. Wat doe je zoal op een normale dag?: ik werk op kantoor. ’s ochtens, 6u opstaan, 7.15 naar de trein in Zwolle, half uur trein Amf. Tot een uur of 5 op het werk, dan trein terug. 2x per week sporten. In het weekend heel verschillend, graag naar het voetbal toe en ga heel veel mee naar allerlei culturele activiteiten waar mijn vrouw bij betrokken is.

2. Hoe gebruik je de pomp dan?: nee, ik hoef niets aan m'n pomp te doen. 1x in de 3/3.5 dag moet ik hem bijvullen. Wel meten (5/6 keer), en eventueel bijspuiten als je iets extra's eet. Het meten vind ik niet vervelend, maar ik denk als ik er van af ben dat ik dan pas zie hoeveel moeite het is.

3. Gebruikeisen pomp?: technisch geen mankementen, op tijd aangeven dat ik moet bijvullen/batterij is leeg. Flexibel zijn en aan mijn eetpatroon aanpassen. Systeem dat ik kan afkoppelen en een stukje plastic erop. Hij hoeft niet waterdicht te zijn.

4. Kennis/vaardigheden? Ja, niet zozeer de technische handelingen (is aan te leren), maar je moet wel weten hoe je met je diabetes met je bezig bent. Wat maaltijden met je doen, lichaamsbeweging,stress, hormonen etc. Ik heb nu 33 jaar diabetes dus ik weet nu heel veel over mijn diabetes. Ik heb in het begin heel veel cursussen gevolgd met de diabetesvereniging. Als je afhankelijk bent van een ander is het een onding.

5. Diabetesverpleegkundige? Tegenwoordig minder. Ik kwam er zelf achter dat de kennis van de internist/verpleegkundige niet meer was dan de kennis die ik heb. Diabetesverpleegkundige zouden zelf ook diabetes moeten hebben.

6. Pomp gebruiksvriendelijk? Ja, als je hem eenmaal kent is hij gebruiksvriendelijk.

7. Hoe heb je het ervaren als jongere? Ik heb mezelf altijd gelukkig geprezen dat het aan het einde van de puberteit was. Geen last van de hormonen. In het begin was het vrij makkelijk want toen werd er voor je besloten. Eet maar wat minder suiker, ga dan toch maar spuiten. Het eerste wat ik wilde is kennis over mijn diabetes en zelfregulatie. Ik vind het ontzettend naar om afhankelijk te zijn van een ander.

8. Ervaren als een sociale beperking? Nee, toen ik het kreeg toen zeiden ze stop maar met sporten, dat is het stomste advies wat ik ooit heb gehad. Als je naar het buitenland wil moet verklaringen hebben, je spul allemaal mee. Je moet de insuline koel houden (lastig in warm land). Het zijn dingen die je allemaal wel weet maar die het wel lastiger maken. Maar het beperkt mij niet. Alleen in het diepzeeduiken. Eigenlijk kun je alles doen.

AP:

1. Meest ideale behandeling: dat je er niet meer bij hoeft na te denken. Als de AP doet wat hij belooft, kun je weer gaan sporten/niks doen/eten wanneer je wilt. Je kunt alles doen wat je wil, als mens vrijheid hebt dan ga ik overstag. Technisch moet het apparaat stabiel zijn, betrouwbaar zijn. Als je kijkt naar de behandeling is dat het beste wat je kunt wensen. Je voelt je daardoor ook beter. Je functioneert in algemene zin gewoon veel beter.

2. Gebruikseisen?: Nee, dat zijn allemaal bijzaken. Hij zal niet te zwaar moeten zijn, hoe kleiner hoe beter. Als ik ga sporten en ik merk halverwege dat ik een dalende bloedsuiker krijg, en nu heb ik geen apparaatje dat dit kan corrigeren tussentijds, dus nu moet ik

tussentijds iets eten of een sportdrankje nemen. En dat soort dingen zijn straks verleden tijd. Het moet makkelijk draagbaar zijn. Goede plakker.

3. Veiligheidseisen?: hij moet tegen een stootje kunnen. Een beschermhoesje zou handig zijn. Hij moet niet breekbaar zijn. Je moet een keertje kunnen vallen (OV, onverwacht remmen in een drukke bus oid), dan moet ie niet meteen ophouden. Waterdichtheid, waterafstotend.

4. Waar schiet je pomp nu tekort?: De betrouwbare meting. De techniek is er wel in de zin dat er draadloze communicatie en sensoren zijn maar het vertraagt gewoon veel te veel en daardoor loop je achter de feiten aan.

5. Een laatste ding meegeven: keep it simple. Hou het makkelijk, waarvoor het apparaat daadwerkelijk gemaakt is. Die bloedsuikerwaardes zijn helemaal niet meer belangrijk, het apparaat handelt voor me, dat is de grote winst. Geen toeters en bellen. En liever gisteren dan vandaag.

Interview 9

Man
68 jaar
MBO

Product:

1. Welk apparaat gebruikt u nu? Pen + meter

2. Heeft u ook andere behandelingen gehad?: vroeger, metalen glazen spuit die je moest uitkoken.

3. Gebruikseisen? makkelijk hanteerbaar, zo mee kan nemen zonder dat je het bij iedereen moet laten zien. Mensen mogen het wel zien maar ik heb geen zin in vragen. Meter: dat hij goed meet, goede waarden geeft. Af en toe heb ik wel eens een rare meting. Makkelijk te gebruiken, het liefst dat alles in één apparaat zit.

4. Hoe ervaart u de pen ten opzicht van het de ouderwetse spuit?: de pen is een vooruitgang omdat hij al gevuld is. Geen luchtbellen meer. Meteen klaar voor gebruik. Ik heb hele korte naaldjes, dus ook lang niet zo pijnlijk.

5. Verwachtingen pen: een vooruitgang ten opzichte van de glazen spuit. Het was direct goed. Betere waarden.

6. Positieve aspecten pen: handzaam, kunnen weggooien als ie leeg is. Makkelijk te gebruiken. Verschil van kleur zodat het afleesschermpje duidelijk is vanwege het slechtere zicht van diabetici. Het beste is als ik hem niet meer nodig heb.

7. Negatieve aspecten pen: geen slechte dingen van de pen

8. Meer tevreden met pomp? Nee, weet ik niet. Vind het niet prettig dat er wat aan mijn lichaam hangt. En zoals ik het nu met mijn pen kan regelen maakt het niet zoveel uit. Het enige wat ik wel zou willen is een pomp met CGM.

V-I-U

1. Hoe gebruikt u uw pen op een normale dag?: als ik wakker word dan gaat de langwerkende insuline erin, na het eten; kortwerkend. Lunch; kortwerkend. 's Avonds met eten ook kortwerkend. Voor het naar bed gaan ook langwerkend. Meten bloedsuiker: minimaal 4 a 6 keer. Ligt eraan hoe ik me voel. Als ik het niet vertrouw prik ik vaker.

2. Gebruikseisen pen?: handzaam, makkelijk.

3. Kennis/vaardigheden?: Vergt geen kennis en vaardigheden. Als je ermee begint moet je de plug goed aanduwen omdat er altijd in het begin iets lucht in zit. Training verpleegkundige? Nee, niets.

4. Verpleegkundige kom ik niet. Ik kan haar meer vertellen dan zij mij. Het zijn theorie mensen, maar ik heb meer kennis. Als ik ze nodig heb kom ik er, en anders zien ze me niet. Wel 2x per jaar naar de internist.

5. Hoe heeft u dat ervaren als jongere?: altijd als een last ervaren, je kon niks meer ineens en je moest overal op letten. Je snapte het niet. Het heeft lang geduurd voordat je meer kennis had omdat er geen ondersteuning was. Het kwam allemaal niet zo precies. Het zal allemaal niet zo goed geweest zijn voor de ziekte en het ziektebeeld. Pas vanaf je 40ste kon je het een beetje meten. Er zijn zoveel factoren die je bloedwaarden beïnvloeden, vooral stress. Sociaal gebied last gehad? Ja zeker. Je kunt niet meer zo meedoen als dat je eerder deed. Je had ook nog eerdere keer hypo's, daar had je geen controle op. Men begreep ook niet wat een hypo was.

AP:

- Ampullen toch wel een probleem, zwaar en maakt het apparaat ook groot.

1. Wat zou de ideale behandeling zijn voor u?: nergens meer last van hebben, het zou mooi zijn als hij inwendig zou zijn.

2. Gebruikseisen? ik zou zo niet gaan zwemmen, met zo'n apparaat op mijn lichaam. Ik zou onbezorgd mijn gang moeten kunnen gaan. Het houdt zo op allemaal dat meten en eventueel weer bolussen of eten. De eeuwige aarzeling; wel of niet ingrijpen. Is het te hoog, maar gaat ie dan zakken? Hoe op te reageren? Allemaal onzekerheden en een hoop rompslomp. Hij moet tegen een stootje kunnen, makkelijk draagbaar zijn. Met een riem/klittenband/klip.

3. Bereid om te switchen? Ja, natuurlijk. Omdat ik hoop dat ik dan niet meer hoef te spuiten, dat hij het dus voor me gaat regelen.

4. Wat meegeven aan het productteam? Opschieten. Hij ziet er nog wat groot uit, mag kleiner. Het liefst ook zonder slangetjes. Als je al 50 jaar diabetes hebt wil je graag een keer wat revolutionairs hebben dat het ongemak toch nog een beetje kan verlichten.

Interview 10

Man
45 jaar oud
HBO

Product

1. Welke behandeling heb je? Ik gebruik een meter en een pen.

2. Andere behandelingen gehad in het verleden? Ook nog de naalden meegemaakt. Pen is al wel een verbetering tov de naalden; veel meer werk.

3. Gebruikseisen pen:

a. Extra eis: ik had voor twee maanden terug een hele hoge bloedsuiker, misschien voelde ik me niet helemaal happy. Het bleek dat mijn langwerkende ampul in mijn kortwerkende ampul past. Dus het moet voorkomen kunnen worden dat de langwerkende en kortwerkende ampul niet

b. Compact zijn, makkelijk te bedienen daar voldoen ze wel aan.

4. Verwachtingen pen: uitkomst tov de naalden. Je moest al die naaldjes altijd meenemen, dus heel veel vragen van publiek.

5. Positieve aspecten:

a. Ik heb heel lang in de buik gespoten, te veel plekken beschadigd door veelvuldig spuiten op dezelfde plek. Toen bleek dat ik verdikkingen heb door het spuiten. Ik had het zelf beter in de gaten moeten houden, maar dat is dus wel een nadeel van het spuiten. Nu probeer ik zo veel mogelijk te varieren.

b. Positief: gemakkelijk, makkelijk mee te nemen, handbaar.

6. Prikken vervelend? Ik ben bang voor prikken, 14 dagen in het ziekenhuis gelegen om het te leren. Het is gewoon geworden. Verder geen last van het prikken, het hoort bij de dagelijkse bezigheden.

7. Meer tevreden met een andere behandeling? Ik heb wel vaak gedacht om over te stappen op een pomp, maar voortdurend mitsen en maren. Ik denk wel dat ik nog wel wat

stabieler ingesteld kan worden. Maar de maren hebben de overhand. Met de pomp loop je voortdurend met iets aan je lichaam maar de hypo's voorkom je er niet mee. In het geval van de AP voorkomt wel de hypo's. het houdt me tegen dat je vrijheid ingeperkt wordt door het bij je dragen van een apparaat. Dat remt me.

V-I-U:

1. Gisteren dag met normaal ziektebeeld: Ja.

2. Normale werkdag: product manager bij Nefit, op kantoor, afspraken/vergaderingen staan. Op het werk weet iedereen dat ik het heb. Anders gewoon werk achter de pc. Hobby's: klussen aan mijn oude huis, vooral in het weekend.

3. Hoe gebruik je de pen op een normale dag: 's ochtends, standaard ritueel: ontbijt + spuiten. 's Ochtends (12), 's middags (14) en 's avonds (14-18). Extra bolus als er iets speciaals is. Meten: 4 a 5 keer op een dag. 20.00: langwerkende insuline, doe ik bewust wat eerder omdat ik niet zoveel discipline heb in het naar bed toe gaan.

4. Vergt kennis/vaardigheden? Nee, als je het apparaat kent en hebt ingesteld is het heel eenvoudig. Meter instellen lukte niet, dus diabetesverpleegkundige gebeld en ging het ook makkelijk. Veel contact met verpleegkundige? Nee, 2x per jaar naar de internist, maar ik ga niet 2x per jaar naar de verpleegkundige (varieert als ik haar nodig heb).

5. Gebruik pen, belangrijk te weten hoe je diabetes werkt? Ja, heel belangrijk dat je weet wat je doet. Mijn idee is dat ik wel weet wat ik moet doen.

6. Apparaat gebruiksvriendelijk? Ja, maar touch screen van de meter is niet handig met een hoesje erom heen.

7. Andere behandeling nog makkelijker? Ja, vast en zeker. Hoe en wat weet ik niet.

8. 18 jaar diabetes kreeg, hoe heb je het ervaren als jongere? Ja, soms wel lastig. Het eerste halfjaar heb ik er wel even mee geworsteld. Ik had wel heel snel het idee dat ik moest weten hoe het werkt. Diabetesweekenden om te leren. De drive was de zomervakantie en ermee om te kunnen gaan op vakantie buiten het oog van ouders en verpleegkundigen. Uiteindelijk kon ik er goed mee omgaan met vallen en opstaan. Moeite met het duidelijk maken van diabetes tijdens je werk. Daarin moet je je weg vinden. Sociale belemmering? Later niet meer, maar tijdens mijn eerste baan wel. Ik moest het kenbaar maken toen ik voor de bedrijfsbrandweer werd gevraagd.

9. Cursussen/Lezingen etc. over diabetes? Hele tijd niet totdat Bas van Goor (volleyballer) vertelde over zijn omgang met diabetes. Verhalen en activiteiten moeten wel interessant en pakkend zijn.

AP:

1. Ideale behandeling: ideale situatie zou zijn dat ik het zelf zou kunnen regelen waarbij het mij direct duidelijk wordt als er iets fout gaat en waarbij het nooit zo fout zou zijn dat ik mezelf niet meer kan helpen. Het is me wel eens gebeurd en het is niet prettig om mee te maken. Graag zo compact mogelijk en inwendig. Dat is ook de reden waarom ik nu niet met een pomp rondloop.

2. Switchen? Als ik dit zo zie is het aardig wat op je lijf. Dat is ook wel hoe je 24u per dag. Maak visueel wanneer de batterij bijna leeg is, dan heb je ook maar één patch nodig. Apparaat is in mijn optiek te groot en er zit te veel op je lijf. Ik zou er wel voor kiezen omdat ik weer kan leven als iedereen met een gezond lijf. Ik vind hem nog wel groot en ik zou denk ik nog een paar jaar wachten totdat hij kleiner wordt.

3. Gebruikseisen: minder plakkers aan je lichaam, dat is voor mij de reden waarom ik wel/geen pomp/AP zou nemen. Zorg voor plakkertjes zonder hardplastic capsule. Het apparaat zou toch kleiner moeten. Als ik kijk naar het model vind ik hem groot, maar er zit een raar uitsteeksel aan. Heel benieuwd wat er op het display getoond wordt. Het is heel erg te koop lopen met dit ding. Ik zou het niet zo prominent willen tonen. Het gaat veel vragen oproepen bij iedereen die je op straat tegenkomt. Als je dit formaat hebt zou je hem in je achterzak willen stoppen en dan zijn de draadjes te kort. Maak een connectie met de telefoon voor het uitlezen van de gegevens en laat het display op het apparaat achterwege.

4. Onder welke omstandigheden moet ie blijven functioneren: waar het bij mij misgaat, in het dagelijks leven heb ik een regelmatig leven. Maar als ik me dan een keer extreem inspan dan gaat het wel eens fout (niet goed overzien of niet genoeg gegeten) en in dat geval is dit ideaal. Hoe wordt afwisselend gedrag geïnterpreteerd in het algoritme? Kan de software dit zo snel volgen?Graag waterdicht, hij moet tegen een stootje kunnen.

5. Verder: design is vrij hoekig, dit kan vanwege het feit dat je hem dagelijks op je draagt gaan irriteren of storen tijdens het dragen.

6. Wat zou u het ontwerpteam nog willen meegeven? Hou het simpel, zorg dat het algoritme goed in elkaar zit en probeer wat aan het design te doen. Maak het ronder.

Interview 11

Man
30 jaar
HBO

1. Wat gebruik je voor behandeling? Ik gebruik een pen, met lantus en novorapid.
2. Heb je in het verleden andere behandelingen gehad? Altijd wel gebaseerd op insuline, wel andere types insuline gehad. Maar ik regel mezelf in en ik hou zelf de controle, ik bepaal zelf wat ik spuit en hoe ik het inregel.
3. Welke eisen stel je aan de pen? Ik vind het handig dat ik nu een flexpen heb, dat is een pen die ik overal mee naartoe kan nemen. Als ik hem kwijtraak hoef ik nu geen nieuwe te zoeken. En haal ik gewoon een nieuwe vulling uit de koelkast. Gewoon gemak dat ik hem overal mee naartoe kan nemen. Iets aan je lichaam zou je lastig vinden? Ja.
4. Welke verwachtingen had je van de pen toen je ermee begon? Toen ik 13 was had ik normale insuline, de flexpen is lichter en kan hem overal mee naartoe kan nemen. En dat de insuline naar behoren werkt. Kun je je waarden nu goed regelen? Ja.
5. Positieve punten zijn je kunt hem overal mee naartoe nemen, je bent heel flexibel.
6. Ook nog minder positieve punten? Nee, het is gewoon insuline en dat moet het gewoon doen. De minder positieve punten van insuline is dat je het heel lang heel warm oud dat de kwaliteit vermindert. Of het kan bevriezen. De pen werkt ook goed, alleen lastig als je hypo's krijgt, maar dat heeft ook meer met de insuline te maken.
7. Zou je meer tevreden zijn over een andere behandeling? Nee, niet over een andere behandeling die nu op de markt is. Kunstmatige alvleesklier zou wel een stuk fijner kunnen zijn.

V-I-U

1. Hoe gebruik je je pen? Hoe veel spuit je? Hangt er vanaf hoe veel ik ga eten. Ik eet wanneer ik wil en mijn insuline wordt daarop afgestemd. Want jij bent niet iemand die een standaard ontbijt of lunch heeft? Nee, en ik ga ook sporten wanneer ik wil..
2. Heb je er wel eens over nagedacht om aan een pomp te beginnen? Ja, wel eens over nagedacht maar eigenlijk helemaal geen zin in aan nu. Alles werkt goed, ik kan alles in principe en met een pomp moet je helemaal op in gesteld worden en je hebt dezelfde gevaren. Dus als dit nu goed werkt voor mij zou ik niet zo snel overstappen.
3. Wat doe je zoal op een normale dag? Ik sta op, ontbijt thuis of soms op het werk. Dan ga ik aan het werk, dan eet ik af en toe wat en dan ga ik naar huis en sporten, met vrienden afspreken, voor de TV hangen, of klimmen. Sporten? Klimmen, parachutespringen, wielrennen, fitness, squash, dus genoeg. Tijdens sporten last van je diabetes? Toen ik in het begon echt ging sporten had ik veel lage bloedsuiker waar ik niet zoveel raad mee wist maar nu neem ik gewoon dextro mee onder het hardlopen en heb ik er niet zoveel last meer van.

4. Welke gebruikseisen stel je aan je pen? Dat ik erop kan bouwen, dat er duidelijk is wat hij doet en wat daar afhankelijk van is. Je bent er afhankelijk van en als je een foutje maakt moet hij niet meteen op hol slaan.
5. Vergt kennis? Het vergt heel veel van je, dat je precies moet weten wat je moet doen, wat insuline doet op je bloedsuikers, welke langzame en snelle koolhydraten zijn. Je moet heel veel kennis hebben van je diabetes.
6. Pomp makkelijker met kennis? Weet ik niet, heb ik me niet in verdiept. De pomp zie ik niet als heel veel makkelijker omdat je hem constant op je lichaam moet hebben. Als er een naaldje er toevallig een keer uitraakt schiet je bloedsuiker omhoog. Ik zie meer nadelen dan voordelen.
7. Hoe was het als kind om diabetes te hebben? Dramatisch, ik raakte geïsoleerd door diabetes en wat andere omstandigheden. Ondervindt je die sociale isolatie nog? Nee, nu niet meer.
8. Hoe ervaar je het nu? Belemmert het je in je dagelijks leven? Ja, als ik stappen en ik drink toch wat biertjes moet ik goed oppassen dat ik niet te laag zit en niet in een coma raakt. Ik ben vorige week op vakantie geweest en dan ga je een heel ander voedingspatroon je eigen maken en ga je toch meer schommelen. Altijd implicaties in alles wat je doet.
9. Als je geen diabetes hebt zou je anders leven? Nee, maar ik zou mijn huidige leven makkelijker kunnen leiden.

Kunstmatige alvleesklier

1. Wat zou volgens jou meest ideale diabetesbehandeling zijn? Dat je eilandjes van langerhans krijgt toegediend dat je ook niets kan zien aan de buitenkant.
2. Ben je bereid om te switchen naar de kunstmatige alvleesklier? Weet niet of ik het permanent zou doen, maar ik zou het zeker willen proberen. Maar die pleisters zien er niet uit, en dat is lastig als je gaat zwemmen of naar het strand gaat. Je zegt niet permanent, wil je dan afkoppelen? Dat zou ideaal zijn, maar dat zou wel niet de bedoeling zijn voor het ritme van de CGM.
3. Waarom zou je wel of niet overstappen als je je pen vergelijkt met de kunstmatige alvleesklier? Wel, omdat je niet meer met de ziekte bezig hoeft te zijn met je hoofd. Dat je alleen niet in bad gaat of dat je alleen een beetje ongemakkelijk maakt op het strand. Het apparaat maakt dat je er chronisch ziek uit ziet. Ik heb niet een heel standaard ritme, dus hoe goed is het algoritme erachter? Zouden mijn waarden beter worden dan nu met mijn pen?
4. Gebruikeisen: ik pas me aan wat er nodig is. Rationeel lijkt me dit de beste oplossing, dus dan plak ik wel het een en ander aan mijn lichaam. Ik wil toch een beetje invloed hebben. Stel dat het algoritme op hol slaat, hoe krijg ik dan zo snel mogelijk weer een normale glucose waarde? Die draadjes blijven wellicht haken als je gaat klimmen en dan moet ie wel snel up and running zijn. Of alles eraf trekken en de pen pakken om de glucose over te nemen.
5. Schiet pen tekort in dagelijkse activiteiten? Wat ik nu heb is dat ik een basisinsuline spuit en novorapid werkt 4u en koolhydraten houden zich niet aan dat tijdritme, dus af

en toe gaat je bloedsuiker ineens dalen of ben je nog eten aan het verteren terwijl de insuline al is uitgewerkt.

6. Veiligheid: als die op hol slaat moet ik de controle kunnen overnemen.
7. Wat is het laatste wat je wil meegeven aan het ontwerpteam van de kunstmatige alvleesklier? Ik zou het allemaal wat compacter maken, twee sensoren in één sensor verpakken met twee verschillende naaldjes. Glucagon en insuline bij elkaar zetten. Alles in twee pleisters proberen