

AALTO UNIVERSITY  
School of Science  
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Antero Vanhala

**EFFECTS OF RESOURCE UTILIZATION ON CUSTOMER  
OUTCOMES IN TYPE 2 DIABETES CARE**

Thesis submitted in partial fulfillment of the requirements for the degree of  
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Espoo, January 30, 2013

Supervisor: Paul Lillrank, Professor, Aalto University

Instructors: Antti Peltokorpi, D.Sc. (Tech.)  
Karita Reijonsaari Lic.Sc. (Tech.)

Author: Antero Vanhala		
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Instructors: Antti Peltokorpi, D.Sc. (Tech.) Karita Reijonsaari Lic.Sc. (Tech.)		
<p>The purpose of this thesis is to research the connections between resource utilization factors and customer effects in type 2 diabetes care. Research problem was approached with a literature review of service and health management research related to chronic care and an empirical study. The aim was to build a theoretical model between concepts, and to test this model with empirical data.</p> <p>Three relevant resource utilization factors in diabetes care were found: (1) main care provider asset specificity, or specialization, (2) visit frequency to main care provider, and (3) professional resource variety, or multidisciplinary. The relevant customer effects were identified as customer satisfaction, patient adherence to care, health outcomes, and patient perception of own health.</p> <p>A patient survey to diabetes care customers was performed in six European regions to gather empirical data (N = 1418). Multiple linear regression method was used to examine the hypothetical connections between the variables.</p> <p>The study found that main care provider asset specificity and professional resource variety have an positive impact on customer satisfaction. Health outcomes and professional resource variety were negatively connected to patient's perception of own health. Weak connection of main care provider asset specificity and professional resource variety with patient adherence was observed. Four of the eleven hypotheses received statistical support (<math>p = 0.05</math>), two remained slightly over the threshold and rest did not receive support.</p> <p>The suitability of the overall model was assessed low. The found relations were supported by existing literature and add to the body of knowledge. Some implications for managers are drawn and future research topics are put forward.</p>		
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# 1 Introduction

## 1.1 Background

Our health care is struggling to make the ends meet as demand for services rises and resources seem scarcer by the day. Currently the public healthcare systems in the developed countries are facing serious challenges because of chronic life-style related illnesses, of which type 2 diabetes mellitus is inarguably one of the most widespread. In Europe the prevalence of diabetes is estimated at 8,6 % in age group 20-79 and is expected to grow to 10 % by 2030 (International Diabetes Federation, 2011; Wild et al., 2004). However, even those projections may be underestimations of the future prevalence (Rathmann and Giani, 2004).

The health care challenge calls for interdisciplinary approach to solve how we can make the most of the resources we have. Service operations management is a discipline which aims at understanding technical, economical, and social aspects of service production systems. Resource management is a part of service operations management which concentrates on the efficient use of resources, how they are set in relation to each other, and for what purposes they are used.

It is my belief that service operations management can offer significant help in tackling the public healthcare system challenges by providing valuable knowledge on how productivity and quality are improved in services.

### 1.1.1 Managed Outcomes -project

This thesis is done as a part of European Union 7th Framework Program research project: Managed Outcomes – Operations management and demand-based approaches to healthcare outcomes and cost-benefits research. Managed Outcomes -research is a three year project from 2009 to 2012 funded by the European Commission. The results of this Master's thesis are intended to contribute directly to the project goals.

The Managed Outcomes project explores the assumption that healthcare outcomes and costs are affected by the efficiency of service production, the time- and location-constrained regional structure of healthcare delivery, and the degree to



which people are empowered to participate in their own care. These relationships have been insufficiently understood and need to be studied to meet the objectives of the new European health strategy.

In the Managed Outcomes research project the service systems of four common diseases – type 2 diabetes, dementia, hip osteoarthritis, and cerebrovascular stroke – are studied in six EU-member states: Germany, Netherlands, Spain, United Kingdom, Greece, and Finland. This Master's thesis concentrates on type 2 diabetes.

## 1.2 Diabetes as a disease

Type 2 diabetes mellitus is a chronic metabolic disorder that is caused by a decrease of insulin effect in cells and in later stages by decrease of insulin secretion by pancreas. The result of this is an increase in blood sugar levels which is the main indicator and diagnostic criterion of type 2 diabetes. The high blood sugar levels in turn affect normal cell functions and cause damage to cells, especially the nervous system and the circulatory system. The effects of diabetes mellitus include long-term deterioration, dysfunction and failure of various organs. Diabetes mellitus may present with characteristic symptoms such as thirst, polyuria, blurring of vision, and weight loss. In its most severe forms conditions such as stupor and coma and – in absence of effective treatment – premature death may follow. However, often symptoms are not severe, or may be absent, and consequently hyperglycemia of sufficient degree to cause pathological and functional changes may be present for a long time before the diagnosis is made. The damage to tissue causes the complications such as diminished blood circulation in remote areas of the body, increased risk of strokes, and foot and eye problems.

Type 2 diabetes is a major cause of severe incapacity, suffering, and poor perception of own health if not treated properly. The ways of treatment are well understood but have limited effectiveness because the treatment methods involve ample changes in the person's lifestyle; Main causes of type 2 diabetes are lack of physical exercise, unhealthy diet, obesity, and sedentary lifestyle. It is also partly caused by genetic susceptibility, particularly in certain ethnic groups. (Zimmet, Alberti, and Shaw, 2001)



## **1.3 Aims of the study and the research problem**

### **1.3.1 Aims**

This research aims at investigating how service resource utilization affects the customer and care in type 2 diabetes services. These effects may include among others satisfaction, perceived health, clinical outcomes, and care adherence. By studying existing health system resource utilization and care outcomes, it is aimed at providing new knowledge for future resource management decisions based on a better understanding of the current system.

More specifically the aim is to build a theoretical model that connects resource utilization and patient or customer level effects based on previous research, and then to test this model with empirical data. As an outcome of this research the appropriateness and validity of the model can be discussed in order to draw implications to managers and for further research.

### **1.3.2 Research gap**

Berry and Bendapudi (2007) identified a gap of knowledge in health care related service management literature. This research hopes to fill a small part of that gap by applying service management knowledge in health care setting. This is done by drawing from service management literature, forming relevant hypotheses, and testing them with health care service data.

Moreover resource utilization choices in long-term chronic care has received little attention in both service management and health management streams. Yet, the topic is important because of the growing demand for long customer relationships in health care and other services.

### **1.3.3 Research questions**

To attain the goals of the research two research questions are formulated:

- i           How is resource utilization of type 2 diabetes -care related to customer adherence, satisfaction, and health outcomes according to service and health care management literature?
  
- ii           How does the theoretical model developed in research question i stand statistical testing with empirical data from type 2 diabetes patients that receive continuous care?



### 1.3.4 Scope and delineation

This study concentrates on the resource utilization in type 2 diabetes care services in existing health care systems, and on its effects on the customer. Several closely related topics are ruled out in order to enable the concentration on the phenomenon of interest.

The research studies the group of patients with diagnosed type 2 diabetes who receive continuous care from their care provider organization. The people who unknowingly have diabetes, or are otherwise left outside the care provision are thus not in the scope of this study. The idea of the research is to see how the current health care customers in diabetes care could benefit from more efficient use of resources.

The aim of this study is not to provide cost-information but it is left to the managerial decision-making and further research. The costs and cost-benefits of care provision are researched extensively in other publications of the Managed Outcomes research.

The research topic is approached from service operations management angle and does not aim at creating clinical knowledge.

Figure 1 summarizes the delineation of this research in relation to the overall scientific framework of the Managed Outcomes -project. This research studies the connections between resources and outcomes taking into account the mediating factor of health behavior. Health care funding, demand, and production are outside the scope of this study, but they are further elaborated in Managed Outcomes reports.

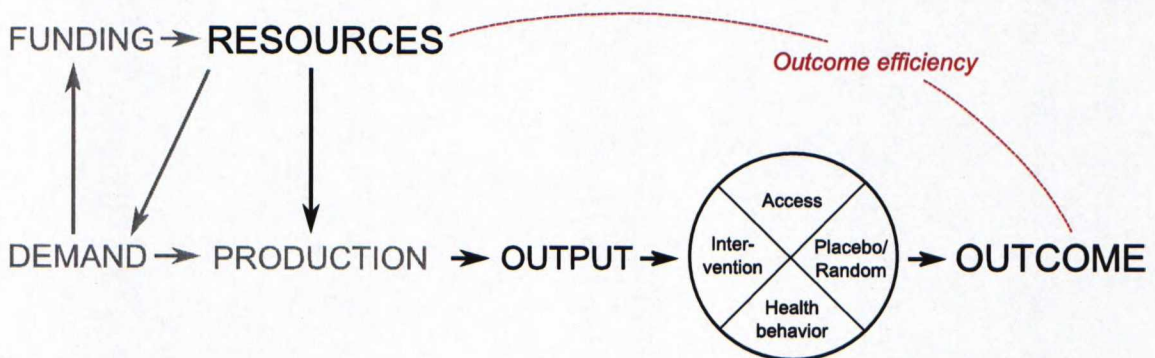


Figure 1: The scientific background of Managed Outcomes and the scope of this research



### 1.3.5 Intended contribution

**Managerial contribution** The aim is to provide knowledge for resource management decisions for health care managers. (Bohmer, 2009) lists resource provision as one of the important managerial approaches to care management.

By the end of this research there will be more knowledge of resource-related decisions in diabetes services such as:

- Should the number of visits with patients be increased to get better results?
- Should there be a health care professional in the region that specialize on this particular patient group – type 2 diabetics?
- Should the variety of services and care professionals be widened?
- Can the resource utilization be optimized without affecting care results?

The study does not contribute to clinical decision-making which should be left to physicians and other health care professionals.

**Academic contribution** The research contributes to the scientific streams of service research and health care management research by providing new knowledge on how the resource utilization choices may be relevant for service outcomes in long service relationships, or, more specifically in chronic disease care. The findings of this research will help in filling a part of the knowledge gap identified by Berry and Bendapudi (2007).

## 1.4 Structure

This work is structured around the research questions. In section two the topic is opened from the perspective of the literature. A set of theoretical hypotheses are formed, and a model of relations is developed as a conclusion of the literature review. This provides an answer to the first research question.

Section three explains the methods used for the collection of empirical data, and the analysis methods. In section four the results of the statistical analysis are presented in connection with the hypothetical model that was developed in the literature part in order to provide an answer to the second research question.

Finally in sections five and six the results are discussed followed by final conclusions. Implications for managers and for further research are offered.



## 2 Literature review

### 2.1 Structure and methods of literature review

The aim of the literature review is to understand the current scientific knowledge concerning the topic, and based on that knowledge to build a theoretical model that explains the connections between resource utilization and effects on customer in type 2 diabetes care.

The structure and story line of the literature part is presented in Figure 2. The section will start by investigating and defining some key concepts which are relevant to the understanding of the phenomenon. Then scientific knowledge of care service management in diabetes care is reviewed from both service research and health management research streams. Theoretical reasoning will begin from the characteristics of the disease, continues by identifying what are the relevant aspects of care based on those characteristics, and advances on discussing the important factors for resource-related decision making.

Last, as a synthesis of the literature review, a set of hypotheses and a model is developed.

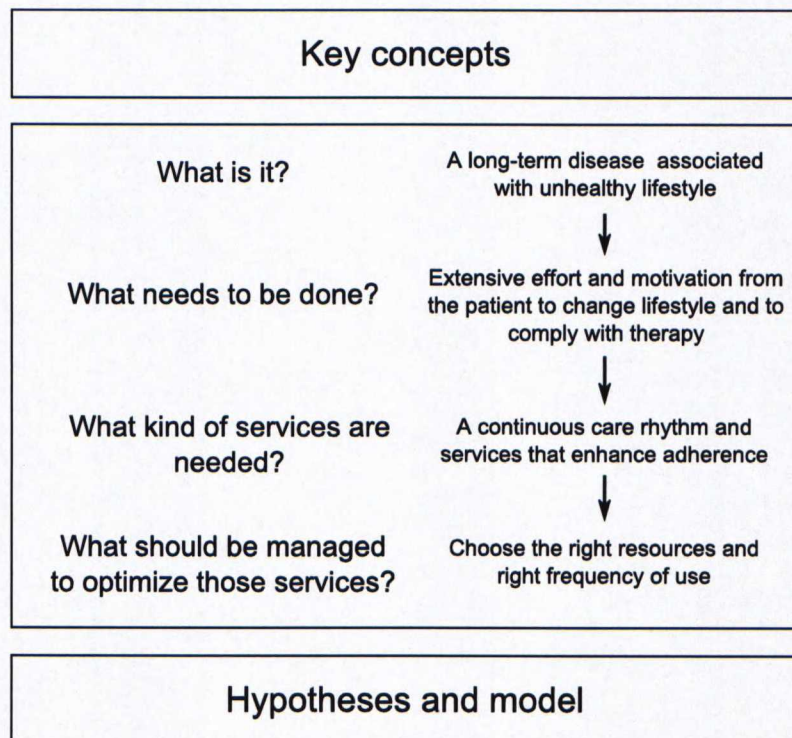


Figure 2: Literature review structure.



## 2.2 Key concepts

In order to accurately treat the research topic some terms and theoretical concepts need to be defined. In this section the concept of resource utilization in diabetes services is defined, and several interrelated key concepts are discussed: value in health care, health outcomes and other effects or benefits for the customer, service quality, customer satisfaction, customer compliance and care adherence.

### 2.2.1 Resource utilization and resource allocation

Two closely related concepts are discussed: resource utilization and resource allocation, and the way they are related to each other.

Resource allocation is a discipline of deliberate decision-making where the supplier directs its scarce resources to a specific purpose as efficiently as possible. Resource allocation can be done on organizational or customer-relationship level. Resource allocation is always a supplier view on how the resources should be divided and used. (Johnston and Clark, 2008)

Resource utilization means the total amount of resources actually consumed. Resource utilization may or may not be the result of deliberate decision-making. Furthermore resource utilization does not differentiate between the supplier or customer view of resource use.

Deliberate decisions of resource allocation should lead to desired resource utilization. By investigating the current resource utilization and its efficiency, one can gain new knowledge for future allocative decisions.

In service research the concept of resource utilization is bound with the production of value in “interactive configurations of mutual exchange” that can be called a service system (Vargo, Maglio, and Akaka, 2008). Service system is a broad term that includes the resources and their connections to each other. Edvardsson, Skålén, and Tronvoll (2012) argue that value co-creation<sup>1</sup> takes place within service systems through integration of resources. Vargo and Lusch (2008) use the following description for a service system: a “dynamic configuration of resources in which value is co-created and evaluated”

In this study the human resource utilization in contact with diabetes care customers is investigated in relation to outcomes. In the context of Managed Outcomes

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<sup>1</sup>Co-creation means the action where consumers engage in the processes of both defining and creating value. See e.g. Prahalad and Ramaswamy (2004) and McColl-Kennedy et al. (2012).



resource utilization in contact with the patient forms the output of health care system (Figure 1). According to the project theoretical background outputs are “identifiable and measurable activities done to a patient, such as giving advice, a visit, prescription or surgical intervention.” (Malmström et al., 2012, p. 8). Resource utilization is used in this research as synonymous to human resource utilization, and is defined followingly:

*(Human) resource utilization means the variety of human resources, type of resource, and use intensity in contact with the patient.*

### **2.2.2 Health care outcomes, value in health care and customer effects**

Services have various effects on a customer. In health care context especially the outcomes, and nowadays increasingly the value for customer are seen as important concepts. Next, definitions on health care outcomes are discussed, followed by a discussion of two views on value: one from health management research and second from service research.

#### **Health care outcomes**

The aim of health care system is to produce desired health outcomes in the patient.

Health care outcomes in the Managed Outcomes project are defined followingly: “Outcomes are observable changes in a patient’s health condition, i.e. what happens to a patient.” (Malmström et al., 2012, p. 8). In the project it is suggested that despite being potentially laborious and not always precise, outcomes measurement can be successfully used to assess the performance of care pathways.

In the literature health care outcomes are mostly discussed in the context of outcome measurement. Two different views can be identified from the literature on what health care outcomes are.

**Traditional view** Donabedian (1966) states in his classical paper that the traditional view of health care outcomes means the “recovery, restoration of function and of survival” of the patient. Porter (2010) suggests a similar view where the outcomes of care are the health status achieved or retained, process of recovery, and sustainability of health. Both authors stress that outcomes need to be chosen and measured in an illness-specific and relevant-to-care manner. In a review of



outcome measurement in health care Clancy and Eisenberg (1998) state that traditionally health outcomes are surrogates of physiological functions, and definable clinical events. Traditional view is predominant in clinical research.

The traditional view is very clear on the idea that health care outcomes are objective changes in patient's physiology and do not include subjective elements. However, it is necessary to remark that in many cases the measurement of outcomes may include subjective elements possibly making the measurement unprecise (e.g. measurement of depression). The outcomes are objective but the measurement may sometimes be subjective.

**Expanded view** A broader view on health care outcomes includes patient's subjective perceptions. Donabedian (1966) included in his discussion of outcomes measurement "patient attitudes and satisfactions" to the list of measurable items. Clancy and Eisenberg (1998) suggest that in addition to the traditional outcomes, patient health perceptions, functional measures, preference-based measures, and patient satisfaction should be taken into account.

The expanded view introduces subjective and preference-dependent elements to the definition of health care outcomes.

### **Value in health care**

Value is identified as the fundamental purpose of exchange. The discussion on the definition of value in health care has numerous different views and no commonly agreed definition exists.

Porter (2010) suggests the narrowest view for value in health care. He states that value should be solely defined by the health outcomes meaning the health status achieved. Health outcomes may contain treatment disutility that destroys value and positive outcomes that create value.

Nelson et al. (1996) widens the angle in a framework called the Clinical Value Compass. The framework defines the value in healthcare to have four dimensions: (1) functional status, risk status, and well-being; (2) costs; (3) satisfaction with health care and perceived benefit; and (4) clinical outcomes. This model includes the costs in the value function implicating that the real additional value is what is left to the customer after sacrifices and paying for the expenses. The value in health care, as defined by Nelson et al. (1996), includes the clinical outcomes, and



in addition subjective perceptions.

Nordgren (2009) expands the notion of value in health care even more. He defines it as the “experienced health, quality of life, accessibility, trust, communication, avoidable suffering and avoidable deaths, and not only reduced costs, activities and outcomes.” In Nordgren’s (2009) definition the traditional view on health care outcomes (“avoidable deaths, ... ,outcomes”) is widened to cover the subjective perceptions (“experienced health, quality of life, ... ,trust, communication, avoidable suffering”) and even the health system characteristics and outputs (“accessability, ... ,activities”). The “reduced costs” component is similar to the ‘cost’ in the definition of Nelson et al. (1996).

‘Value in health care’ -definitions seem to contain at least the elements of benefit (e.g. clinical outcomes, satisfaction) and cost, or sacrifice (e.g. disutility, monetary cost). Beyond that the views have very different broadness ranging from strict definition of Porter (2010) to Nordgren’s (2009) wide spectrum definition. Other views exist in literature that are not further elaborated here but they follow a similar logic of definition broadness.

### **Customer value in services**

The meaning of the concept ‘customer value’ has been discussed in service operation management and service marketing streams extensively. The existing views have similar components.

Zeithaml (1988) has offered an influential definition of customer value: “Perceived value is the customer’s overall assessment of the utility of a product based on perceptions of what is received and what is given”. Zeithaml discusses products, and the notion is transferred to services almost unchanged: Storbacka, Strandvik, and Grönroos (1994) define customer value as “Service quality<sup>2</sup> [Customers’ cognitive evaluation of the service across episodes compared with some explicit or implicit comparison standard] compared with Perceived sacrifice [Perceived sacrifices (price, other sacrifices) across all service episodes in the relationship compared with some explicit or implicit comparison standard].”

Woodruff (1997) reviewed customer value definitions and identified that they typically see customer value as something that is perceived by the customer, and not objectively assessed by the seller. Furthermore the notions of customer value include

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<sup>2</sup>The notion of (perceived) service quality is discussed in the next section.



a trade-off between “what customer receives (quality, benefits, worth, utilities) and what he or she gives up to acquire and use a product (e.g., price, sacrifices). “ (p. 141).

The overarching idea in customer value in services is the difference between the perceived benefit and the perceived sacrifice: Benefits and sacrifices may be monetary, physical or emotional but the *perception* of them is what matters. The definition of customer value in service research is solely subjective and excludes objective measures. Although monetary costs, time or some measures of benefit may be objectively measured, customer value is still formed from the subjective perception on them.

### **Summary of health care outcomes and customer value in health care**

The concepts of health care outcomes, value in health care, and customer value in services were reviewed. In this research all these concepts together are called service effects on customer. Effects on customer include all imaginable effects, objective or subjective.

The different definitions are compared in Figure 3 on the next page. On the left hand side are listed the three concepts that were discussed. On the upper side there is a division of effect types: objective (e.g. physiological effects), or subjective (e.g. perception of health) customer effect. The different views are named in the table for the sake of simplicity. Customer effects include the positive and negative effects, the negative meaning for example physiological damage because of care (objective), and for example perceptions of sacrifice (subjective).

The definitions overlap. In health care outcomes the traditional and expanded view both include objective effects. Similarly value in health care is defined in different ways which all include the objective effects. Service research definition of customer value includes only the subjective side i.e. perceptions by customer.

Value in health care, and customer value in services should intuitively mean the same thing: health care is a service. By combining the two concepts into one value definition, let it be called here 'customer value in health care', three competing definitions exist: two from health care field and one from service research field.

In order to avoid overlaps between the concepts of health care outcomes and customer value in health care, the following choice is made (marked with green in Figure 3): Health care outcomes are defined according to the traditional view, as in



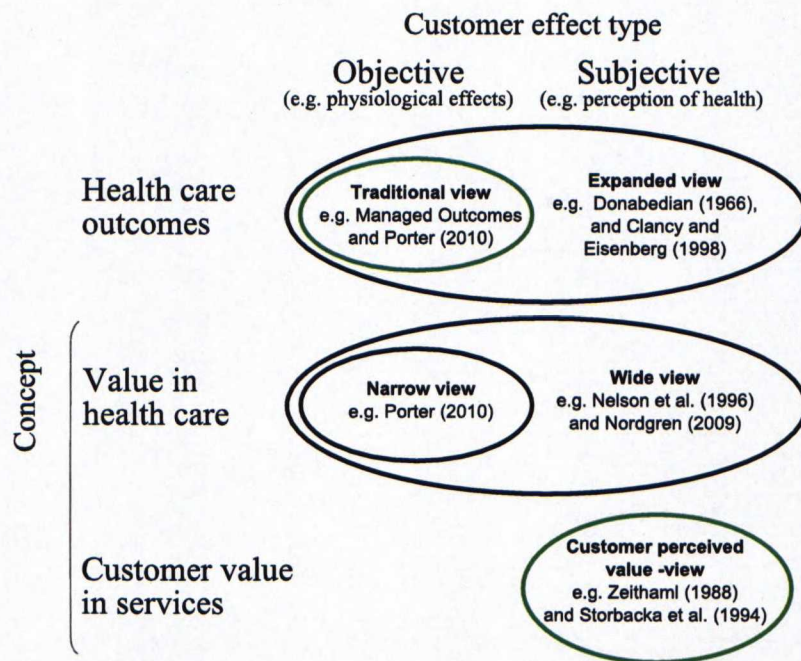


Figure 3: Definitions of health care outcomes, value in health care, and customer value.

Managed Outcomes project (Malmström et al., 2012, p. 8) and by Porter (2010), however rejecting Porter's view that health care outcomes and value in health care should be seen the same. Customer value in health care is defined according to customer perceived value -view following Zeithaml (1988) and Storbacka, Strandvik, and Grönroos (1994).

Consequently, in this research:

*Customer value in health care means the difference between customer perception of health care benefits and the perception of health care related sacrifices.*

*Health outcomes for the customer mean the objective changes in the patient's health condition.*

Health outcomes and health care outcomes are used synonymously in this research. The relation of these concepts is further illustrated in Figure 4 and some examples of their meaning are presented.



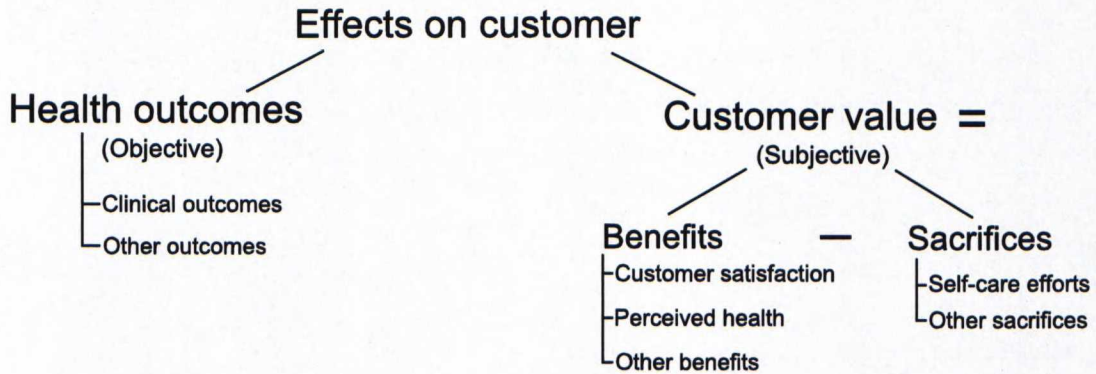


Figure 4: Customer value and benefits in type 2 diabetes care.

### 2.2.3 Customer perception of service quality and customer satisfaction to services

Quality in industrial management theory means the measured difference between intended (or planned) characteristic and the realized characteristics of a product when it is produced in a production process. According to Juran and Godfrey (1998, p. 2.2) quality can mean two concepts that must be kept separate: product features that meet customer needs, or freedom from deficiencies.

Service-related quality can be similarly separated into two concepts: service delivery process that meets customer needs, and service conformance to the intended pre-defined measures (e.g. service level agreement, or care guidelines). The former is called functional quality, or “how?”, and the latter technical quality, or “what?” (Grönroos, 2007).

The two concepts relate to each other through a third concept – the service quality gap (Fitzsimmons and Fitzsimmons, 2011, p. 44), also called total perceived quality (Grönroos, 2007, p. 77). Service quality gap means the discrepancy between a customer’s expectations of a service and the perceptions of a service that is delivered. These three concepts link to each other in a complicated manner. A simplified model from Brogowicz, Delene, and Lyth (1990) is presented in Figure 5. It is to be noted that the boxes below quality gaps (perceived [...] quality offered or experienced) use same terminology as Grönroos (2007) uses to define the service quality gap. The word quality is thus used in both meanings: difference of experienced and perceived, and as an ‘absolute’ scale. In this research the term quality is from now on strictly used in the former sense - a difference, or deviation from what was intended (e.g. Lillrank, 1998; Juran and Godfrey, 1998).



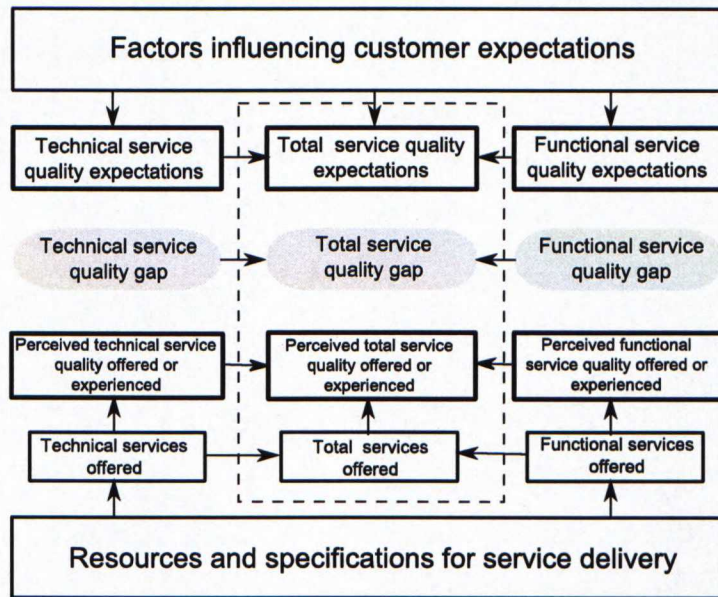


Figure 5: Simplification of the synthesized service quality model (Brogowicz, Delene, and Lyth, 1990, p. 39)

The influential model of Parasuraman, Zeithaml, and Berry (1985) also implies similar construct for service quality gap. From hereafter service quality gap is referred as perceived service quality or customer perceived service quality.

An important implication of the above definition of perceived service quality is that it is closely related to customer satisfaction to service, and even overlapping.

Juran and Godfrey (1998) define customer satisfaction as “A state of affairs in which customers feel that their expectations have been met by the product features.” Dissatisfaction is defined as “A state of affairs in which deficiencies (in goods or services) result in customer annoyance, complaints, claims, and so on.” According to the authors dissatisfaction often arises from deficiencies (i.e. technical quality problems) but satisfaction from features compared to other products an customer needs (i.e. functional quality).

In services the *perception or experience*, and *expectation* are relevant for customer perceived service quality. The question whether there is a difference between service quality and satisfaction have been debated in the service literature (Grönroos, 2007). Grönroos (2007, p. 89) concludes that the perception of service quality appears first in the customer’s mind, and then – from this perception – the satisfaction or dissatisfaction arises. In support of this view Tabrizi et al. (2008) state that perceived service quality leads to better customer satisfaction. Parasuraman, Zeithaml, and Berry (1988) stress that perceived service quality is a global judgement



and satisfaction is related to transactions.

Customer satisfaction is sometimes discussed in service operations research as equivalent to perceived service quality (e.g. Fitzsimmons and Fitzsimmons, 2011). Johnston and Clark (2008, p. 109) also explicitly state that perceived service quality and satisfaction are the same.

The causality or equivalence of perceived service quality and customer satisfaction may have little meaning if these two constructs cannot be measured separately: During a service encounter, the satisfaction arises in the mind of the customer in the same moment as the service quality is perceived.

In services with long time frame – such as the overall service of diabetes care – the satisfaction and perceived service quality may converge. Despite making a sharp distinction between perceived service quality and satisfaction, Parasuraman, Zeithaml, and Berry (1988) also state that “incidents of satisfaction over time result in perceptions of service quality” (p. 16). Consequently in this study the convergent view is adopted because in relationship type services the two concepts are so closely related that their distinction would provide little additional value.

*Customer satisfaction to services means the customer’s subjective assessment of satisfaction to the received services, and perceived service quality i.e. the difference between perception of service and the expectation. In a long-term customer relationship customer satisfaction and perceived service quality are convergent concepts.*

#### **2.2.4 Customer adherence and compliance**

The role of the patient as his or her own caregiver has been studied extensively. There is an ongoing debate on terminology around concepts such as compliance, adherence, and concordance to medication or prescribed treatment (e.g. Bell et al., 2007; Osterberg and Blaschke, 2005).

Compliance is seen to mean the action of consenting to outside orders, or to yielding to a request. An influential definition of compliance is from Haynes, Taylor, and Sackett (1979):

Compliance is the extent to which a person’s behaviour (in terms of taking medication: following diets, or executing other lifestyle changes) coincides with medical or health advice.



Authors such as Aronson (2007), Bell et al. (2007), and Sabaté and WHO (2003) are unanimous that 'compliance' as a term implicates a passive patient, and therefore 'adherence' should be used. Vrijens et al. (2012) identified the shift from 'compliance' to 'adherence' as a reflection of refocusing on cooperation versus obedience.

Sabaté and WHO (2003) define adherence:

Adherence is the extent to which a person's behaviour – taking medication, following a diet, and/or executing lifestyle changes, corresponds with agreed recommendations from a health care provider (p. 3).

The definition includes the notion of patient participating in the care decisions. It relies heavily on Haynes, Taylor, and Sackett's (1979) definition.

Moreover the term 'concordance' furthermore stresses the involvement of the patient: care decisions are a negotiation between physician and patient, and concordance reflects this nature of interaction (Bell et al., 2007).

Service literature, on the other hand, uses a plethora of terms: customer contribution and role, customer participation (e.g. Bitner et al., 1997), co-production and co-creation (e.g. Vargo, Maglio, and Akaka, 2008), product-use compliance (e.g. Bowman, Heilman, and Seetharaman, 2004). Of these interrelated concepts, the 'product-use compliance' is the closest to the medical field's definition of compliance and adherence.

As a synthesis, the phenomenon of a customer doing his or her part in a service relationship is widely discussed in both medical and service research. In this study the term adherence and compliance are used interchangeably, and are defined as Sabaté and WHO (2003) have done. It is to be noted that *adherence* – as *quality* – indicates the objective difference between intended and realized (the pill is taken as prescribed or not), and not the subjective *effort* of adhering which is in this research seen as a customer sacrifice (taking the pill may feel difficult or easy depending on the person).

*Adherence is the extent to which a person's behavior – taking medication, following a diet, and/or executing lifestyle changes, corresponds with agreed recommendations from a health care provider.*



### 2.2.5 Key concepts and the Managed Outcomes conceptual model

The discussed key concepts need to be set in relation with the Managed Outcomes conceptual model. Customer value, health outcomes, customer satisfaction and patient adherence are represented in Figure 6 in relation to the initial conceptual model (Figure 1). The left part of the initial model is simplified to 'Health care system'. The colored parts are additions and modifications.

Output of the health care system is the resource utilization in patient care relationship. Outcomes mean the health outcomes of care, mainly clinical and other objective effects. The customer value results from the subjective perceptions of outcomes: the difference between the perceived benefits and perceived sacrifices related to the care service. Customer benefits further include customer satisfaction that is the difference between the subjective perception of the service and customer expectations. Perceived sacrifices are not further studied in this research.

Patient adherence is the customer's input to care. Where health system output and patient input meet the service is co-created. Patient adherence can be seen as an outcome of care services combined with customer sacrifices of effort.

The added concepts introduce a customer side conceptual mechanism that helps to explain the customer role in the creation of health outcomes and customer value.

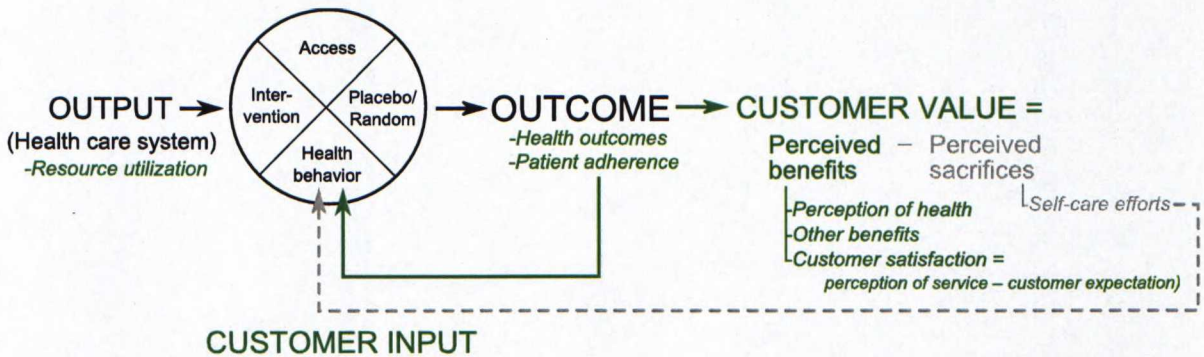


Figure 6: Effects on customer in Managed Outcomes conceptual model

## 2.3 Characteristics of type 2 diabetes and implications for care services

Many of the key literature pieces of service research and service operations management refer to health care as a whole and do not differentiate diseases and care



services by their individual characteristics. Yet, type 2 diabetes care is in many ways different from other care services. These differences rise from the characteristics of the disease itself. In this subchapter a logical chain from the disease characteristics to the service needs is derived.

### 2.3.1 Diabetes is a disease with deferred consequences, and requires patient adherence

Christensen, Grossman, and Hwang (2009) define diabetes as a behavior intensive disease with deferred consequences in a framework called the chronic quadrangle represented in Figure 7. The quadrangle shows that the treatment of type 2 diabetes needs extensive change in customer or patient behavior, including diet and lifestyle changes, and regular medication use. The consequences of *not* changing behavior are distant in time: the complications and decrease in perceived health status can take numerous years.

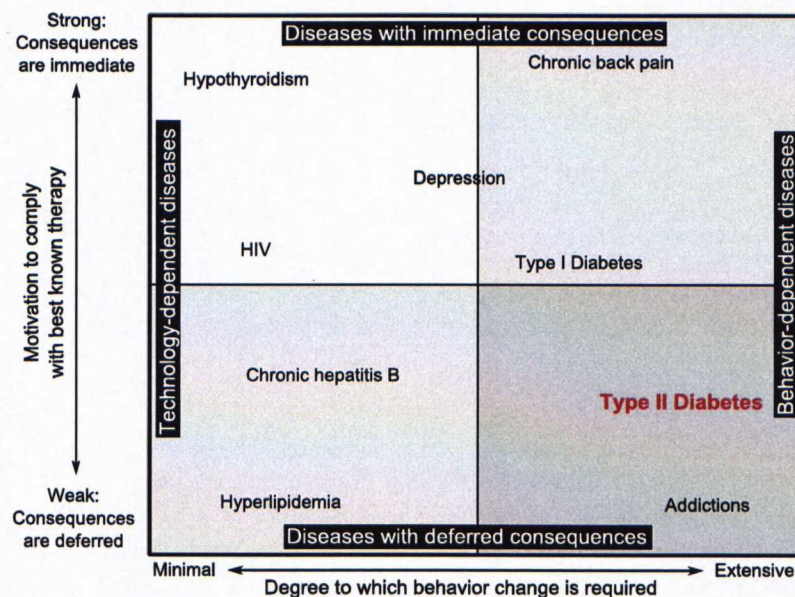


Figure 7: The chronic quadrangle (Christensen, Grossman, and Hwang, 2009, p. 161)

The consequence of this well-known imbalance between short-term efforts and long term benefits increases the role of the service provider as a supporter of self-care. Type 2 diabetes care services aim at enhancing the ability and motivation of the patient to care for him- or herself. As defined in the previous chapters, customer adherence describes to what extent the patient follows the medical advice received from the healthcare professional.



Diabetes care adherence often requires the customer to change some past behaviors that have provided short term pleasure: give up smoking, decrease sugar and high calorie food intake, and increase exercise. Thus the 'costs' may seem greater than the benefits in the short run. Also the perceived threats – complications arising from poorly managed diabetes – may seem distant as they take years to develop and not all type 2 diabetes patients develop them in spite of bad care balance. Probably the threat associated with non-compliance is therefore perceived quite low.

Yet, the care of chronic diseases requires extensive effort from the part of the customer. In a simplistic example the hours of direct care provided by health care system, and the hours provided by the person for him- or herself are compared. Russell, Suh, and Safford (2005) estimated that a diabetes patient that uses oral medication for lowering blood sugar would need to provide themselves care approximately 143 minutes daily. In the Managed Outcomes research (Malmström et al., 2012) the hours of direct care provided by health care professionals for a similar customer ranged from just over an hour to three and a half hours per year, and averaged in two hours per year. In Table 1 the self care and professionally provided care are compared.

Table 1: Comparison of time spent for self-care and for professionally delivered care in the case of type 2 diabetes with oral medication.

	Diabetes self care	Professional care
<b>Frequency</b>	Daily	Several times per year
<b>Time</b>	143 minutes per day <sup>a</sup>	1-3.5 hours per year <sup>b</sup>
<b>Time per year</b>	870 hours	In average 2 hours
<b>Proportion of total care time</b>	99.8 %	0.02 %

<sup>a</sup>Russell, Suh, and Safford (2005)

<sup>b</sup>Malmström et al. (2012). Hours of realized care.

The example emphasizes that the actual diabetes care really happens outside the formal service system, and the customer participation level is very high (Bitner et al., 1997, illustrated in Figure 8).



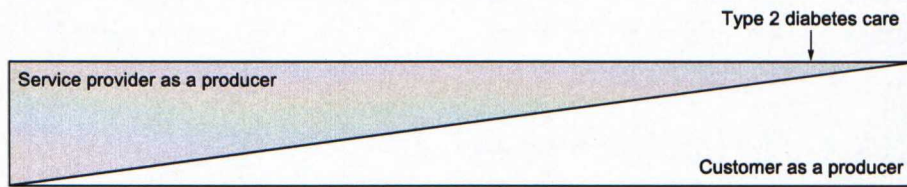


Figure 8: Level of customer participation in type 2 diabetes care

Nevertheless the service provision should be able to gain good outcomes of care through enabling the customers to provide themselves with the right care on a daily basis. This is attempted with continuous services that form a service relationship.

### 2.3.2 Diabetes care as a long-term service relationship

Type 2 diabetes care is a long-term service relationship between the service provider and the customer. Czepiel (1990) makes a division between a service encounter and the service relationship which forms from the encounters. The continuity of encounters that form a relationships does not make diabetes care a special case in services because such relationships can be found in numerous other service industries, e.g. business consulting or hair dressers. It however highlight that diabetes care should not be seen solely as service encounters.

In service and health management literature the long-term service relationships are discussed to some extent.

In health operations management, Vissers and Beech (2005) focus mainly on elective and hospital-based treatment. They note that chronic illnesses mainly differ from the point of view of length of process, unclear definition of end point and the complexity of the process.

Lillrank, Groop, and Malmström (2010) define chronic care as a health care operating mode that needs continuous cyclical care visits in a non-elective manner, and has no clear ending point or cure. The authors suggest that the relevant time dimension is the rhythm of care provision i.e. “regular schedule of care and therapy needed for an optimal life”. Relevant measures for chronic care mode are offered: For knowledge management the balance of care is seen important. In process and time management the ongoing and cyclical rhythm of care is crucial. As performance measures the stability of the patient’s condition, or decreased decline in health state in progressive diseases, should be used.

The process, episodes, and events approach (Lillrank, Groop, and Venesmaa,



2011; Lillrank, 2009) further elaborates the ideas of care rhythm and resource choices. In Figure 9 health events that form the patient episode, and the supplier side production process are illustrated. Patient episode is the overall journey that the patient goes through and is related to the disease in question. The episode consists of health events which are any actions or events that have effect on the disease. Positive events may include for example the taking of prescribed medicine, exercise, or eating healthy. Some events have negative impact on the health status of the patient: e.g. smoking and excess eating of pastries. Some of the events are related to the provision of care services, and are called service event - a health event in patient episode that is co-produced with health care provider resources.

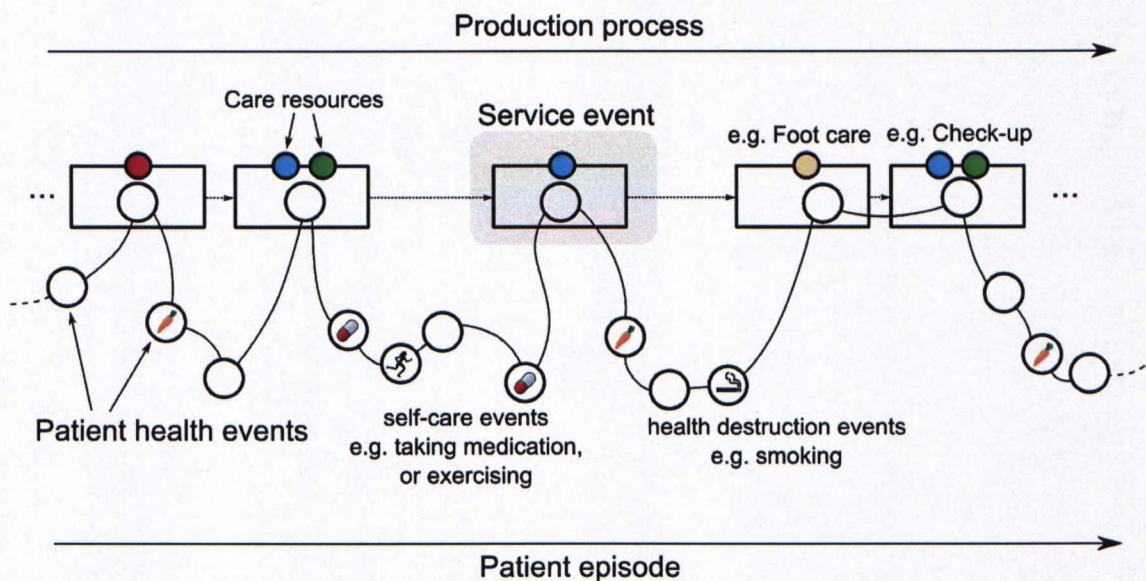


Figure 9: Service process, patient episode, and events. (adapted from Lillrank, 2009)

From the care service provider side the service events form a care process: a sequence of care provision events. For example in the case of diabetes care, a service event can be a foot care visit or a check-up visit. Service events are produced with provider resources.

As seen earlier, the aim of diabetes services is to influence the care that the patients provide to themselves – to enhance adherence to care. With limited resources in production process it is hoped to influence customer behavior in a way that the patient would produce to him- or herself more positive health events and less negative health events. The choices concerning the resources are thus central to the care provision.



## 2.4 Resource utilization in diabetes care

To enable successful type 2 diabetes care the health care managers need to choose and offer health care resources to the customers. In other words, health care managers carry out strategic resource management choices for service provision: With what resources? To what extent?

Resource utilization is called resource configuration by Vargo, Maglio, and Akaka (2008) and they form the output to the health care system. These outputs are then hoped to transform into desirable outcomes. This is also the fundament on which the Managed Outcomes research is constructed on (see Figure 1). Bohmer (2009, p. 43) identifies resource decisions as one of five broad approaches that can be used to deliberately manage care.

For type 2 diabetes care the single most important group of resources is the health care professionals that provide the care. Other resource decisions, such as choice of medication or use of glucose monitoring, are not discussed because they belong to the realm of clinical medicine. In the process, episode, event -approach (Lillrank, Groop, and Venesmaa, 2011) two resource utilization considerations can be identified (see Figure 9): the choice of care professionals, and the frequency of their usage.

The choice of professional care resources includes furthermore two decisions: how much should the professional specialize to one patient group, and how many different professionals should be involved in the care provision. These translate in this research to the asset specificity, or specialization of the main care professional (i.e. the professional that the customer sees most often), and to professional resource variety (i.e. how many different professionals are involved in the care of one patient).

Frequency of resource usage means from the view point of the customer how often there is contact with the service provider, and mostly, with the main care provider.

**Chronic care model** The Chronic care model (CCM) has been influential in the development of clinical care for chronic diseases. It is thus necessary to describe some of its contents in relations to service operation management literature and resource decisions. Chronic care model was developed more than a decade ago and is nowadays a widely adopted approach to care provision in the Western countries (Coleman et al., 2009).



CCM is based on a review of interventions by Wagner and Austin (1996) that were later organized by Renders et al. (2001) in four categories that lead to greatest improvements in health outcomes: (1) increasing providers' expertise and skill (2) educating and supporting patients (3) making care delivery more team-based and planned, and (4) making better use of registry-based information systems.

Chronic care model has been found effective in improving care outcomes in intervention studies. Coleman et al. (2009) found in a review article that the implementation of CCM components improve the quality of care, patient satisfaction, and health outcomes, although the implementation methods vary considerably. In a randomized controlled trial Piatt et al. (2006) found a small decrease in long blood sugar (HbA1c), and increase in patient empowerment in the customer group that participated in a CCM intervention.

#### **2.4.1 Human asset specificity, or professional expertise and specialization**

The phenomenon of one professional concentrating to one type of service process is discussed in both health management and industrial management streams. Generally, health care related research discusses of specialization or expertise, and in industrial context the term is human asset specificity, or resource dedication (Visser and Beech, 2005).

Klein (2006) states that "expertise involves mastering some area of knowledge and in turn using this mastery to educate others or skillfully practice one's craft." Shanteau (1992) states that expertise characteristics include extensive and up to date content knowledge and highly developed perceptual/attentional abilities. These views support the need for specialization in clinical care.

Specialization to a group of customers enables more focused experience that increases employee ability. This is called learning curve. Adler and Clark (1991) point that the reasons behind learning curve include experience and training. Also Chi, Glaser, and Farr (1988) suggest that experts excel mainly in their own domains.

According to Simons, Berkowitz, and John (1970) the greater the expertise of the communicator, the greater is the move towards the position that the communicator advocates. In the case of diabetes services the position towards which the customer is advocated is adherence to care. Also in sales literature Busch and Wilson (1976) suggest that experts are more influential than non-experts. Dellande, Gilly, and



Graham (2004) demonstrated in a weight-loss clinic setting that provider expertise leads to better customer compliance through enhanced customer role clarity and customer ability.

In long-term buyer-seller relationships, the quality of the relationship and also the satisfaction is enhanced by seller competency (Crosby, Evans, and Cowles, 1990). Gwinner et al. (2005) found that the service employees' customer knowledge and ability to modify self-presentation can lead to better interpersonal adaptiveness and service offering adaptiveness. They are in turn linked to increased customer satisfaction by customization of services.

Human asset specificity is defined by Riordan and Williamson (1985) as "highly specialized human skills, arising in a learning by doing fashion," and by Zaheer and Venkatraman (1994) as the degree to which skills, knowledge and experience of the personnel are specific to the business process. According to these authors specific human assets are more efficient in realizing specific processes. In diabetes services a specific asset could thus lead to better health outcomes, and other benefits for the patients through more fluent processes.

#### **2.4.2 Frequency of contact**

Service management and health operations management streams seem to suggest that the frequency of contact is a relevant factor in service resource decisions. Lillrank, Groop, and Malmström (2010) pointed out the need for "cyclical rhythm" in the care of chronic conditions. They suggest that care should be provided up to a level where the marginal impact of additional effort is low. After this a coordinated schedule for care provision is made. This view implies the importance of care frequency in managerial decisions of care provision. Contact frequency seems to be associated to outcomes and other effects on the customer.

Payne, Storbacka, and Frow (2008) emphasize the development of customer-supplier relationships through interaction and dialog: The supplier contributes to customer learning or " 'teaching' the customers some co-creation behaviors" (p. 93). They also see every encounter important as they make a cumulative contribution to value. Relationships is builded from individual encounters which all teach the customer in co-creation and help the supplier learn more about the customer and thus enhance the service.

In a similar view Ennew and Binks (1999) highlight the importance of participa-



tive behaviour from both sides: the customer and the service provider. They state that the service quality and accordingly service satisfaction increase in participative relationships because the provider is more knowledgeable of customer needs and expectations, and enhanced customer awareness lead to more realistic expectations.

Both of the above views seem to suggest that increased visit frequency in services could improve adherence through 'teaching' co-creation, and enhance customer satisfaction by better handling of customer needs and expectations.

A counter-argument would state that the increased visits could decrease satisfaction because it means more time and energy sacrificed from the side of the customer. Perceived sacrifice could thus exceed the perceived quality (Zeithaml, 1988; Storbacka, Strandvik, and Grönroos, 1994).

Johnston and Clark (2008) have created an activity-attitude matrix for customer relationship and suggest that "allies" or "champions (p. 82)" are what organizations want their customers to be. This means that the customer has a positive attitude towards the service and is willing to be active in participating the process. They elaborate that in order to create allies, the organization should either communicate, counsel, or involve the customer. This research argues that to achieve these actions, a frequent contact with service provider and customer is needed. "Ally" in the context of diabetes care translates to customer that is willing to be active in self-care i.e. is adherent to care

In medical literature, McDonald and Garg (2002) performed a review of adherence interventions. The list of intervention types show that most attempts to increase care adherence include increased number of contacts between the customer and health care systems. Miller (1997) identified that the time since previous physician visit affects compliance, a shorter time increasing care adherence. In a literature review Tabrizi et al. (2008) constructed a model that links service quality to diabetes care outcomes. They stated that increased care provider visits lead to better adherence to guidelines.

Most of the literature sources seem to support the idea that contact frequency is beneficial in improving health outcomes and customer satisfaction. Effect on perception of own health could be however negative because frequent visits remind the patient of his or her illness. A feedback effect where patient with poorer health receive more frequent service is evident and discussed more in the methodology.



### 2.4.3 Professional resource variety

Professional resource variety in care means the participation of multiple health care professionals in the care provision of an individual patient. A closeby term that is used in medical and health management literature is multidisciplinary.

The recent research and guidelines strongly support multidisciplinary in chronic care. In a review article of chronic care model -research, Coleman et al. (2009) found that team-based care is associated with better outcomes of care in chronic diseases. Also according to the care guidelines of American Diabetes Association (2010) collaborative, multidisciplinary teams are best suited to provide care for people with chronic conditions like diabetes and to facilitate patients' performance of appropriate self-management. Haynes and McDonald (2002) suggest that support from other health care professionals in addition to main care provider may increase adherence to care. Additionally Sabaté and WHO (2003) calls for a multidisciplinary approach to care adherence.

In effect, sources that would support the opposing view of unidisciplinarity are almost extinct in the current discussion on chronic care management.

The satisfaction to services may be influenced either negatively, positively or not at all by the increase in number of professionals involved in care. American Diabetes Association (2010, p. S47) suggest in their objectives for diabetes care management that "collaborative, multidisciplinary teams to provide high-quality care and support patients' appropriate self-management." The concept of 'high-quality care' could mean in that context either good glycemic control, and other clinical outcomes, or better service quality perceptions.

Service research stream has studied suprisingly little how does the number of different resources in service provision affect customer satisfaction. The broadness of resources in contact with the customer may mean better human asset specificity through specialization. The indirect connection may prove difficult to study.

Professional service variety may or may not also affect other preference-based benefits of care: perceived health and perception of functional status. As in the case of visit frequency, broader resource variety may affirm the patient of the severity of her illness thus resulting in lower perception of health.



## 2.5 Customer-level effects of services

The above discussed resourcing decisions have effects on the customer through service production (see the Managed Outcomes theoretical model in Figure 1). These effects include the benefits to the customer as seen in subchapter 2.2.2. In addition, patient adherence is in this research seen as an important effect as it is the main mediator of successful care.

### 2.5.1 Care adherence

Care adherence is not a direct benefit of care. Yet, it is the main mediator that lead to the benefits. A clear aim of type 2 diabetes care is to increase the patient's care adherence, and thus it is a relevant measure when researching care service effectiveness.

Customer satisfaction seems to be in connection with customer adherence. In a review of patient satisfaction literature Pascoe (1983) concludes that satisfaction serves as a predictor of health-related behavior. Miller (1997) states that according to literature that patient satisfaction with the provider is correlated with compliance, and that the likelihood of adherence is increased when the patient's expectations of a visit are matched by what actually occurs. The latter coincides perfectly with the definition of service quality by e.g. Fitzsimmons and Fitzsimmons (2011) and Parasuraman, Zeithaml, and Berry (1985). Morisky et al. (2008) found statistically significant connection between patient satisfaction to medical care and patient adherence.

The direction of the connection seems to be under debate: does compliance lead to satisfaction or satisfaction to compliance? The former is supported by Dellande, Gilly, and Graham (2004) in a weight control clinic: customer compliance leads to satisfaction directly and through customer goal attainment (i.e. the customer is able to attain the weight loss goal and is thus satisfied with the service that was apparently efficient). In diabetes however the results of compliance are not as visible as in weight loss because the main aim is to reduce blood sugar levels. Kellogg, Youngdahl, and Bowen (1997) have suggested in a conceptual model that customer participation can lead to better satisfaction because the service adapts better to customer needs. In their research the participation means customer communication during the service encounter, and not compliance after the service event as would



be necessary in diabetes context.

Satisfaction leading to customer compliance is somewhat supported by Bowman, Heilman, and Seetharaman (2004): they concluded that perception of medication efficacy leads to satisfaction which leads to compliance. The effect is perhaps not present in case of diseases with deferred consequences. Burgoon et al. (1987) found a positive correlation between satisfaction to service and care compliance, and they suggested a causal link from satisfaction to compliance. Miller (1997) identified patient satisfaction as a factor that increases compliance in chronic asymptomatic diseases. Service quality is seen to lead to customer adherence to guidelines by Tabrizi et al. (2008). Often perception of service quality and customer satisfaction cannot be separated in measurement, as discussed in subchapter 2.2.3.

Morisky et al. (2008) found a statistical association between poor perceived health and lower levels of medication adherence. The causality is difficult to prove: in long-term poor care adherence probably leads to poorer perceived health through increased complications, but in short-term poor perception of own health may have a reverse effect on adherence. Christensen, Grossman, and Hwang (2009) suggested that deferred consequences lead to less motivation to comply. Other way around it would mean that the presence of consequences could increase adherence to the care regimen.

### **2.5.2 Health outcomes**

Health outcomes of type 2 diabetes care are the objective measures of clinical results (see subchapter 2.2.2). The main aim in clinical outcomes are the controlled blood sugar and avoidance of complications. In laboratory tests the common guideline for controlled blood sugar is a long blood sugar level HbA1c below 53 mmol/mol or 7 %. Diabetes complications include mostly problems with eye sight, lower extremities, and kidney. (e.g. Aalto and Uutela, 1997; American Diabetes Association, 2010; International Diabetes Federation, 2011)

The above measures of clinical successfulness of care are taken as granted from the medical research. Other possible health outcomes could include patient BMI, cholesterol level and blood pressure. They are not however direct measures for diabetes. In this study the health outcomes that are directly related to the illness are used.

The basis of clinical care of type 2 diabetes is that adherence to care regimen



leads to measurable health outcomes. The mechanisms that explain how medication and diet influence blood sugar are in the realm of medical and biochemical sciences and thus not discussed here.

### **2.5.3 Other customer benefits**

In addition to health outcomes, the care services have other effect on the customer, as Clancy and Eisenberg (1998) suggested. These include

- customer satisfaction to health services,
- customer perception of health, and
- other effects on the customer

**Customer satisfaction** Customer satisfaction to services is an effect of care provision. In strictly clinical sense satisfaction may be seen irrelevant but in order to have a long lasting customer relationship, satisfaction is important according to service marketing stream. Diabetes care services are long lasting customer relationships.

**Customer perceived health** Customer perceived health is the subjective feeling of own health. It may not be in direct link with clinical indicators. It should be considered as one key outcome of health care services because health, and closely related concept wellbeing, are what health care systems in general aim at producing.

**Other effects on the customer** In addition to satisfaction and perception of health, the care services may have many individual effects on the customer. It would not however help in the research problem to list those effects, and thus this study satisfies in stating that various other effects exist.

## **2.6 Hypotheses and theoretical model**

Drawing from the researched literature, a model of relations between the concepts is developed. This is done by proposing a set of hypotheses, and constructing a structural model out of them. For all hypotheses presented in this section the corresponding null hypothesis states that no connection exists.



### **2.6.1 Human asset specificity, or professional expertise and specialization**

It is hypothesized based on the literature:

- 1a Specialization of the main diabetes care provider enhances customer adherence to care.
- 1b Specialization of the main diabetes care provider increases customer satisfaction to services.

Based on the service marketing literature, and theoretical concept of expertise the hypothesis 1a is formed. It seems that the specialization of the service provider may enhance the abilities to advocate care adherence, thus making diabetes specialized care professionals more efficient in promoting adherence.

A service professional that is specialized in serving one customer segment can make use of the learning curve effect. Expertise enhances adaptiveness to the customer needs and expectations which in turn decreases the gap between service expectation and service experience. Through this logic the hypothesis 1b is drawn.

### **2.6.2 Visit frequency with main care provider**

Three hypotheses on the effect of visit frequency with the main health care professional providing the care are drawn:

- 2a Increased number of encounters with main care professional lead to better care adherence.
- 2b Increased number of encounters with main care professional lead to better customer satisfaction to services.
- 2c Increased number of encounters with main care professional is associated to poorer perception of own health.

The hypothesis 2a is based on the notion that increased interaction enhances the possibilities of the provider to persuade the customer with the stance of adherence to care. More frequent visits may also work as reminders.

The hypothesis 2b is created from service literature and is based on the logic that a greater number of contacts between the customer and service provider lead



to better understanding of customer needs and expectations, which lead to increased service quality and better satisfaction to service. The hypothesis is however weakened by the increase in perceived sacrifice: increased visits may be seen as an extra burden that decreases satisfaction.

The hypothesis 2c is drawn from the idea that the frequent visits increase the feeling of illness i.e. decreases the perception of own health. Also, patients with poorer health may demand more frequent visits.

### **2.6.3 Professional resource variety involved in care**

Three hypotheses on the effect of professional resource variety are formed:

- 3a            Increased number of care professionals in service provision lead to better customer adherence to care
- 3b            Increased number of care professionals in service provision lead to better customer satisfaction to services
- 3c            Increased number of care professionals in service provision is associated to poorer perception of own health.

The hypothesis 3a is based mostly on chronic care model and other chronic care literature. The evidence from literature gives strong support that multidisciplinary increases adherence. From the same sources, hypothesis 3b is drawn.

The increased number of professionals in care may advocate the patient's feeling of illness. Also sicker patients tend to be seen by more professionals. These lead to the hypothesis 3c.

### **2.6.4 Customer satisfaction and care adherence**

- 4             Higher customer satisfaction to diabetes services increases customer adherence to care.

According to existing research on care adherence the hypothesis 4 is reasonable: normally in health care satisfaction increases adherence. Here, it is investigated whether it holds true in type 2 diabetes care.



### 2.6.5 Customer adherence and health outcomes

5 Customer adherence to care leads to better health outcomes.

Based on medical research the hypothesis 5 is formed.

### 2.6.6 Health outcomes and perceived health

6 Better health outcomes are associated with better perceived health

Improvement in health outcomes measures - long blood sugar level and number of complications - should lead to better functionality and perception of health. Hypothesis 6 is based on the idea of effective medical care that improves patient's status in the long run.

### 2.6.7 Theoretical model of resource utilization and care outcomes

In conclusion of the literature research a model of diabetes service resource utilization and customer effects is build. The hypotheses are presented in a structural model in Figure 10.

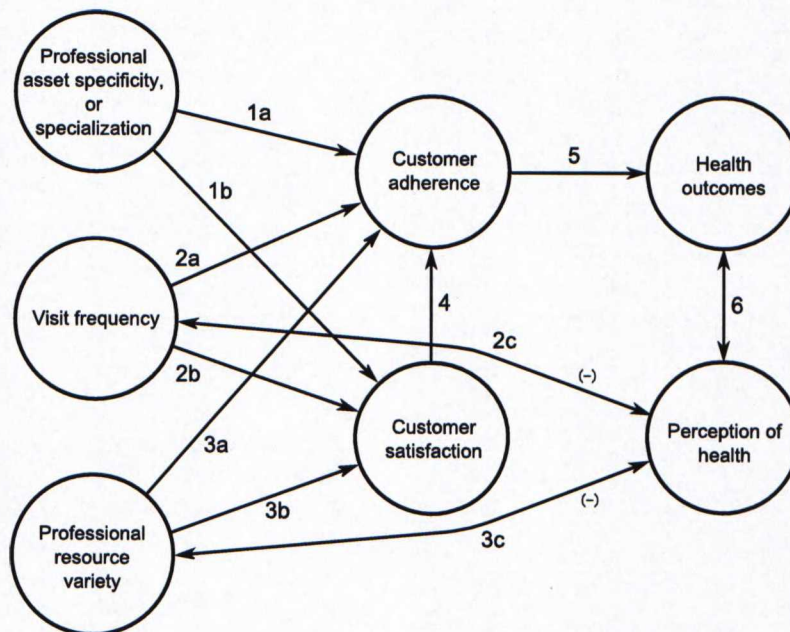


Figure 10: Hypothetical model of resource utilization, care effects and mediators.

From the structural presentation it can be deduced that there are several mediated effects that need to be addressed in the analysis. These will be discussed in more detail in the next chapter.



### 3 Research methods

This section explains the methodology that aims at testing the hypotheses drawn from the literature. Broadly, the method includes a patient survey and a statistical analysis. First the operationalization of the theoretical concepts is explained, next the research setting and survey method are represented. Finally the statistical regression methods are described.

#### 3.1 Operationalization of theoretical concepts

Ketokivi (2009) points out that theoretical concepts need to be bound to empirical concepts to ensure the validity of measures (Figure 11). Theoretical concepts need to correspond with empirical concepts (correspondence rule C1) in order to avoid specification error, and empirical concepts need to be measured correctly (correspondence rule C2) to avoid measurement error. (Ketokivi, 2009)

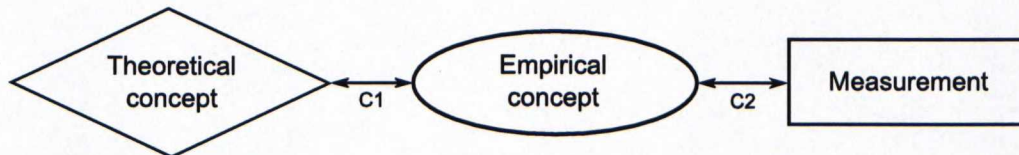


Figure 11: Theoretical concept, empirical concept, and measurement with their correspondence rules (Ketokivi, 2009, p. 44).

In this subchapter each of the theoretical concepts found in the literature review part are connected with an empirical concept thus leading to the measurement methods that reflect the theoretical concepts. The operationalizations, correspondences, and the relevant validity issues are discussed for each of the concepts.

**Visit frequency** Visit frequency is operationalized through the use of main professional resource. The main care professional is the person that the patient sees most often, and is responsible for care. Visits may include also encounters with other care providers but in this study the main care provider visits are chosen as most relevant. The measurement method is patient reported number of visits during the last twelve months.



**Main care provider asset specificity** A health care professional may concentrate on one type of patients or provide general care. In this research the specialization is measured with a dummy that indicates whether the main care professional for the patient is specific to diabetes or not. The groups are formed from patient-reported main care professional title followingly:

- Generalist professionals: a physician without specialization, or specialization in general medicine, or a general nurse
- Specialized professional: a physician specialized in the care of diabetes or endocrinology, or a nurse specialized in diabetes or in diabetes-related chronic care

The choice of operationalization is based on two assumptions. The first and most important is that a care professional with a similar work title mainly treat similar patient groups. In other words it is assumed that the generalist professionals treat diabetes patients only in minor or average degree, whereas diabetes-specialized professionals treat mainly diabetic patients, and to a lesser degree other patients. Second assumption is that diabetes-specialized professional titles are roughly equivalent in the six research regions which is based on personal interviews with Managed Outcomes project partners from each country.

Issues affecting the validity and causing specification error may be caused by flaws in the basic assumptions. The professionals that are named e.g. diabetes nurses may in fact do diabetes related work less than is assumed.

**Professional resource variety** The professional resource variety of care is measured from the patient perspective and is patient-reported: how many care professionals are involved in the care?

The theoretical concept is close to the concept of multidisciplinary. However this operationalization is does not take into account whether the professionals communicate with each other or not, whether they come from the same service provider organization or from multiple sources, and to what extent these professionals are involved (once, or multiple times per year). The chosen measure indicates well the customer view of care as it is not dependent of organizational boundaries.

Measurement error may arise from memory biases, and other biases that are associated with self-reported resource use (Podsakoff et al., 2003). Patient-reported



resource use measurement may tend to underestimate the amount of real resources in care (Richards, Coast, and Peters, 2003).

**Customer satisfaction to services** Customer satisfaction to services is the patient reported degree of satisfaction on the overall type 2 diabetes care services. Measurement is done in a 1 - 7 ordinal scale. The validity of the measurement is good because the customer is asked directly of his or her satisfaction. Reliability of the measure may be affected by the one-item measurement. Potential biases include: the customer assesses the most recent encounters instead the service as a whole, some experiences dominate and cause memory bias, and the mood of the answerer at the time of the survey (Podsakoff et al., 2003).

**Customer perception of health** Customer perception of own health was operationalized with the help of EuroQol Group EQ-5D Visual Analogue scale. The scale is widely used in health care research and includes a vertical 'thermometer' from 0 (worst imaginable health) to 100 (best imaginable health) from where the patient is asked to choose a point that represents the current health state at the time of the survey. Validity of the measure is assessed at fairly good. The measure represents the health perception in a point of time and thus the value may vary considerably. Reliability can be thus seen low. Large data masses tend to overcome this problem by evening out daily variation.

**Customer adherence** Customer adherence to the prescribed care was measured as patient self-assessment. The empirical concept was measured with scales that ask how well does the patient follow the treatment scheme that they are prescribed.

The operationalization of adherence with self-assessment is problematic and may have validity and reliability issues. The answerers may be inclined to overestimate adherence or have difficulties assessing own adherence (Podsakoff et al., 2003; Haynes and McDonald, 2002). The surveys were anonymous which decreases tendency to exaggerate. The survey was performed identically in all research regions and thus the potential bias is more likely systematic.

**Health outcomes** The health outcomes are the physical effects on the patient that can be objectively measured. Porter (2010) suggested that outcomes should be measured in a disease-specific manner. In type 2 diabetes care the most important



health outcome measure of long-term good care is seen to be long-blood sugar balance (HbA1c) (e.g. American Diabetes Association, 2010). The typical threshold for diabetes care balance is long blood sugar value under 53 mmol/mol of glycated hemoglobin (HbA1c). The measure indicates how well the blood sugar levels have been in control over the past weeks and months. Thus the glycated hemoglobin is the single most valid indicator of care balance.

Health outcomes are operationalized by a dummy variable that indicates whether the patient has achieved the threshold or not. The absolute HbA1c value was asked in the survey, and could be reported in two formats: as mmol/mol or a percentage. The two HbA1c scales are interchangeable but some countries, health care providers and health care professionals use one more than the other. The transformation between the scales can be done with a simple mathematical formula. A dummy -variable was formed because of the poor reliability of self-reported long blood sugar values. Respondents may have problems remembering exact numbers and may tend to give an answer that is close by (Podsakoff et al., 2003).

Questionnaire method was chosen due to practical reasons. Patient-level clinical data that could have been connected to survey data would have been more reliable but was not available from provider records. Also due to privacy issues such matching would have been difficult.

The theoretical concepts and their corresponding empirical concepts and measurement methods are listed in Table 2.



Table 2: Operationalization of research variables

Theoretical concept	Empirical concept	Measurement <sup>a</sup>
Visit frequency with main care professional	Customer reported visit frequency	Number of visits per year asked in questionnaire
Main care provider asset specificity	Customer reported main care provider specialization according to the professional title	Main care provider professional title selected from a list in the questionnaire. Transformed to a dummy.
Professional resource variety	Customer reported all involved care professional	All involved care provider professional titles selected from a list in the questionnaire. Sum of the ticked answers.
Customer satisfaction to services	Customer reported degree of satisfaction	Satisfaction to diabetes services scale (1-7)
Customer perception of health	Customer reported perception of own health at the moment	Questionnaire question asking to assess own health situation with EQ-5D-VAS <sup>b</sup> (1-7)
Customer adherence	Self-assessed adherence to prescribed diet, oral medication, and insulin	Questionnaire questions asking to assess the adherence in a scale (1-7) for each (if applicable): diet, oral medication, and insulin
Health outcomes	Care-balance and complication -rate	Long blood sugar as reported by the patient and transformation to a dummy

<sup>a</sup>All measures are asked in a patient filled questionnaire.

<sup>b</sup>EQ-5D-VAS is a visual analogue scale from 0 to 100 for self-assessed health at the moment of survey, developed by EuroQol Group. See Appendix I for further detail.

### 3.1.1 Controlling variables

In order to successfully test the hypotheses, some covarying factors need to be controlled.

Clancy and Eisenberg (1998) suggest that in health outcomes research the controlling variables should include age, social and demographic factors, severity of disease and the relation between organizational characteristics of health system and clinical care. Gender and personal ability or functionality in caring oneself are important controlling factors in health behavior research. Special case in type 2 diabetes is the presence of complications. Complications are likely to affect the degree of treatment and thus the use of resources. Eye and foot complications are included



in the controlling variables under disease severity.

The above controlling variables are adopted and used in all analysis. They are operationalized as presented in Table 3. For detailed questions of how the measurement was performed, see the questionnaire questions in Appendix I.

Table 3: Operationalization of controlling variables.

Theoretical concept	Empirical concept	Measurement <sup>a</sup>
Age	Age	Age in years
Gender	Gender	Gender (man/woman)
Education	Education	Education after compulsory schooling (yes/no)
Disease severity	The diabetes treatment segment, functionality and complication status	Treatment segment (life style/oral medication/insulin)
		Mobility (EQ-5D -measure)
		Selfcare ability (EQ-5D -measure)
		Ability for usual activities (EQ-5D -measure)
		Pain (EQ-5D -measure)
		Anxiety (EQ-5D -measure)
		Degree of eye complications (1 - 3)
		Degree of foot complications (1 - 3)
Organizational characteristics	Differences of health care systems	Region -dummies

<sup>a</sup>All measures are asked in a patient filled questionnaire.

### 3.2 Research setting

The research was done as a part of the research project Managed Outcomes: Operations management and demand-based approaches to healthcare outcomes and cost-benefit research (European Commission Seventh Framework Programme, HEALTH-2009-3.2.2: Healthcare Outcomes and cost-benefit). In the type 2 diabetes study six regions in six European countries were included. This section describes the basic characteristics of the regions and their national health systems.



### 3.2.1 Research regions

The six research regions and their demographic figures are represented in Table 4.

The regions differ greatly in terms of population and population density, environmental setting (rural or urban), ethnicity, and somewhat in age structure

Table 4: The regions involved in Managed Outcomes diabetes research and their demographic information in 2009.

Region	Country	Population	Population density
<b>Bamberg</b>	Germany	214 269	175
<b>Herakleion</b>	Greece	299 689	113
<b>Keski-Suomi</b>	Finland	272 784	16
<b>Nieuwe Waterweg Noord, Delft, Westland and Oostland (NWN &amp; DWO)</b>	Netherlands	443 281	1 624
<b>Tower Hamlets, London</b>	United Kingdom	238 100	11 502
<b>Valencia</b>	Spain	814 208	6 047

To appreciate the geographical differences of the regions, the outlines of each region is presented in scale in Figure 12.

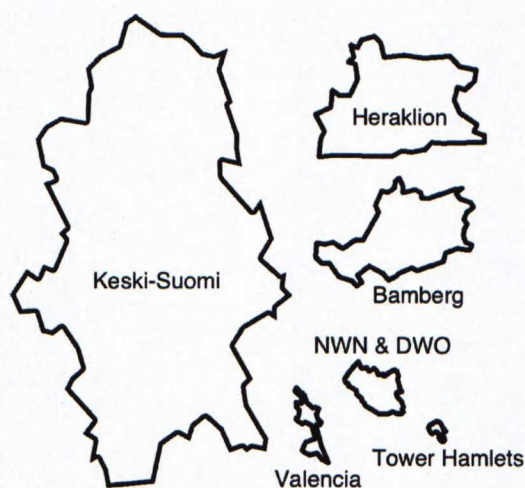


Figure 12: Research regions' maps in same scale

### 3.2.2 European health care systems

A brief introduction to the fundamentals of the health care system in each country is necessary for the understanding of the research setting. The European systems



are by no means equal and the variation may affect the generalizability of the study. The general descriptions are based on the work of Malmström et al. (2012) in the Managed Outcomes project. A more detailed view abridged from Malmström et al. (2012) can be found in Appendix II.

**Finland** The Finnish health care system is a municipality-driven and is characterized by wide public production of services, strong gate keeping and public universal coverage. The Finnish system is most often classified as a social welfare state and NHS-model. Degree of choice to the patient is low.

**Germany** Germany is classified under the social insurance model with compulsory universal coverage, also known as 'Bismarck model'. The German system is characterized by large amount of private and public service providers and easy access to care.

**Greece** Greece has transformed from a social security based healthcare system to NHS model but still has features of both. The Greek system is characterized by high supply and low barriers to care.

**The Netherlands** The Dutch health care system is similar to the German 'Bismarckian type' healthcare system. The Dutch people have mandatory private insurance coverage. The supply is both private and public with strong market mechanisms, the state setting the rules. Patient freedom of choice is high.

**Spain** The Spanish health care system is a NHS-model where provision is controlled by the state and universal coverage is based on citizenship. Supply of services is relatively low, gate-keeping is strong, and user choice is limited.

**United Kingdom** The United Kingdom has a public-contract healthcare system where the health provision is based on the public payers contracting with private healthcare providers in an internal market. The model is a version of NHS. The British system is characterized by medium to low supply, gate-keeping arrangements, and ample patient choice of provider.

Despite differences in health care systems, the underlying phenomenon of interest is thought universal, and thus an international data set broadens the generalizability



of the model. The inclusion of different regions adds to the variation of explaining variables which increases the analysis power of the statistical methods.

### **3.3 Survey method**

A customer survey was performed to gather the necessary empirical data. The survey is cross-sectional of the six research regions performed once. All regions distributed the questionnaires during year 2012.

#### **3.3.1 Sampling method**

The scope of the research is the group of patients with diagnosed type 2 diabetes, and who receive continuous care from their care provider organization. Consequently the relevant sampling source is the providers' customer databases - either electronic or in paper form. The diabetes services customers were extracted from provider databases in chosen service providers in each region.

The sampling was done in two stages: sampling of service providers and sampling of customers.

Service provider sampling was mostly convenience based, meaning that service providers in the research region who were willing to cooperate and with whom previous research agreements existed. In some cases the provider sampling may have covered all service providers in the region.

Customer sampling included all patients that met the inclusion criteria: a diagnosed type 2 diabetic, that has received care from the service provider. The dead were excluded before sending out the surveys.

The customers of diabetes care services participating in the study were contacted with an anonymous questionnaire form by mail, and a prepaid return envelope. The posting was done by the health care provider organizations from whom the patient addresses were found. The accompanying letter asked to return the filled form in four weeks of the receipt. The questionnaire was collected one time and thus presents a cross-sectional data set of the research population.

#### **3.3.2 Survey structure and questions**

The survey used to collect the research data was designed by the Managed Outcomes research consortium for the purposes the research project.



The original survey form was produced in English, and was translated in each country to the language or languages spoken in the research district. Translations were done by professional translators in cooperation with the research group. The survey consisted of 11 pages.

The questions included in the analysis can be found in Appendix I. The following question groups were included in the whole questionnaire:

**General information about the sociodemographic features and the medical history of the participants**

The questions concerning general information can be further divided into two parts. They addressed 1) sociodemographic features of the participants including language proficiency, and 2) basic information concerning patient's diabetes

**The features of the health care from the perspective of the participants**

Four different subjects referring to the diabetes care were addressed by the questionnaire: 1) the access to the physician mainly involved in the diabetes treatment, i.e. the mainly treating physician, 2) the frequency of comprehensive consultation given by the mainly treating physician, 3) the different care professional involved in the patient's care, and 4) the patient's assessment of the whole care experienced in the course of the diabetes treatment.

Questions concerning four different aspects of access to the physician mainly involved in the diabetes treatment were asked: 1) distance between the place from which the patient usually starts his visit to the mainly treating physician and this physician's place, 2) the usual traveling time from the place from which the patient usually starts his visit to the mainly treating physician and this physician's place, 3) the time from applying for an appointment with the mainly treating physician until the appointment, and 4) the waiting time in the mainly treating physician's practice.

**The outcomes** Three different aspects of the outcomes were addressed in the survey. 1) the transitions from less severe to more severe states of diabetes, 2) secondary complications which might be caused by diabetes, and 3) the health-status at the time of the survey.



### 3.3.3 Inclusion criteria

In order to be included in the analysis, the survey respondents needed to have a sufficient skill in the survey language. Language proficiency was asked in two questions concerning the native tongue and proficiency in the language of the survey. Especially in the region of Tower Hamlets a high number of returned questionnaires had to be excluded due to too low language proficiency. Tower Hamlets has a large minority of native Bangladeshi speakers.

### 3.3.4 Response rate

Descriptives of response rates of the survey for each research region are presented in Table 5. Response rate ranged from 15.5 % to 61.4 % and the average was 27.4 %. Most loss due to exclusion of questionnaires was in Tower Hamlets in the United Kingdom and Nieuwe Waterweg Noord, Delft, Westland and Oostland (NWN & DWO) in the Netherlands. All in all the response rate is adequate.

Table 5: Questionnaire forms distributed and returned, and the survey response rate

Region	Investigated institutions	Forms distributed	Forms returned	Response rate	Forms included
Tower Hamlets	7	3070	475	15.5%	313
Keski-Suomi	9	436	183	42.0%	183
Bamberg	5	462	286	61.9%	282
Herakleion	4	600	179	29.8%	179
NWN & DWO	5	779	400	51.3%	387
Valencia	1	625	115	18.4%	115
<b>Total</b>	<b>31</b>	<b>5972</b>	<b>1638</b>	<b>27.4%</b>	<b>1459</b>

## 3.4 Statistical analysis

The research questions and the hypotheses are examined with the help of statistical methods. For this purpose a multiple regression analysis is realized. For all analysis SPSS Statistical Package version 20 for Windows is used.

In this subchapter the choice of statistical method based on the research problem and data characteristic is explained.



### 3.4.1 Variable characteristics

Before regression modeling several tests are made to assess and ensure the appropriate choice of statistical method. According to Ketokivi (2009) the following questions need to be addressed (p. 120):

- Do the variables of interest contain enough variance for regression analysis to be useful?
- Is the quality of variable estimates sufficient (e.g. is the sample size large enough?).
- Are the assumptions on the error term sufficiently fulfilled?

The descriptives of the variables are presented in Table 6. The characteristics of the variables including scales and performed transformations are listed in Appendix III, including scales and performed transformations.

**Variance** The variables of interest each contain a sufficient amount of variance when compared with the mean values. Consequently regression analysis calculations are plausible.

**Sample size and estimate quality** The usable sample size varies between variables. In the regression analysis the amount of usable cases may be considerably lower due to incompleteness of many of the returned surveys. Yet the sample size is at least several hundreds, and when compared to the number of variables it is seen satisfactory.

The quality of the estimates means how well they are able to measure the phenomenon of interest. The validity and reliability of the variables was discussed were subchapter 3.1.

**Distribution** Many of the variables contain some amount of skewness (the distribution is crooked to lower or larger values, not shown in Table 6). However, due to the sufficient sample size the skewness should not affect the results considerably (Ketokivi, 2009). Heteroscedasticity (the variance is different based on the variable value) of the variables is a potential pitfall.



Table 6: Variable descriptives

	N (valid)	Mean	S.D.	Variance	Min	Max
<b>Exogenous variables</b>						
Main care provider asset specificity	1121	0.502	0.500	0.250	0	1
Visit frequency	1267	3.942	3.471	12.046	0	40
Professional resource variety	1418	2.383	1.477	2.183	0	12
<b>Endogenous variables</b>						
Adherence	1264	4.349	0.919	0.844	1	5
Perception of health	1302	67.853	19.491	379.887	0	100
Satisfaction to services	1316	5.729	1.474	2.172	1	7
Care balance <sup>a</sup>	710	0.675	0.469	0.220	0	1
<b>Controlling variables</b>						
Gender	1364	0.562	0.496	0.246	-	-
Education	1290	0.517	0.500	0.250	0	1
Age <sup>b</sup>	1378	65.602	11.425	130.524	20	98
Diabetes severity	1418	2.058	0.629	0.396	1	3
Mobility	1385	1.42	0.501	0.251	1	3
Selfcare ability	1376	1.16	0.418	0.175	1	3
Ability for usual activities	1382	1.36	0.550	0.303	1	3
Pain	1373	1.66	0.616	0.379	1	3
Anxiety	1354	1.39	0.580	0.336	1	3
Degree of eye complications	1356	1.20	0.406	0.165	1	3
Degree of foot complications	1327	1.18	0.415	0.172	1	3
Region <sup>c</sup>	1418	-	-	-	-	-

<sup>a</sup>Values under 5 mmol/mol and over 400 mmol/mol were excluded.

<sup>b</sup>Values under 20 years were excluded.

<sup>c</sup>Variable is nominal, see Table 5 for distributions.

**Error term** The distribution of the error term is assumed normal or near normal. Error term contains the variance that is not explained by the model variables. Main sources of error are likely to be individual respondent characteristics that are assumed to vary randomly.



### 3.4.2 Multiple regression method

Standard multiple linear regression method is used for the analysis of the hypotheses. Linear regression is a statistical technique where a linear function is fitted to the data. In general form regression equation is  $y_i = \beta_1x_1 + \beta_2x_2 + \dots + \beta_ix_i$ , where  $y_i$  is the dependent variable,  $x_i$  the independent variables, and  $\beta_i$  the coefficient of each independent variable. Linear regression algorithm minimizes the square sum of data points producing the best fitting line. As a result the beta coefficients are calculated. (Hair et al., 1998)

Multiple regression method identifies only linear or near-linear dependencies. In a severely non-linear connection the linear regression methods does not provide proof thus resulting in type II error (hypothesis is rejected, even though it is in reality true).

**Regression tests** To evaluate the statistical appropriateness of the regression models standard F-test, goodness-of-fit index, and t-test for significance are calculated. Goodness-of-fit is evaluated with the adjusted  $R^2$  value which takes into account the embedded regressions (Hair et al., 1998). Significance of the regression coefficients is measured with two-tailed t-test and significance levels of 0.01 and 0.05.

### 3.4.3 Mediation

Multiple regression method can be used to test mediation effects and paths of relationships (Baron and Kenny, 1986; Venkatraman, 1989). Mediation specifies the existence of an indirect effect between variables through a third variable (Venkatraman, 1989, see Figure 13). The extent of mediation measures how much of the effect is mediated through the third variable (Baron and Kenny, 1986). This research limits on first degree mediation and does not include effects mediated through two or more consecutive variables.



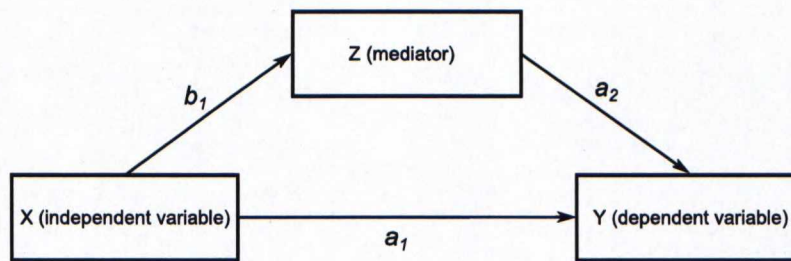


Figure 13: A schematic representation of mediation (Venkatraman, 1989)

In order to establish mediation, four criteria ought to be tested (Baron and Kenny, 1986 as listed in Sauso, 2004):

1. Show that the independent variable (X) is correlated with the dependent variable (Y). Use Y as the criterion in regression equation and X as the predictor (estimate and test path  $a_1$ ). This step establishes that there is an effect that can be mediated.
2. Show that the independent variable is correlated with the mediator. Use Z as the criterion in the regression equation and X as a predictor (estimate and test path  $b_1$ ).
3. Show that the mediator affects the outcome variable. Use Y as the criterion variable in a regression equation and X and Z as predictors (estimate and test path  $a_2$ ). It is not sufficient to correlate Z with the Y; the mediator and the criterion variable may be correlated because they are both caused by the independent variable X. Thus, the independent variable X must be controlled in establishing the effect of the mediator on the dependent variable Y.
4. To establish that Z completely mediates the X — Y relationship, the effect of X on Y controlling for Z should be zero. This implies that the presence of Z is necessary for the transmission of effects of X on Y. If the path  $a_1$  is reduced in absolute size but is still different from zero when the mediator is controlled, partial mediation is implied (i.e. the first three steps apply). The effects in both steps 3 and 4 are estimated in the same regression equation. (p. 27)

The statistical significance in mediation can be approximated with Sobel's test  $z$  statistic. The test has three commonly used alternatives (MacKinnon, Warsi, and



Dwyer, 1995) of which Goodman I version is chosen in this study as suggested by Baron and Kenny (1986):

$$z = \frac{a_2 \cdot b_1}{\sqrt{(b_2^2 \cdot se_{a_2}^2 + a_1^2 \cdot se_{b_2}^2)}}$$

### 3.4.4 Regression models

The number of regression calculations for hypothesis testing is four. The dependent variable, independent variables and their exo- or endogeneity, and the hypotheses testes are listed in Table 7. The controlling variables remain the same in each regression model and are listed in Table 3. Cases with missing variables are treated list-wise within each regression.

Table 7: List of linear regression calculations

	Dependent	Independents	Exo/endogeneity	Hypothesis
I	Customer satisfaction	Prof. asset specificity	Exogenous	1b
		Visit frequency	Exogenous	2b
		Prof. resource variety	Exogenous	3b
II	Customer adherence	Prof. asset specificity	Exogenous	1a
		Visit frequency	Exogenous	2a
		Prof. resource variety	Exogenous	3a
		Customer satisfaction	Endogenous	4
III	Health outcomes	Customer adherence	Endogenous	5
IV	Perception of health	Visit frequency	Exogenous	2c
		Prof. resource variety	Exogenous	3c
		Health outcomes	Endogenous	6

Three mediation effects are implicated by the model and presented schematically in Figure 14.



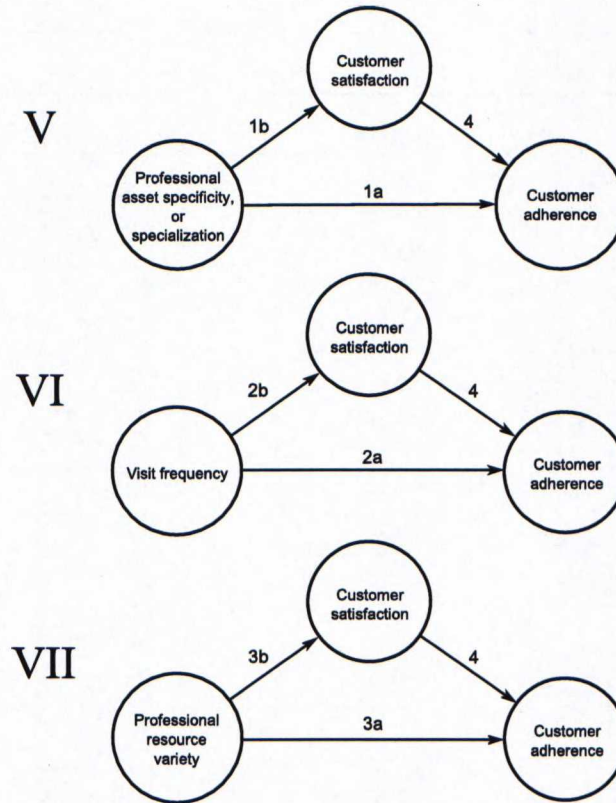


Figure 14: Schematic representations of model-based mediation effects.

The regression calculations for linear regression and mediation effects overlap. Hypothesis 9 is studied in the test number III (see Table 7 for test numbering) fulfilling the criteria 3 and 4. Thus two additional correlations need to be calculated: one that excludes the mediator to study criterion one, and second that excludes independent variable to study criterion two. After this the mediation hypothesis can be assessed.

With the previously explained methods each hypothesis is tested in the results chapter.



## 4 Results

In this chapter the results of the statistical analyses are presented. The interpretation of the results is done in the following chapter.

### 4.1 Analysis

The correlation matrix of all included variables is presented in Appendix IV. Strong and statistically significant ( $p \leq 0.01$ ) correlations are found between the EQ-5D functionality measures and patient perception of health measured with EQ-5D-VAS. The correlations are anticipated as functionality and perceived health are measured side to side, and partly represent the same phenomenon. Strong correlations cause problems of collinearity in regression calculations which will be addressed in conjunction with the regression calculations.

#### 4.1.1 Customer satisfaction

The results of regression calculation I are presented in Table 8. The coefficients in the table are standardized beta coefficients for which two-tailed significance tests were performed. The cases with missing values were eliminated listwise.

Region variable NWN & DWO was excluded from the calculation as it represented the base case for the region -dummies.

Model goodness-of-fit (the adjusted  $R^2$ ) indicates that the power of the model is relatively weak. The calculation suggests that main care provider asset specificity and professional service variety are statistically significant in predicting increased customer satisfaction to type 2 diabetes services. The effect is, however, quite small. Of the controlling variables, pain and ability for usual activities seems to predict the most lower satisfaction to services.

Hypothesis 1a predicted that main care provider asset specificity increases patient satisfaction, and hypothesis 3b predicted that wider professional resource variety increases satisfaction. Both 1a and 3b receive support and the corresponding null hypotheses are rejected. Hypothesis 2b predicted that increased visit frequency would increase satisfaction but did not receive support.



Table 8: Regression analysis for customer satisfaction (N = 784)

	<b>Customer satisfaction</b>
Main care prov. asset specificity	.08*
Visit frequency	.01
Professional resource variety	.08*
Gender	.03
Age	.09*
Education	-.02
Diabetes segment	.05
Mobility	.01
Selfcare ability	-.08
Ability for usual activities	-.04**
Pain	-.11*
Anxiety	-.09
Eye complications	.01
Foot complications	-.05
Tower Hamlets	.03**
Valencia	-.13
Bamberg	-.09
Herakleion	.08
Keski-Suomi	.08
NWN & DWO (variable excluded)	-
R <sup>2</sup> = 0.15	
Adjusted R <sup>2</sup> = 0.13	
F = 6.91**	

\*  $p = 0.05$ , \*\*  $p = 0.01$  (two-tailed tests for the regression coefficients)

#### 4.1.2 Customer adherence

The result of regression calculation II is presented in Table 9. The coefficients in the table are standardized beta coefficients for which two-tailed significance tests were performed. The cases with missing values were eliminated listwise.

Region variable Bamberg was excluded from the calculation as it represented the base case for the region -dummies.

Adjusted R<sup>2</sup> of regression model II remains low suggesting that several factors that predict customer adherence may have been left outside the model. The independent resource-related variables do not correlate significantly with adherence on level  $p = 0.05$ . For main care provider asset specificity and professional resource variety the two-tailed significance tests yielded  $p = 0.06$  which gives weak indications of a connection.

Hypotheses 1a, 2a and 3a predicted that main care provider asset specificity, increased visit frequency, and wider professional resource variety are positively related



to customer adherence to care. Hypothesis 4 predicted that increased customer satisfaction is related to better adherence. As a result of regression calculation II none of the hypotheses received sufficient support to reject the null hypotheses.

Table 9: Regression analysis for customer adherence (N = 725)

	Customer adherence
Main care prov. asset specificity	.07
Visit frequency	.03
Professional resource variety	.08
Customer satisfaction	.05
Gender	-.03
Age	.03
Education	-.05
Diabetes segment	.20**
Mobility	-.03
Selfcare ability	-.05
Ability for usual activities	.07
Pain	.00
Anxiety	-.01
Eye complications	.05
Foot complications	-.11**
Tower Hamlets	-.10*
Valencia	-.04
Herakleion	-.13*
Keski-Suomi	.01
NWN & DWO	.07
Bamberg (variable excluded)	-
R <sup>2</sup> = 0.12	
Adjusted R <sup>2</sup> = 0.1	
F = 4.85**	

\*  $p = 0.05$ , \*\*  $p = 0.01$  (two-tailed tests for the regression coefficients)

Of the controlling variables diabetes care segment and the health care system (region) seemed to affect most customer adherence.

**Mediation effects** The hypothesis 4 predicted that customer satisfaction has a positive relation to customer adherence. The null hypotheses could not be rejected in the calculation II, and thus the relation receives little support.

In order to prove a mediation hypothesis the mediator needs to be related to the dependent in presence of the independent variable as a control (criteria 3). This criteria was not filled and thus the study of mediation effect is not relevant.



### 4.1.3 Health outcomes

The result of regression calculation III is presented in Table 10. The coefficients in the table are standardized beta coefficients for which two-tailed significance tests were performed. The cases with missing values were eliminated listwise.

Table 10: Regression analysis for care balance (N = 561)

	Care balance (HbA1c)
Customer adherence	.02
Gender	.05
Age	.00
Education	.08
Diabetes segment	-.22**
Mobility	-.07
Selfcare ability	-.04
Ability for usual activities	.03
Pain	.01
Anxiety	-.03
Eye complications	-.01
Foot complications	.06
Tower Hamlets	-.02
Valencia	-.04
Herakleion	-.01
Keski-Suomi	.14**
NWN & DWO	.20**
Bamberg (variable excluded)	-
R <sup>2</sup> = 0.13	
Adjusted R <sup>2</sup> = 0.1	
F = 4.61**	

\*  $p = 0.05$ , \*\*  $p = 0.01$  (two-tailed tests for the regression coefficients)

Region variable Bamberg was excluded from the calculation as it represented the base case for the region -dummies.

Model goodness-of-fit (the adjusted R<sup>2</sup>) indicates that the power of the model is weak. The regression calculation does not indicate that customer adherence would increase the possibility of long blood sugar balance in type 2 diabetes patient, and thus this data set does not support hypothesis 5. Best predictors in model III are diabetes segment and region.

### 4.1.4 Perception of health

The result of regression calculation IV is presented in Table 11. The coefficients in the table are standardized beta coefficients for which two-tailed significance tests were performed. The cases with missing values were eliminated listwise. EQ-5D



functionality measures were excluded from the calculation due to strong collinearity with the dependent variable (see Appendix IV).

Region variable Bamberg was excluded from the calculation as it represented the base case for the region -dummies.

The adjusted  $R^2$  of the last regression model is moderate. The collinearity of some of the variables is likely to further decrease the validity of the model. It is discussed more in the Discussion section.

Professional resource variety seems to be associated with lower perceived health. The patient being in care balance is positively related with better perception of health. Also several controlling variables seem to predict the dependent variable: most importantly foot complications, age and region.

Table 11: Regression analysis for perception of health (N = 567)

	Perception of health
Visit frequency	-.03
Professional resource variety	-.07*
Care balance	.06*
Gender	.06*
Age	-.13**
Education	.08**
Diabetes segment	-.09**
Eye complications	-.04
Foot complications	-.21**
Tower Hamlets	-.10**
Valencia	.00
Herakleion	-.08*
Keski-Suomi	.03
NWN & DWO	.16**
Bamberg (variable excluded)	-
R <sup>2</sup> = 0.22	
Adjusted R <sup>2</sup> = 0.21	
F = 20.65**	

\*  $p = 0.05$ , \*\*  $p = 0.01$  (two-tailed tests for the regression coefficients)

Hypotheses 2c and 3c predicted that increased visit frequency and wider professional resource variety are negatively related to patient perception of own health. The hypothesis 3c received support. The direction of effect on of visit frequency seems to be as predicted – a negative association – but the hypothesis 2c did not receive sufficient support to reject the null hypothesis. Hypothesis 6 predicted that health outcomes are positively related to perceived health, and received empirical support.



## 4.2 Model summary

In summary four of the proposed hypotheses received support and in seven tests the null hypothesis could not be rejected in significance levels  $p \leq 0.01$  or  $p \leq 0.05$ . The hypotheses and the results are presented in Table 12.

The resulting model of the studied variables is presented in Figure 15. Overall explanative power of all models was low although F-tests indicated reasonable fit. The total model of interrelated connection could not be proven but some connections were found significant.

Table 12: The results of hypothesis testing

Hypothesis	Dependent	Independents	Calculation	Result	Beta
1a	Customer adherence	Prof. asset specificity	II	0	.07
1b	Customer satisfaction	Prof. asset specificity	I	+	<b>.08*</b>
2a	Customer adherence	Visit frequency	II	0	.03
2b	Customer satisfaction	Visit frequency	I	0	.01
2c	Perception of health	Visit frequency	IV	0	-.03
3a	Customer adherence	Prof. resource variety	II	0	.08
3b	Customer satisfaction	Prof. resource variety	I	+	<b>.08*</b>
3c	Perception of health	Prof. resource variety	IV	+	<b>-.07*</b>
4	Customer adherence	Customer satisfaction	II	0	.05
5	Health outcomes	Customer adherence	III	0	.02
6	Perception of health	Health outcomes	IV	+	<b>.06*</b>

\*  $p = 0.05$  (two-tailed tests for the regression coefficients)

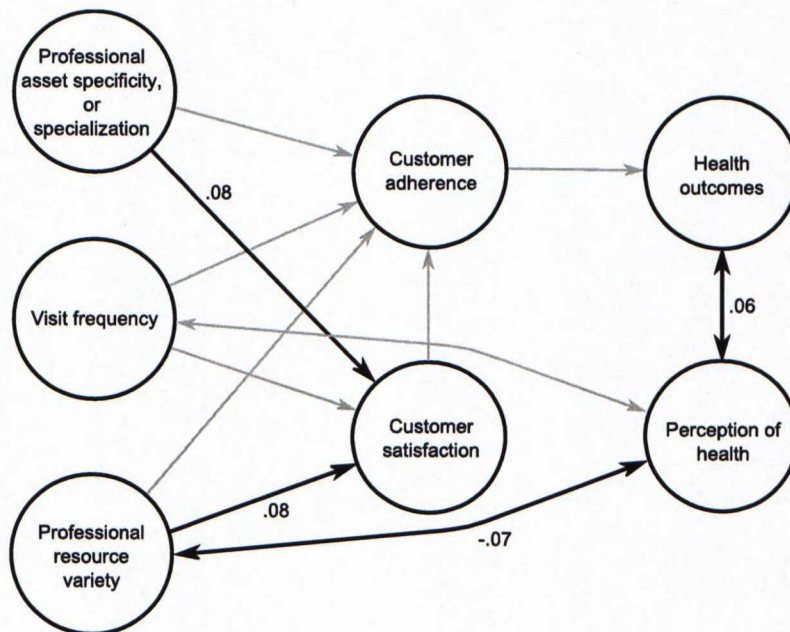


Figure 15: Summary of the observed relations



## 5 Discussion

This research aimed at constructing a theoretical model of interrelated connections between resource utilization factors and patient effects in type 2 diabetes care, and then to test this model with empirical data. This knowledge on the effects of resource utilization on customers could help health care decision makers in making informed resource allocation decisions, and in improving outcomes of type 2 diabetes care.

In the discussion section the findings are evaluated and some explanations are offered.

### 5.1 Theoretical model

This research was based on the conceptual background of the Managed Outcomes research and its extension based on literature review (Figure 16). A set of hypotheses was constructed based on service operations management and health management literature, and the conceptual background of the Managed Outcomes project.

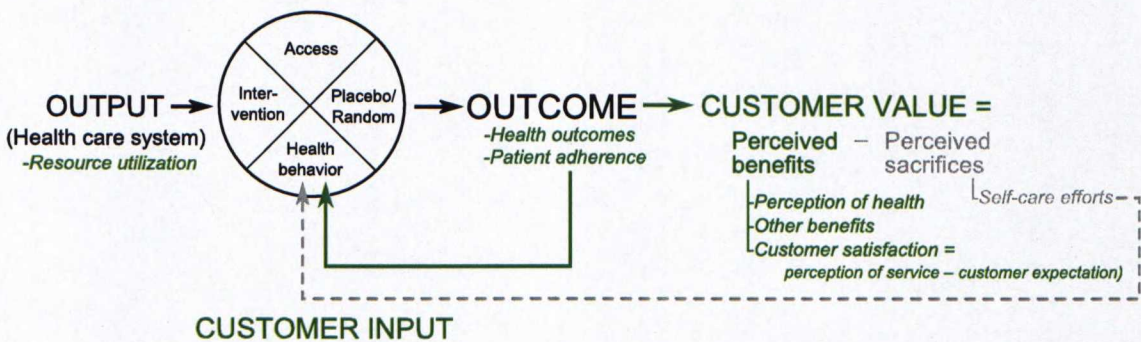


Figure 16: The Managed Outcomes conceptual model extended with customer effects

A theoretical model could be successfully proposed based on literature, and tested with empiric data. The model included type 2 diabetes main care provider asset specificity, frequency of visits to this provider, and professional resource variety involved in the care of the patient. Effects on customer included customer satisfaction to services, customer adherence to care, health outcomes and perception of own health.

However, the theoretical model received low support from the observations suggesting that the relations may be more complex than the proposed model specified.



Some connections between resource utilization, outcomes and benefits could be established. It however seems that the resource choices may be secondary to the production considerations, intervention characteristics, access, and random effects. It may be thus necessary to look deeper into the care processes, and the characteristics of service relationship and service events for a better understanding of successful chronic care.

Next, the findings on literature, resource utilization factors, and customer effects are discussed.

### 5.1.1 Literature on chronic care service management

The existing service operations management and service marketing literature seems to be mostly discussing non-health care, for-profit services. Some literature exists that specifically concentrates on health care services but the chronic care services management continues to lack theoretical knowledge. It seems evident that the gap identified by Berry and Bendapudi (2007) is still broad. Lillrank, Groop, and Malmström (2010) give some insight on the reason: health care is a sector with multiple different, but interrelated, supply and demand logics which each call for different research and management angle; The landscape of health care services is wide and heterogenous.

The main reasons that make type 2 diabetes care different from other services were found to be the strong customer role in care, need for behavioral changes while the consequences are deferred, and the role of service provider as an enabler and supporter of care. The unique set of characteristics makes chronic care a challenging field for research and management. Few analogous services in other sectors can be found which may partly explain the shortage of service operations management research knowledge.

**Health care outcomes and customer value** It was found that health management streams routinely include subjective constructs – such as satisfaction – to health care outcomes (e.g. Clancy and Eisenberg, 1998; Nelson et al., 1996) whereas service research is almost unanimous that these belong to customer value. The used definition separated outcomes as objective effects, and value as customer perception of benefits and sacrifices. Chronic care research can benefit from such a distinction: understanding that the traditional patient outcomes are not equivalent



to what constitutes value for customer may offer support in aligning the needs and wants of customers and health care providers.

### 5.1.2 Main care provider asset specificity

**Impact on customer satisfaction** Main care provider asset specificity was found to have a positive association with customer satisfaction. The finding is supported by both health management and service research.

Research on the Chronic care model (Coleman et al., 2009) suggests that provider expertise is relevant in chronic care services but does not specify the mechanism of action.

Service marketing research gives insight on how the effect may work. Gwiner et al. (2005) hypothesized that service employee's experience in one customer group can enhance knowledge on customers, and increase ability to modify self-presentation which leads to better interpersonal and service offering adaptiveness. Dube, Belanger, and Trudeau (1996) found that picking up emotional cues of the patient and adapting the intervention accordingly can increase customer satisfaction. In other words experienced and segment-focused service employees give more individualized services. The experience on a certain patient group is undoubtedly beneficial thus supporting the asset specificity hypothesis.

In addition to personal communication the specialized care professional may be more adept in process control and use of care-related tools, most importantly information systems for diabetes care.

The positive impact of care provider asset specificity to customer satisfaction may be thus explained with better individualization skills, better communication, and more efficient use of supporting tools.

**Impact on patient adherence** The effect of professional asset specificity to customer adherence received weak support. Effect size was similar to other variables but significance remained slightly above the  $p = 0.05$  threshold used in this research. In the light of existing literature a connection is however plausible. It is possible that the measurement problems of adherence (discussed in research evaluation later on) have lead to a type II error.



### 5.1.3 Frequency of contact

**Impact on customer satisfaction** Contact frequency with the main care provider employee was not found to affect satisfaction to a statistically significant degree. The result is interesting because service marketing research (e.g. Payne, Storbacka, and Frow, 2008) gives indications that satisfaction should be enhanced.

The definition of customer value used in the research stated that customer value is the difference between perceived sacrifice and perceived benefit (Zeithaml, 1988; Storbacka, Strandvik, and Grönroos, 1994). It can be hypothesized that the increase in visit frequency adds to the perceived sacrifice in form of customer effort and time lost. If at the same time the customer perceived benefit does not increase the result would be negative for customer perceived value.

Customer satisfaction was defined as the difference between the perception of service and the expectation. It seems that increasing visits does not necessarily help in meeting customer expectations.

**Impact on patient adherence** The impact of visit frequency to patient adherence did not receive statistical support. Yet, it has received quite convincing backing in the past research, and the results of this research are not in line with the existing evidence. Health intervention research (e.g. McDonald and Garg, 2002; Miller, 1997; Tabrizi et al., 2008) give clear suggestions that adherence should improve.

The lack of effect may be caused by problems in the measurement of adherence, or existence of a reverse effect: more visits are offered to the patients with a lower adherence. This would mean that although increased visit frequency enhances adherence, at the same time the less adherent patients have the most visits. The statistical method would effectively fail in finding the relation.

A possible explanation may also be related to diminishing marginal benefit. Lillrank, Groop, and Malmström (2010) suggested that additional care should be provided to a patient until the marginal impact of care is too low. The findings of this research could be interpreted that the marginal benefit of additional visits are often low in developed health systems and thus do not increase satisfaction or adherence. Such claim would however need additional research.

**Impact on the perception of health** Indications of a connection between the frequency of contact and worse customer perception of own health was not found.



It was hypothesized in the beginning that increased visits may communicate to the patient a notion of illness which would decrease the perception of health. It seems that if such effect exists, it is very weak.

#### 5.1.4 Professional resource variety

**Impact on customer satisfaction** In resource choices, professional resource variety gains most support in attaining better satisfaction.

Increased satisfaction may be explained with service quality gap model (see Figure 5, Brogowicz, Delene, and Lyth, 1990): the number of professionals in the patient's care increases perceived functional quality i.e. the customer has a better perception of the service delivery ("more is done for me"). Consequently the expectations and experience come close to each other resulting in service satisfaction.

This researched showed that – of the three chosen resource choice inputs – professional resource variety had the widest effects on patient satisfaction. While satisfaction may be increased with number of professionals involved in care, patient perception of own health is negatively associated. If the same decision has two opposite effects one must weight the trade-off between benefits and losses. Moreover the effect seemed to be approximately the same size.

**Impact on patient adherence** The effect of professional resource variety to customer adherence was found positive nearly attaining the significance threshold of  $p = 0.05$ . Measurement error may have dampened the effect but it is reasonable to believe that the connection exists.

Previous research indicates strongly that involving various professional to diabetes care improves treatment results and adherence. For example current treatment guidelines (American Diabetes Association, 2010) and the Chronic care model (Coleman et al., 2009; Renders et al., 2001) are unanimously in favor of multidisciplinary.

The mechanism of action can be only speculated because little research exists on the ways that resource variety affects customers in services. Possibly a greater number of professional can persuade patients to adhere better.

**Impact on the perception of health** A decrease in the patient's perception of health was found when number of professional involed in the treatment increases.



The finding may be explained by two effects: either the greater number of care professionals conveys an idea of sickness (“I must be very ill because I receive so much care attention”), or, patients with poorer health – and perception of health – are likely to need wider variety of care professional. The latter effect was controlled with the degree of complications and diabetes segment. The controlling with functionality measures was not done due to strong collinearity of variables which may decrease the reliability of the analysis and affect the results.

### **5.1.5 Effects of type 2 diabetes care**

Based on the literature review the effects of diabetes care on customer were found to be health outcomes, and customer value. Outcomes were defined as objective health outcomes, or changes in patient’s clinical health status. Value in diabetes was defined as the difference between perceived benefits and sacrifices. The perceived benefits include customer satisfaction and perception of health, and sacrifices the efforts put in adherence among others. The structure between these definitions was illustrated earlier in Figure 4.

**Patient adherence and health outcomes** A relation between adherence to care and long blood sugar balance could not be established in this research. The causal connection is however the very basis of clinical care of diabetes suggesting that one of the variables must contain considerable measurement error. The error of adherence measurement is discussed in the evaluation.

**Health outcomes and the perception of health** Objective health outcomes – the care balance in type 2 diabetes patients – was found to be in a positive connection with perception of health. The finding may seem at first hand self-evident, yet the mechanism of action may be complicated: a person cannot directly feel one’s long blood sugar and thus the relationship must mediate or covariate through other factors, or the mere knowledge of blood sugar balance increases perception of health. Degree of complications was controlled and therefore should not be the main mediating factor in the regression model. Bad blood sugar balance is known to cause complications which are very likely to decrease a person’s perception of own health situation.



**Customer satisfaction and adherence** The connection between satisfaction and adherence was not found although previous research suggests a positive relation. The relevance of the finding may be quite low due to measurement error which is discussed later on. One can speculate that satisfaction to services may not be even necessary for good adherence: efficient services do not need to be pleasant.

## 5.2 Evaluation

### 5.2.1 Reliability and validity of results

The overall reliability of the results is affected by three sources: model inaccuracies, input data inaccuracies, and analysis method inaccuracies

**Model** The model of resource utilization factors and customer effects may contain assumptions that are incorrect. The weak model fit to the empirical data suggests that the model as such is not very powerful in predicting the researched phenomenon. The model errors are potentially due to the omitted variable bias which is suggested by the low goodness-of-fit ratios of the regression model. It is necessary to discuss which could be variables that are not included in the model but may still have influence in the phenomenon.

Patient-physician communication quality is seen to be an important factor in successful care of type 2 diabetes (e.g. Haynes and McDonald, 2002). In this research the communication quality was not measured, and it is not known whether it covariates with the independent and dependent variables. Possibly communication quality correlates with satisfaction to services.

Patient personal characteristics may affect preference-based measures and adherence. In this research gender, age and education were taken as controlling factors, but factors such as motivation or personal preferences were not taken into account.

**Data and measurement** The measurement of adherence may be an important source of error. The effect of adherence to long blood sugar could not be established. Yet, the causal relationship is well proven in previous research and the clinical care of diabetes relies on it. Furthermore the relationship between satisfaction and adherence could not be established, and the connections of professional resource variety and specialization to adherence received only little support. Thus it is reasonable to believe that the measurement of customer adherence to care has been erroneous.



Various authors have found that self-reported adherence is often notoriously unreliable (e.g. Morisky et al., 2008; Garber et al., 2004). Moreover the degree of unreliability may be related to nationality, education and even the real adherence: the patients that are in reality less adherent may tend to give more positive answers on their adherence, and patients that are highly adherent may not feel need to exaggerate. This can also cause heteroscedasticity which lowers the usability of linear regression method. Adherence could be measured more reliably with either well-validated multi-item questionnaire tools, electronic medication monitoring devices (Shi et al., 2010), or based on medical expense claims (Pladevall et al., 2004). Research design should be different if personal data was gathered from multiple sources and sample size would probably remain smaller.

Sampling and exclusion methods may have caused some bias: a certain group of patients may have higher response rate than others making the analysis less powerful in the base population. The number of surveys data points included in each of the regression calculations varied because of listwise selection: the survey form with a missing value was excluded, and each regression had a slightly different set of surveys as analysis data. It is possible that certain groups of patients are more likely to leave certain questionnaire items unanswered which would bring additional bias. In this research this effect was assumed random.

**Analysis method** The multiple regression method analyzes linear relations between variables, and it is possible that some of the relations are non-linear. Severe non-linearity (U or W shape interdependency) cannot be detected with linear regression. The visual inspection of data did not suggest non-linearity. Some issues of heteroscedasticity in the input data may also affect the regression calculations, and error term may not have behaved as assumed.

Especially in the case of adherence the different extreme ends may behave differently resulting in non-linear relationships which would be difficult to identify with the chosen linear regression method.

### 5.2.2 Generalizability

The results of the study are reasonably well generalizable in populations which are similar to the base group: type 2 diabetes patients who receive continuous care in an European health care setting. The use of international data increases



generalizability.

The findings may be transferrable to other chronic diseases where the disease and care characteristics are similar: long-term disease with deferred consequences to the patient, and needing extensive patient effort in care.

The found effects may not behave in a same way in health systems where patient care is funded by out-of pocket payments. The generalizability to countries with such systems is limited.



## 6 Conclusions

### 6.1 Practical implications

This study intended to give managerial implications on resource use choices. Although statistically significant relationships could be found, the practical implications to managers are not straightforward due to the small explanatory power of the model. Yet some indicative suggestions can be given.

Increasing visit frequency does not seem to add to patient satisfaction and adherence significantly. The additional costs of increasing visits may not bring desired benefit, and may even worsen patient's perception of own health which can potentially lead to even more service demand. Segmentation is advised to find the customers who benefit from more visits.

Multidisciplinary is a proven way of improving care results but may deteriorate patient perception of health. Offering a wider professional resource variety in diabetes patient care is a potential method to increase customer satisfaction and adherence.

Customer satisfaction as a measure seems to be of limited use when making system or organization level resource decisions. Rather, satisfaction may be more important in individual level service relationship monitoring and in provider level improvement. Managers should be careful in using overall population satisfaction as a measure of the health system. It is suggested to rely primarily on objective health outcomes, and to complement them with customer value -based measures.

Increasing resource supply in in type 2 diabetes services does not automatically improve results. Rather, it may be more beneficial to optimize resource use on patient segment level. Resource allocation decisions should be done jointly with process considerations while taking into account other important factors that affect chronic care outcomes, such as patient access, and demand characteristics.

### 6.2 Scientific contribution

This research intended to contribute to the knowledge gap that exists in applying service management to health care setting. The scientific contribution relates to the results of literature review and the results of the analysis.



A definition and classification for type 2 diabetes care effects on customer was introduced, stating that health outcomes and customer value are separate constructs. Health outcomes are disease-specific effects on the patient. Customer value in type 2 diabetes care is the difference between perceived benefits – such as satisfaction, and perceived health – and the perceived sacrifice – such as the emotional effort of changing one’s lifestyle or adhering to care. The suggested definitions differ from both service research and health management research streams, and may be useful in understanding customer behavior in chronic care.

The literature review revealed a gap in service operations management and service marketing literature concerning chronic care services in a public health care setting. The special characteristics of chronic care, mainly the very important role of the customer in the co-creation of the service, and the role of service provider as a service enabler, are not well understood yet.

The analysis and findings gave additional support to the existing body of knowledge about resource utilization effects on the customer.

### **6.3 Future research**

The phenomenon of service resource utilization effects on customer outcomes needs more research for a better understanding. Future research suggestions are aimed for service operations management, service marketing streams, and chronic care research in health management.

Clearly the service operations management and service marketing literature streams would greatly benefit of future research on the effects of resource choices in long-term services where the customer is main creator of value. Both conceptual and empirical studies are needed because of the current gap in the field. Resource variety or the broadness of the palette of resources in contact with one customer is a phenomenon with little research and theoretical knowledge. The mechanism how multidisciplinary affects the customer relationship is not understood and deserves more research. Furthermore the idea of marginal benefit versus additional costs and sacrifices of services should be investigated more in the context of chronic care. The costs and sacrifices of diabetes care for the customer are considerable, thus a better understanding of their balance could provide valuable knowledge to care management and of patient behavior.

Value in health care and health outcomes of services remain poorly defined con-



cepts. More conceptual research is needed to find a useful definition on which the future research could build on.

Some of the effects were found difficult to investigate because of possible reverse effects. To overcome these issues this research could be duplicated using a randomized controlled trial -design

All in all, the resource utilization decisions in health care services is a field that has great managerial importance but lacks scientific knowledge for decision-makers. Hopefully future research will shed more light on the matter.



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## Appendices

### Appendix I – Survey items

The survey form was developed for the purposes of Managed Outcomes -project by the research consortium. In this appendix the question items that were relevant in this thesis research are presented. The formatting and page layout are not identical to the survey form. Survey included other questions that are used elsewhere in the Managed Outcomes -project.

How old are you? _____ years
Are you: _____ X female X male
Did your education continue after the minimum school leaving age? _____ Yes X No X
If [Survey language] is not your first language, how well do you master it? Not at all X Poorly X Moderately X Well X Perfectly X

Please describe the state of your legs, feet and toes by ticking one of the following boxes. X I have no problems with my legs, feet and toes which are caused by diabetes X I have lesions in my legs, feet or toes which are caused by diabetes; but I have no amputation of my legs, feet or toes caused by diabetes. X A toe, a foot or a leg has been amputated because of problems caused by diabetes.
---

Please describe the state of your eyes by ticking one of the following boxes. X I have no problems with my sight which are caused by diabetes. X I have problems with my sight which are caused by diabetes; but I am not blind. X I am blind as a result of diabetes.
---



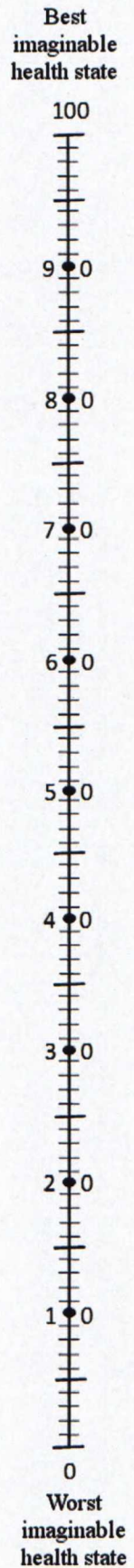
By placing a tick in one box in each group below, please indicate which statements best describe your own health state today.	
<b>Mobility</b>	
I have no problems in walking about	X
I have some problems in walking about	X
I am confined to bed	X
<b>Self-Care</b>	
I have no problems with self-care	X
I have some problems washing or dressing myself	X
I am unable to wash or dress myself	X
<b>Usual Activities</b> ( <i>e.g. work, study, housework, family or leisure activities</i> )	
I have no problems with performing my usual activities	X
I have some problems with performing my usual activities	X
I am unable to perform my usual activities	X
<b>Pain/Discomfort</b>	
I have no pain or discomfort	X
I have moderate pain or discomfort	X
I have extreme pain or discomfort	X
<b>Anxiety/Depression</b>	
I am not anxious or depressed	X
I am moderately anxious or depressed	X
I am extremely anxious or depressed	X



To help people say how good or bad a health state is, we have drawn a scale (rather like a thermometer) on which the best state you can imagine is marked 100 and the worst state you can imagine is marked 0.

We would like you to indicate on this scale how good or bad your own health is today, in your opinion. Please do this by drawing a line from the box below to whichever point on the scale indicates how good or bad your health state is today.

Your own  
health state  
today





Who is generally involved in treating you because of your diabetes?			
	Yes	No	I don't know
A general practitioner	X	X	X
A specialist diabetes doctor	X	X	X
A dietician	X	X	X
An optometrist	X	X	X
A podiatrist	X	X	X
A practice nurse	X	X	X
A nurse who specialises in diabetes	X	X	X
A community nurse	X	X	X
Other (please specify)			

Which of those listed below is the one you see most often in connection with your diabetes? Please tick <b>only one</b> box.	
X	A general practitioner
X	A specialist diabetes doctor
X	A dietician
X	An optometrist
X	A podiatrist
X	A practice nurse
X	A nurse who specialises in diabetes
X	A community nurse
X	Other (please specify)



Are you on a special diet for your diabetes?	Yes X	No X
If yes, thinking back over the last four weeks, to what extent have you kept to the dietary advice?		
Not at all		Perfectly
X	X	X
Are you on tablets for your diabetes?		
	Yes X	No X
If yes, thinking back over the last four weeks, to what extent have you kept to the advice for taking these tablets?		
Not at all		Perfectly
X	X	X
Are you on tablets for your diabetes?		
	Yes X	No X
If yes, thinking back over the last four weeks, to what extent have you kept to the advice for injecting insulin?		
Not at all		Perfectly
X	X	X
Do you know your most recent HBA1C value?		
	Yes X	No X
If yes, could you please tell us this value		
	% (or)	mmol/mol

Thinking back over the last year, how many times have you visited your physician for diabetes care?	times
---	-------

How satisfied are you with the supply of diabetes-related services you have experienced?						
Extremely dissatisfied		Neutral			Extremely satisfied	
X	X	X	X	X	X	X



## Appendix II – Typologies of European health care systems

In this appendix the health care systems of the countries involved in the study are described in general level. The descriptions contain information about the provision logic, financing, and regulation of health care services based on typologies developed by several authors. The text is abridged from the Managed Outcomes mid-project report (Malmström et al., 2012).

**Finland** According to the traditional healthcare system classification of OECD 1987 (OECD, 2011), Finland is classified as a NHS (National Health Services) healthcare system. The system is characterized from this basis by universal coverage where the patient entitlement to receive care is based on citizenship. The financing of healthcare relies on general taxing and the healthcare provision is based on national ownership and control of the factors of healthcare production.

The Finnish healthcare system differs from many other NHS countries by municipalities having the responsibility for organizing health services. For this, municipalities raise funding from municipal taxes, from state subsidies and from user-fees. The majority of municipal health services are provided by municipal-owned health centers and hospital districts and municipalities both fund services and own the service provision organizations. Finland is classified as a low-budget healthcare system with strong restrictions in access to care. According to Reibling (2010), Finnish system combines gate-keeping features with regular cost sharing to coordinate patient access to care in the healthcare system.

**Germany** According to the OECD 1987 (OECD, 2011) classification, Germany is classified under the social insurance model. The SI (Social Insurance) model is characterized by compulsory universal coverage within the framework of social security. As NHS systems, social health insurance systems are “public” by nature, because of the wide coverage and funding principle. According to Busse, Schreyögg, and Smith (2008) the publicly-financed health insurance scheme covers approximately 88% of the German population, 10% of the population are covered by private health insurance and less than 1% of the population has no insurance coverage at all. German healthcare system is characterized by extensive service provision especially in the outpatient sector (Wendt, 2009). The access to care is smooth because of the high number of service providers and the modest out-of-pocket payment, patients have



free access and free choice of medical doctors. Doctors are mainly paid on a fee-for-service basis, which is thought to motivate doctors to offer “more active treatment”. According to Reibling (2010) there is no gate-keeping and cost-sharing instruments to regulate access. Germany is labeled as a weakly regulated and high supply state.

**Greece** Greece transformed in 1983 from a social security based healthcare system to NHS (National Health System) system. However this major shift to public-driven healthcare system is still in progress and is not yet finished.

It has been stated that Greek healthcare system is characterized both by social insurance system and NHS features because healthcare is financed by both taxes and social insurance. There is also two separate authorities that govern public services: NHS and the largest sickness fund (IKA) (Toth, 2010). According to Toth (2010), distinctive for Greece is also the high private expenditure compared to other European countries. In relation to public-private mix of financing, healthcare was financed 60% by general government and 40% by out-of-pocket payments and private insurance in 2009. According to OECD (2011) typology, Greek healthcare system relies on market mechanisms in service provision and has no gate-keeping arrangements to restrict patient access to care. The healthcare system is classified as market-oriented because of high degree of private provision and wide patient choice. Reibling (2010) describes the Greek healthcare system with a high degree of physicians but low level of GP’s with modest regulative restrictions in patient access to care. She labels Greece as a weakly regulated and high supply state. It has also been noted that the situation having no gate-keeping arrangements and a referral system can lead to the situation where the patient access to care is actually restricted and not fluent in Greece. Mossialos, Allin, and Davaki (2005) frame Greek healthcare system as a fragmented and stagnant: the system is characterized not only by a mixture in healthcare financing and authority, but a high degree of centralization, fragmentation of coverage and access to health services, distortions in the allocation of resources, perverse incentives for providers, escalating costs and heavy reliance on relatively expensive inputs derived from the mix of the two healthcare system types.

**The Netherlands** Several typologies classify healthcare system in the Netherlands in the same healthcare system regime with Germany. This so called “Bis-



marckian type” healthcare system is financed by social contributions and managed by health insurance funds. Healthcare provision is characterized both public and private healthcare actors, private providers playing important role. The Dutch system has overcome a wide structural change after implementing several reforms in the 1990’s, latest the Health Insurance Act in 2006 which removed the dual system of social and private health insurance. In contrast to traditional social insurance systems with the role of sickness funds, the citizens are now mandated to buy a basic package of healthcare benefits from a private insurer at a community-rated premium. The role of the government is to set the “rules of the game” when the healthcare insurers, insured or patients and healthcare providers are acting in the healthcare market (the market for the health insurance, healthcare provision and healthcare purchasing). According to Reibling’s (2010) classification, Dutch healthcare system is characterized by strong gate-keeping arrangements and a low level of healthcare professionals.

**Spain** Healthcare system in Spain can be classified as a NHS (National Health Services) model because the patient entitlement to receive care is based on citizenship, healthcare is financed mostly by general taxing and healthcare provision is characterized by ownership and control of the state. According to OECD (2004) typology, in Spain the financing and provision of services are under the states’ control and responsibility. According to Moran (2000) and Toth (2010) the Spanish system lacks the delivery of healthcare services universally in practice, the healthcare financing is based on high share of private financing and lower degree to public funding, there is a high share of private providers, and there still exist arrangements of earlier social insurance system.

According to Reibling (2010), Spain has applied gate-keeping arrangements of GP registration, geographical restrictions to care, and a referral system to specialist care. The supply of healthcare providers and medical technology is analyzed to be low, which also influences the patients’ access to care. In Wendt’s (2009) typology the Spanish healthcare system is described as a low budget - restricted access healthcare system. The OECD (2011) typology groups Spain in the gate-keeping-arrangements, limited user choice of providers and soft budget constraints -group. Regarding the nature and stringency of the budget, constraints are a well-known problem. In Spain the health expenditure target is set in both national and regional



level where the regions' own targets are often exceeded.

**United Kingdom** In the typology of OECD (2004) the healthcare system is categorized as a public-contract healthcare system type where the health provision is based on the public payers contracting with private healthcare providers. The policy reform of “internal market” was applied in the 1990s and meant that the provision of healthcare was divided to the purchaser and provider dimensions. In practice this meant that health services which were earlier been in the direct control of health authority were now categorized as healthcare providers and operated under formed units of semi-independent and non-profit making organizations (“public contract model”). The latest typology of OECD (2011) describes the institutional settings of the healthcare system as “mostly public” in relation to healthcare financing and provision with other traditional NHS countries. UK is further characterized by strict budget constraints, gate-keeping arrangements and ample patient choice of providers. Contrast to OECD (2011) typology, Wendt (2009) categorizes the access to care in UK as highly controlled. The access to care is discovered to be limited and controlled by the state because the moderate number of inpatient healthcare and the low number of outpatient healthcare providers, and because of the regulations regarding patient access to care. Reibling (2010) highlights the gatekeeping arrangements and the availability of health services in the case of UK. According to the latest OECD health report (2011), the number of practicing doctors was under and the number of practicing nurses lightly above the OECD average in 2009.



## Appendix III – Characterization of independent variables

Variable <sup>a</sup>	Type	Scale	Transformation
Number of visits	Discrete number, lower boundary limited	0 - ∞	No transformation needed
Main care provider asset specificity	Nominal	-	Nominal groups transformed into ordinal. Generalist professional = 0 and specialized professional = 1
Professional resource variety	Discrete number, lower boundary limited	0 - 12	No transformation needed
Satisfaction to services	Ordinal, both boundaries limited	1 - 7	No transformation needed
Perception of health (EQ-5D-VAS)	Scalar, both boundaries limited	0 - 100	No transformation needed
Adherence	Ordinal, both boundaries limited	1 - 5	Unweighted average of the applicable questions
Long blood sugar (HbA1c)	Ordinal categories	Yes/no	HbA1c: Transformation to a dummy: Under 53 mmol/mol = 1, over 53 mmol/mol = 0
Age	Discrete number, lower boundary limited	0 - ∞ years	No transformation needed
Gender	Nominal categories	man/woman	No transformation needed
Education after compulsory schooling	Nominal categories	yes/no	No transformation needed
Disease severity (treatment segment and functionality with EQ-5D)	Ordinal categories	Life style/ oral medication/ insulin therapy	Life style treatment = 1, oral medication = 2, insulin therapy = 3
	Ordinal categories (EQ-5D -measure)	1 - 3	No transformation needed
	Ordinal categories (EQ-5D -measure)	1 - 3	No transformation needed
	Ordinal categories (EQ-5D -measure)	1 - 3	No transformation needed
	Ordinal categories (EQ-5D -measure)	1 - 3	No transformation needed
	Ordinal categories (EQ-5D -measure)	1 - 3	No transformation needed
Region	Nominal categories	-	Yes (1) / no (0) -dummy for each region

<sup>a</sup>All measures are asked in a patient filled questionnaire.



## Appendix IV – Correlation matrix of independent variables

	1	2	3	4	5	6	7	8	9	10	11	12
1. Main care prov. asset specificity												
2. Visit frequency	-.03											
3. Professional resource variety	.07*	.16**										
4. Customer satisfaction	.13**	-.013	.10**									
5. Customer adherence	.07*	.07*	.17**	.178**								
6. Health outcomes	.06	-.00	.13**	.115**	.06*							
7. Perception of health	.09**	-.11**	-.05	.235**	.06	.15**						
8. Gender	.02	.02	-.06*	.066*	-.03	.03	.07**					
9. Age	-.05	.01	-.08**	-.004	.05	-.05	-.16**	-.06*				
10. Education	.11**	-.02	.18**	.124**	.05	.23**	.24**	.10**	-.19**			
11. Diabetes segment	.01	.14**	.24**	.022	.21**	-.06*	-.16**	.08**	-.02	-.04		
12. Mobility	-.01	.04	.03	-.15**	-.01	-.13**	-.50**	-.12**	.27**	-.17**	.16**	
13. Selfcare ability	-.07*	.08**	.01	-.20**	-.09**	-.16**	-.44**	-.07**	.19**	-.15**	.07*	.41**
14. Ability for usual activities	-.06*	.05	.02	-.21**	-.05	-.16**	-.54**	-.11**	.20**	-.19**	.12**	.60**
15. Pain	-.11**	.08**	.09**	-.20**	-.04	-.10**	-.55**	-.17**	.15**	-.17**	.14**	.54**
16. Anxiety	-.03	.12**	-.012	-.24**	-.15**	-.11**	-.42**	-.10**	-.04	-.19**	.05	.26**
17. Eye complications	-.07*	.13**	.119**	-.11**	-.04	-.13**	-.24**	-.05	.06*	-.11**	.18**	.22**
18. Foot complications	-.03	.15**	.186**	-.11**	-.07*	-.06*	-.31**	-.02	.10**	-.06*	.17**	.31**
19. Tower Hamlets	-.12**	-.04	-.120**	-.14**	-.12**	-.22**	-.21**	.02	-.12**	-.24**	.00	.18**
20. Valencia	-.21**	.05	-.117**	-.11**	-.07*	-.08**	-.04	-.01	.09**	-.12**	-.02	.01
21. Bamberg	-.17**	.10**	.321**	.01	.08**	.11**	-.07**	-.07*	.04	.12**	.11**	-.09**
22. Herakleion	.15**	.09**	-.193**	-.13**	-.12**	-.02	-.09**	.01	.03	-.20**	.02	.05
23. Keski-Suomi	.08**	-.16**	-.045	.13**	.04	.07*	.05	.06*	-.05	.04	.10**	.00
24. NWN & DWO	.20**	-.04	.063*	.18**	.13**	.10**	.28**	-.00	.04	.28**	-.18**	-.11**

*Table continues on the next page*

\*  $p = 0.05$ , \*\*  $p = 0.01$



*Continued*

	13	14	15	16	17	18	19	20	21	22	23
13. Selfcare ability											
14. Ability for usual activities	.59**										
15. Pain	.38**	.52**									
16. Anxiety	.27**	.34**	.33**								
17. Eye complications	.26**	.22**	.22**	.18**							
18. Foot complications	.31**	.30**	.30**	.18**	.36**						
19. Tower Hamlets	.27**	.24**	.18**	.16**	.18**	.10**					
20. Valencia	.02	-.00	.01	.04	.08**	.01	-.14**				
21. Bamberg	-.04	-.06*	.09**	-.05	.01	.14**	-.24**	-.15**			
22. Herakleion	-.03	.01	-.02	.39**	.00	-.03	-.18**	-.11**	-.19**		
23. Keski-Suomi	-.04	-.05	-.05	-.18**	-.08**	-.03	-.18**	-.11**	-.19**	-.14**	
24. NWN & DWO	-.15**	-.12**	-.19**	-.26**	-.15**	-.17**	-.30**	-.19**	-.32**	-.24**	-.24**

\*  $p = 0.05$ , \*\*  $p = 0.01$