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Willingness-to-Pay for a New Pharmaceutical: Is it Worth the Money? Whose Money?

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Abstract

This study seeks to provide evidence for deciding whether or not a new pharmaceutical should be included in the benefit list of social health insurance. A discrete-choice experiment (DCE) was conducted in Germany to measure preferences for modern insulin therapy using long-acting insulin analogue "insulin detemir" in comparison to NPH insulin. The DCE contains two price attributes, copayment and increased contributions to health insurance. Of the 1,100 individuals interviewed in 2007, 200 suffered from type 1, 150 from insulin-treated type 2, and 150 from insulin-naive type 2 diabetes. This allows to compare ex-ante and ex-post willingness-to-pay (WTP). Non-diabetics and insulin-naive diabetics exhibit higher WTP values through copayment, while affected type 1 and insulin-treated type 2 diabetics have higher WTP through increased contributions. However, WTP values exceed the extra treatment cost in both financing alternatives, justifying inclusion of the new drug in the benefit list from a cost-benefit point of view.

JEL-Classification: I11, H51, I18
Keywords: Health insurance, Discrete-choice experiment, preferences, diabetes

1 Introduction

Health care expenditure (HCE) and especially pharmaceutical expenditure is rising in almost all developed countries. For example, in the United States the share of pharmaceutical expenditures in total HCE increased from 9 % in 1996 to 12 % in 2007 (OECD (2010)). In an attempt to curb this surge, several countries have introduced a cost-effectiveness standard for new pharmaceuticals. This led to the creation of the Medicare Payment Advisory Commission (MEOPAC) scheme in Australia, the National Institute for Clinical Excellence (NICE) in the United Kingdom, and the Institute for Quality and Efficiency in Health Care (IQWIG) in Germany. In Germany, the pharmaceutical bill paid for by statutory health insurance (GKV) increased from €22 billion in 2004 to €26 billion in 2007, or from 1.00 % of GDP to 1.07 % (Statistical Offices of the Länder (2009)). Before 2007, pharmaceutical innovations had to meet safety and efficacy benchmarks to be included in the GKV list of benefits. Now, they also have to be cost-effective.

This study seeks to provide evidence for deciding whether or not a new pharmaceutical for insulin therapy, a long-acting insulin analogue[1][2] should be included in the German benefit list of social health insurance. So far, the standard of treatment has been Neutral Protamine Hagedorn (NPH) insulin which is human insulin. The new pharmaceutical promises several medical advantages, such as fewer events of hypoglycemia, less weight gain (or even weight loss), easier preparation, and more flexibility in injection time (for a list of references on clinical outcomes studies, see Section 3 below). These potential advantages come with an average cost of €226 per year and diabetic (in Germany). Concerning the cost-effectiveness of insulin analogues compared to NPH insulin, there have been several studies presenting mixed, but mostly positive results. Whereas e.g. Caermon & Bennett (2009) find the pharmaceutical not to be cost-effective, other studies disagree, e.g. Valentine et al. (2007) for type 2 diabetics[3] in the United States.

There are two reasons why this preparation is of special interest. First, diabetes prevalence is higher then ever in industrialized countries and continues to increase rapidly. The World Health Organization (WHO) projects the number of diabetics worldwide to rise from 170 million in 2000 to 360 million by 2030 (World Health Organization (2007), Wild et al. (2004)). For the United States Huang et al. (2009) estimate the number of diabetics to increase from 23.7 in 2009 to 44.1 million patients in 2034. Expenditure on diabetes treatment is expected to rise from $ 113 billion to $ 336 billion. The prevalence of diabetes in Germany is 4 to 10 % between ages 40 and 59 and 18 to 28 % for ages above 60 (Hauner (2008)). Second, long-acting insulin analogues may well constitute a test case. IQWIG recommended to drop short-acting insulin analogues from the benefit list (and will do so most likely for the long-acting variant), judging it not to be

[1] The product considered in this paper is "Insulin detemir" by Novo Nordisk Pharma GmbH.

[2] Modern insulin therapy uses long- and short-acting insulin in combination. Whereas rapid-acting insulin meets insulin need during mealtimes, long-acting insulin assures base-level supply. Both rapid- and long-acting insulin can be human or insulin analogue. Whereas human insulin is genetically identical to insulin from the human pancreas, insulin analogue differs slightly to improve the insulin's properties.

[3] In case of type 1 diabetes the body does not produce insulin. It is usually diagnosed in children and young adults and has to be treated with insulin from the beginning. In type 2 diabetes, either the body does not produce enough insulin or the cells ignore the insulin. This type is usually diagnosed in the elderly. Diabetics of type 2 are called "insulin-naive" if they are not treated with insulin (yet) but with oral anti-diabetics. However, during the course of their disease they will need insulin treatment as well (American Diabetes Association (2010)).

cost-effective (IQWIG (2009a) and IQWIG (2009b)). However, these recommendations did not take into account preferences of (potential) patients. Several aspects of the drug which may be innovative from the patient's perspective were neglected or judged as therapeutically unimportant. The (potential) patients' preferences can be elicited in a discrete-choice experiment (DCE). With the inclusion of a financial attribute, willingness-to-pay (WTP, or willingness-to-accept (WTA)) values can be attached to the characteristics of the product, permitting to express its (dis-)utility in terms of money. From the point of view of the insured (comprising both actual and potential patients), inclusion of the new product in the list of benefits is justified if they exhibit a WTP that exceeds the extra cost of the treatment.

To the knowledge of the authors, there has been no WTP study concerning long-acting insulin analogues. This study presents a DCE comparing insulin analogue with NPH insulin conducted in Germany in the Fall of 2007. Participants in the DCE are 1,110 members of statutory health insurance GKV, of whom 200 suffer from type 1 diabetes, 150 from insulin-treated type 2 diabetes, and 150 from insulin-naive type 2 diabetes. Distinguishing these groups allows to estimate ex-ante WTP for non-diabetics and insulin-naive diabetics on the one hand and ex-post WTP for insulin-treated patients on the other. Four attributes describing differences in insulin therapy between NPH insulin and insulin analogue were included according to medical outcomes studies: Risk of hypoglycemia, weight gain during the first six months of insulin treatment, need to swing (not shake) the insulin before injections, and flexibility with regard to time of injection. There are two attributes for the mode of payment, financing through patients themselves (copayment) and through increased health insurance contributions, respectively. The inclusion of two financial attributes permits to test whether the new drug has a favorable benefit-cost ratio regardless of the boosting of WTP caused by health insurance.

There are four main questions to be answered. (1) Is there positive WTP for long-acting insulin analogue by the members of German statutory health insurance? (2) If so, which product attributes contribute to WTP? (3) Is there preference heterogeneity between non-affected non-diabetics and insulin-naive type 2 diabetics on the one hand and type 1 diabetics and insulin-treated type 2 diabetics on the other? (4) Is the benefit-cost ratio of the new drug favorable regardless of whether it is financed jointly through increased GKV contributions or by patients through copayment?

This paper is organized as follows. Section 2 gives an overview of cost-effectiveness studies concerning insulin analogue and of preference studies regarding insulin therapy. Section 3 presents the interview strategy and questionnaire design with the attributes and levels. Then theory behind DCEs is briefly presented in Section 4 with emphasis on the difference between ex-ante and ex-post WTP measurement. Hypotheses are formulated in Section 5 before presenting descriptive statistics in Section 6. Section 7 contains the empirical evidence and hypothesis tests. The four questions raised are answered in the concluding Section 8.

2 Literature Review

Cost-Effectiveness Studies
Existing cost-effectiveness studies of the insulin analogue use quality-adjusted life years (QALYs) as the benefit measure and the incremental cost effectiveness ratio (ICER) as the valuation criteria. Until recently, they focused on the treatment of type 1 patients. For the UK, Palmer et al. (2004) and Palmer et al. (2007) find improvements of 0.09 and 0.66 QALYs, resulting in ICER of £19,285 and £2,500, respectively, which compare favorable with the ICER of £30,000 used by NICE. These estimates are confirmed by Palmer et al. (2008) for Denmark with an ICER of kr55,867 or £6,600. In their multi-country study, Gschwend et al. (2009) conclude that the insulin analogue is likely to be a dominant treatment strategy for type 1 patients in Belgium, Germany, and Spain, and highly cost-effective in France and Italy with an ICER of €519 and €3,256 per QALY, respectively. For the United States, Leichter (2008) found the pharmaceutical to be cost-effective due to lower incidence of acute hypoglycemic events and costly, chronic complications such as nephropathy. In the same vein, Valentine et al. (2006) estimate a ICER of $ 14,974. With regard to type 2 patients the findings are slightly more mixed. While Valentine et al. (2007) estimate an even lower ICER of $ 6,269 than for type 1 patients, Caermon & Bennett (2009) arrive at $ 387,729, leading them to conclude that long-acting analogues are unlikely to present an efficient use of health care resources.

WTP Studies
For all its popularity, the cost-effectiveness measures is not satisfactory from an economic point of view for two main reasons. First, QALYs focus exclusively on health outcomes, neglecting attributes of the treatment process such as fear, isolation, and confinement. Second, this measure does not allow to pit resources devoted to health against resources devoted to other uses. Specifically, it fails to reflect the preferences of citizens who may favor an expansion of the health budget, with the consequence that the threshold ICER value (e.g. the £30,000/QALY applied by NICE) could be adjusted upward. By way of contrast, measurement of WTP values permits to compare marginal benefit to marginal cost, both expressed in money.

The first WTP study concerning insulin therapy is Davey et al. (1998) in Australia. The authors compared insulin lispro, the first rapid-acting insulin analogue, with neutral (regular) insulin using a contingent-valuation approach. Respondents first were presented with the descriptions of two types of insulins and had to choose one. Then, they were taken through a series of "bid-up" questions to determine their maximum WTP. The sample consisted of both type 1 and type 2 diabetics who had been treated with insulin before. The same method was applied by Dranitsaris et al. (2000) to elicit WTP for the rapid-acting insulin analogue Humalog Mix 25. Unlike the first study, the sample was drawn from the general tax-paying public. Sadri et al. (2005) analyzed WTP for inhaled insulin, using the payment scale method. The study involved type 1 and type 2 diabetics and presented results both for insulin-naive and insulin-dependent patients.

In contrast to the contingent-valuation approach, the levels of all attributes characterizing the alternative are allowed to change in a DCE, which makes participants repeatedly choose between the status quo and an alternative. The first DCE study concerning insulin therapy is Aristides et al. (2004) who compared Humalog Mix 25, an insulin analogue, with rapid-acting human insulin Humulin 30/70 and found significant WTP in five European countries. Hauber et al.

(2009) elicited preferences in a DCE for oral diabetes treatment in type 2 patients through a web-enabled survey. Special emphasis was on causes for non-adherence. Guimarães et al. (2009a) and Guimarães et al. (2009b) investigated preferences for oral versus injectable insulin therapy in a DCE. They found that once the psychological barrier to initiating insulin therapy had been overcome, patients accommodated and accepted injectable therapy as a treatment option.

3 The Experiment

Sample and Interview Strategy
This DCE was conducted in Germany in the Fall of 2007. Because one of the research questions is whether financing insulin analogue through contributions to statutory health insurance GKV or through copayment makes a difference in terms of preferences, only adult GKV members (some 90 % of the population) were asked to participate. A professional market reserach institute specialized in health care issues was commissioned to recruit individuals and to perform the interviews, which were face-to-face by trained field investigators. Interviewers found participants mainly through their private contacts with people regularly taking part in surveys. Out of the total 1,110 respondents, 602 do not suffer from diabetes, 202 suffer from type 1, and 306 from type 2 diabetes. Within the type 2 diabetics group, a distinction is made between insulin-naive and insulin-treated patients (152 and 154 respondents, respectively). Diabetics are oversampled to be able to study heterogeneity in preferences. While the sample design allocated the non-diabetics randomly across the 12 Länder (states), ages, and gender, it distributed the type 2 diabetics equally over the three age groups, 46-55, 56-65, and over 65 because type 2 diabetes occurs almost exclusively past age 45. The minimum duration of diabetes treatment (insulin injections or oral therapy) was six months. Because it is very difficult to find patients suffering from type 1 diabetes, randomization was limited to the 12 Länder in this case.

Questionnaire
The questionnaire is divided into four parts.
Part 1: The interview begins with questions about the respondent's health (general health status, regular consumption of pharmaceuticals, chronic illness, diabetes, body mass index) and health insurance (such as yearly contribution or supplementary insurance). This part is the same for all participants.
Part 2: The remaining survey distinguishes between non-diabetics, insulin-treated diabetics, and insulin-naive diabetics. For non-diabetics it contains detailed information about diabetes and its treatment. Respondents are asked to indicate their (subjective) probability of becoming insulin-dependent during their lifetime (using a visual analog scale). Patients treated with insulin are asked about the course of their disease, their insulin treatment, and its side effects. Insulin-naive patients are presented with information about diabetes and its treatment as well. They are asked how long they have suffered from diabetes, their treatment, and side effects. They are made to indicate their (subjective) lifetime probability of depending on insulin (again using a visual analog scale).
Part 3: This part is the same for all participants. To prepare them for the DCE, the attributes are explained in detail, with special emphasis on the two payment vehicles "copayment" and "increase in contribution to health insurance". Since the interviews were face-to-face, respon-

dents had the possibility to ask questions and interviewers, to offer more explanation. Then, the insulin used in current therapy is described to respondents (status quo card). Eight times (see below), an alternative type of insulin with changed attribute levels (alternative card) was presented and respondents asked to choose between the alternative and the status quo.
Part 4: The interview finishes with socioeconomic items (gender, age, education, and residence). The last question is monthly household income to be indicated on a visual analog scale to ensure a high response rate.

Attributes
Although both rapid- and long-acting insulin is required for successful therapy, this study only considers long-acting insulin. Current treatment guidelines use long-acting NPH insulin to provide base-level supply. This therapy constitutes the fixed status quo. It is defined by four attributes, which serve to reflect the differences in the properties of long-acting NPH insulin and insulin analogue. In contradistinction to other DCEs, no pretest was therefore necessary to establish the relevant attributes. They are the following.

Risk of hypoglycemia (*Hypo*, see Table 1) is one of the main side effects of insulin therapy. Its incidence depends on the individual, the dose of insulin needed, individual habits, and the insulin preparation. On average the number of hypoglycemic events can be estimated at 1 to 2 per week (Sreenan et al. (2008) and discussions with diabetologists). With a time horizon of up to six months (see weight attribute below), this puts the risk at 100 percent in the status quo. Most studies suggest that incidence is lower with insulin analogue than with NPH insulin (see Russell-Jones et al. (2004), Vague et al. (2002), Hermansen et al. (2004), Home et al. (2004), Kolendorf et al. (2004), Robertson et al. (2004), Russell-Jones (2007), Dornhorst et al. (2008), Marre et al. (2009) and for meta-analyses Raskin (2007), Satish & Ramachandra (2008), Demssie et al. (2009), Freeman (2009), Hermansen et al. (2009), and Monami et al. (2009)). A study that does not find any differences in the frequency of hypoglycemia compared to NPH insulin is Umpierrez et al. (2009), while Singh et al. (2009) report mixed results. A Cochrane review (Horvath et al. (2007)) concluded fewer analogue users experienced symptomatic overall or nocturnal hypoglycemic episodes compared to NPH insulin users. The magnitude of the decrease varies across studies. Hermansen et al. (2009) found a reduction of total hypoglycemic events of over 50 %, Kolendorf et al. (2004) of 18 %, and Vague et al. (2002) of 22 %. IQWIG wrote in its final report (IQWIG (2009c)) that insulin analogue significantly lowers the risk of severe (analogue: 0.0 % vs. NPH: 2.1 %), of mild (analogue: 57.0 % vs. NPH: 78.2 %, OR = 0.37) and of nocturnal hypoglycemia (analogue: 26.2 % vs. NPH: 44.1 %, OR = 0.45) for type 2 diabetes (for type 1 patients there is no final report yet). A conservative value of 30 % risk reduction is therefore attributed to insulin analogue. In order to have sufficient spread for statistical inference, the alternative incidence levels are set to 75 and 50 % relative to NPH insulin in the DCE.

Obesity (*Weight*) is a major problem of type 2 diabetes patients. 80 % suffer from obesity according to Russell-Jones & Khan (2007). Correspondingly, Häussler et al. (2005) found a significantly higher Body Mass Index (BMI) in type 2 patients than in the overall German population. Insulin therapy makes this problem even worse. As a side effect of treatment with human insulin, patients gain weight, especially during the first months of insulin therapy. The UK Prospective Diabetes Study (UKPDS) Group (1998) observed a 2.5 kg increase over 6 months

Table 1: Product attributes and levels

Attribute	Label	Status quo	Alternatives
Overall risk of hypoglycemia	*Hypo*	100 %	100% / 75% / 50%
Weight change	*Weight*	+ 2,5 kg	+ 2.5 kg / ± 0 kg / – 1.0 kg
Swinging	*Swing*	Necessary	Necessary / Not necessary
Time of injection	*Flexibility*	Predetermined	Predetermined / Not predetermined
Copayment	*Copayment*	None	None / €50 / €150 / €300*
Health insurance contribution	*Contribution*	None	None / +0.5% / +1.0% / +2.0%

* €1 = $ 1.25 at 2008 exchange rates.

on average; this value serves to describe the status quo. Insulin analogue is found to mitigate weight gain (see Haak et al. (2003), Haak et al. (2005), Hermansen & Davies (2007), Raslová et al. (2007), Russell-Jones & Khan (2007), Dornhorst et al. (2008), Demssie et al. (2009), Freeman (2009), Mandosi et al. (2009), Marre et al. (2009), Monami et al. (2009)). It may even cause weight loss of up to 1 kg (Russell-Jones (2007), Sreenan et al. (2008), Hermansen et al. (2009), for meta-analyses see Bush (2007), Raskin (2007), and Satish & Ramachandra (2008)). The evidence allows to associate insulin analogue with a weight gain of 0 kg, while the levels used in the DCE are + 2.5, 0, and - 1 kg, respectively.

Before every injection, human NPH insulin has to be swung (not shaken) to achieve uniform dilution (*Swing*), ensuring injection of an optimal amount of insulin. This defines the status quo (see Table 1). Insufficient swinging causes a risk of injecting a suboptimal amount of insulin and inadequate control of blood sugar levels (Schleser-Mohr (2007)). Insulin analogue can be injected immediately, without swinging (Schmeisl (2009)). These two levels also appear in the DCE.

Another difference in the two types of insulin is flexibility with regard to time of injection (*Flexibility*, see Table 1 again). Human insulin reaches its maximum effect often after a few hours (Soran & Younis (2006)). The time of the bedtime injection therefore is set at 10 pm to avoid insufficient insulin levels in the early morning; this defines the status quo. Insulin analogue has a different action profile. Its maximum effect occurs later (see Kurtzhals (2007) and Demssie et al. (2009)), allowing patients to inject insulin already before 10 pm, usually between dinner and bedtime. However, time of injection should not vary from day to day. Insulin analogue is therefore described accordingly, and this attribute again has two levels in the DCE.

The last two attributes listed in Table 1 describe two modes of financing, individually through copayment by diabetics themselves or collectively through increased GKV contributions by the

whole population. Inclusion of these two price attributes can be justified for at least three reasons. First, Germany has been introducing copayment on pharmaceuticals along with reference pricing of drugs, making it a mode of financing of increasing importance. Second, a population may well have preferences with regard to modes of financing, as evidenced by Skjoldborg & Gyrd-Hansen (2003) for the case of Denmark. And third, economic considerations lead one to suspect that those affected by the disease prefer financing through increased insurance contributions (which fall on everyone) over copayment (which burdens only the affected). This hypothesis will be tested (see H4 of Section 5).

As to *Copayment*, there is none in the status quo for diabetes patients, regardless of type of therapy (see Table 1). In the alternative, the levels are 50, 150, and €300 per year, respectively. As to *Contribution*, respondents were asked to look up the actual amount paid to establish an individual-specific status quo. Contributions are estimated to increase by €8.54 per year and GKV member[4] if insulin analogue is added to the benefit list. On average this corresponds to an increase of 0.5 % of annual health insurance contributions, which is the value attributed to insulin analogue. In the DCE levels characterizing the alternative are set to increases of 0.5, 1, and 2 %, respectively.

Pretest and Design

The pretest was conducted by the same market research institute and consisted of 30 face-to-face interviews with individuals from the greater Leipzig area (17 non-diabetics, four type 2 insulin-dependent, four type 2 insulin-naive, and five type 1 patients, 23 women and 7 men, 52 years of age on average). One-third of the interviews were monitored by the authors of this study. In general, participants and interviewers understood the questions well. 25 individuals rated the choices "easy" and five "difficult". However, no one rated them "very difficult". On average the new insulin was chosen 3.8 times out of 10 choices. Econometric estimates confirmed the relevance of attributes and levels, with one exception. In the pretest, increases in insurance contributions were 0.25, 0.5, and 1 %. Apparently, this range was not sufficient to affect decisions. Therefore it was scaled up to 0.5, 1, and 2 %. Figure 1 shows an example of a choice question.

For the main survey, a D-optimal design was constructed (Street et al. (2001), Burgess & Street (2003), and Carlsson & Martinsson (2003)), using the software GOSSET (see Kuhfeld et al. (1994) and Sloane & Hardin (2007)). Out of the 576 possible combinations, 30 were retained in this way and divided into four card sets. Each set consisted of eight choices between the current insulin (status quo) and a new insulin (alternative). Consistency was tested by including weakly dominated alternatives, which however were favored only by a few respondents. "Expensive" alternatives were chosen significantly less often than "cheaper" ones. In total, the new insulin was picked in 40 %, the current insulin in 60 % of cases. 27 individuals did not alternate between the current and new insulins. Half of the respondents stated that decisions were "easy", 39 % "difficult", and 11 % "very difficult".

[4] On average, extra cost of treatment with insulin analogue rather than human insulin is €226 per year and diabetic. Multiplied by the number of insulin-treated diabetics in Germany (=1.9 million, see Giani et al. (2004)) and divided by the number of GKV members paying contributions (=50.471 million, see BMG (2007)) one obtains €8.54 per year and GKV member.

Figure 1: Choice question example: Fixed status quo (current insulin) vs. alternative (new insulin)

Choice Question: Would you prefer insulin-dependent diabetics to be treated with the current or the new insulin?

	Current Insulin	New Insulin
1 Events of hypoglycemia	on average 1-2 per week	approx. 25% lower risk
2 Weight change during first 6 months of therpay	+ 2.5kg weight gain	+ 2.5kg weight gain
3 Accuracy of dosage / preparation of insulin before every injection	Before every injection swinging necessary	No swinging necessary
4 Point in time of injection	Predetermined: After 10pm (daily identical)	Predetermined: After 10pm (daily identical)
5 Additional copayment per year	None	50 Euro
6 Your Contribution to statutory health insurance per year	_____ Euro	+ 0.5% = +_____ Euro
In this situation I choose	☐ the current insulin	☐ the new insulin

4 Ex-ante vs. Ex-post Willingness-To-Pay

Based on random utility theory (see Luce (1959), Manski & Lerman (1977), McFadden (1974), McFadden (1981) and McFadden (2001)), DCEs are designed to investigate individuals' preferences for (non-)marketed goods or goods that do not exist yet.
In a DCE participants are asked repeatedly to choose several times between a fixed status quo and an alternative whose attributes take on different values each time. When choosing between alternatives, a rational individual will always select the alternative with the higher level of expected utility. Neglecting the expectation operator for simplicity, the decision-making process can thus be seen as a comparison of utility values determined by

$$U_{ij} \equiv v(a_j, p_j, y_i, s_i, \varepsilon_{ij}), \tag{1}$$

where U_{ij} represents the indirect utility value attained by individual i in alternative j. It depends on the vector of attributes a_j, price p_j, the individual's income y_i, and socioeconomic characteristics denoted by s_i. Finally, ε_{ij} is an error term that varies over alternatives and individuals. Provided the error term is additive, the individual will choose alternative k over alternative l if

$$u(a_k, p_k, y_i, s_i) + \varepsilon_{ik} \geq u(a_l, p_l, y_i, s_i) + \varepsilon_{il}, \tag{2}$$

where $u(\cdot)$ is the deterministic component of the utility function $v(\cdot)$. Unlike ε_{ij}, this component can be estimated from observed choice behavior. For this purpose it is assumed that the probability of choosing the alternative k over l, P_{ik}, equals the probability of the difference in equation (2) occurring. Solving for the difference in error terms, one obtains

$$P_{ik} = Prob[\varepsilon_{il} - \varepsilon_{ik} \leq u(a_k, p_k, y_i, s_i) - u(a_l, p_l, y_i, s_i)]. \tag{3}$$

For any inference about the left-hand side of inequality (3), a probability law for $\omega{=}(\varepsilon_{il} - \varepsilon_{ik})$ must be assumed. Since the logistic distribution assumes independence of irrelevant alternatives

(IIA), the normal distribution is used here, resulting in probit estimation. It is assumed that errors are correlated between the choices of a given respondent but not across respondents, calling for random effects specification. With the utility function linear in parameters (Louviere et al. (2000)), one has

$$\Delta U_{ik} = \beta_0 + \beta_1 a_{1k} + \beta_2 a_{2k} + \ldots + \beta_L a_{Lk} + \omega_{ij}, \tag{4}$$

with ω_{ik}=μ_i+ν_{ik}. Here, a_{1k}, ..., a_{Lk} are the attributes of the alternative in consideration. According to equation (3) only differences in utility matter. Thus, fixed characteristics of respondents drop out. The βs are the parameters to be estimated.

Based on Hanemann (1983), the marginal rate of substitution between two attributes m and n is equal to the ratio of the derivatives of the indirect utility function with respect to the two attributes,

$$MRS = \frac{\partial v/\partial a_m}{\partial v/\partial a_n} = \frac{\beta_m}{\beta_n}. \tag{5}$$

Defining n as a financial attribute allows to interpret the negative of the marginal rate of substitution as a marginal WTP for attribute m.

A special feature of this study is that it seeks to measure WTP of both individuals who do not suffer from the disease or do not need insulin yet (ex-ante) and insulin-treated diabetes patients (ex-post). Whereas the utility gained (or lost) from a change in treatment is a real and immediate utility change for insulin-treated diabetics, it is an expected utility for non- and insulin-naive diabetics, which can be written as

$$EU_{ij} = \pi_i \cdot U_{ij}(\text{Therapy}|\text{Diabetic}) + (1 - \pi_i) \cdot U_{ij}(\text{Therapy}|\text{Non-Diabetic}), \tag{6}$$

where π_i is the individual-specific (subjective) probability to come down with insulin-treated diabetes. For patients treated with insulin, π_i is equal to 1, causing the second term of eq.(6) to become zero. In this case, eq.(6) is equal to U_{ij}, the individual's utility experienced form alternative j. When substituting the attributes described above into eq.(1), and assuming linearity, utility for insulin-dependent diabetics becomes

$$\begin{aligned} U_{ij} \quad = \quad & \beta_0 + \beta_1 Hypo_{ij} + \beta_2 Weight_{ij} + \beta_3 Swing_{ij} + \beta_4 Flexibility_{ij} \\ & + \beta_5 Copayment_{ij} + \beta_6 Contribution_{ij} + \varepsilon_{ij}. \end{aligned} \tag{7}$$

For individuals not suffering from the disease and insulin-naive diabetics, π_i is between zero and one. Their expected utility function therefore reads,

$$\begin{aligned} EU_{ij} \quad = \quad & \pi_i \cdot (\beta_0 + \beta_1 Hypo_{ij} + \beta_2 Weight_{ij} + \beta_3 Swing_{ij} \\ & + \beta_4 Flexibility_{ij} + \beta_5 Copayment_{ij} + \beta_6 Contribution_{ij}) \\ & + (1 - \pi_i) \cdot (\beta_0 + \beta_6 Contribution_{ij}) + \omega_{ij} \end{aligned} \tag{8}$$

Recall that the variables in eq.(7) represent the differences between the current and the new insulin. For example $Hypo_{ij}$ is the probability of suffering from hypoglycemia when treated with the current insulin minus this probability when treated with the new insulin (NPH insulin).

Consequently, the values for $Hypo$, $Weight$, $Swing$, $Flexibility$, and $Copayment$ are set equal to zero in case of non-diabetics and insulin-naive patients because they do not vary across alternatives. However, health insurance contributions do vary since if the pharmaceutical is paid for by the GKV, every member contributes to the cost of the medications covered, not only patients.

There are two main reasons for a non-diabetic person to derive utility from and hence have a positive WTP for diabetes treatment, namely altruism and/or buying a call option for better treatment in case of coming down with the disease. Starting with the latter, the first term of eq.(8) shows the change in expected utility of a person who envisages coming down with insulin-dependent diabetes and therefore has positive WTP for a call option on new treatments. The higher the probability π_i, the higher the probability of exercising this option, and the higher WTP. With regard to altruism, the second term of eq.(8) represents the change in expected utility of a person who envisages staying healthy. In this case, β_0 can be interpreted as WTP due to altruism. Finally, eq.(8) can be rewritten as

$$\begin{aligned} EU_{ij} &= \beta_0 + \pi_i\beta_1 Hypo_{ij} + \pi_i\beta_2 Weight_{ij} + \pi_i\beta_3 Swing_{ij} \\ &\quad + \pi_i\beta_4 Flexibility_{ij} + \pi_i\beta_5 Copayment_{ij} + \beta_6 Contribution_{ij} + \omega_{ij}. \end{aligned} \tag{9}$$

This equation holds for non-diabetics as well as for diabetics. For the latter, π_i equals 1 if treated with insulin, causing eq.(9) and (7) to be identical. The calculation of WTP has to be modified as well. If the financial attribute (n) is specified to be copayment, eq.(5) holds. However, if it is GKV contributions, the probability of becoming a diabetic has to be taken into account,

$$\text{WTP} = -\pi_i \cdot \frac{\beta_m}{\beta_6}. \tag{10}$$

5 Hypotheses

This section is devoted to the statement of hypotheses concerning WTP values.

Hypothesis H1:
From the GKV members' point of view, insulin analogue generates an additional utility compared to human insulin.
Increases in contributions and copayment will always have a negative effect on utility. However, this hypothesis states that the other attributes generate enough additional utility compared to human insulin to make its total effect positive.

Hypothesis H2:
WTP values for the attributes are in the following rank order.

H2.1 Decreasing the risk of hypoglycemia has the highest WTP, followed by avoiding weight gain.

H2.2 WTP for more flexibility with regard to time of injection is considerably lower than for avoiding weight gain.

H2.3 WTP for no need to swing the preparation before injection is very low, not significantly different from zero.

Hypoglycemia is a traumatic experience. Symptoms of hypoglycemia include shakiness, dizziness, confusion, and difficulty to speak, just to mention a few. Severe hypoglycemia can cause loss of consciousness and even death. Therefore the highest WTP is expected for a decrease in this risk, dominating concerns about weight gain. This is supported by Hermansen & Davies (2007), who found that patients often take a precautionary snack to avoid hypoglycemia, accepting weight gain as the consequence. Further supporting references are Guimarães et al. (2009b) (in the context of oral and inhaled insulin delivery) and Hauber et al. (2009) (in the context of oral glucose-lowering medications) who conclude that patients of both type 1 and type 2 have a higher WTP for avoiding hypoglycemia than for avoiding weight gain. In turn, avoiding weight gain is expected to generate a higher WTP than more flexibility with regard to time of injection. Aristides et al. (2004) analyzed WTP for flexibility in meal-time insulin injections. Whereas WTP values are significantly positive, they are lower than for avoiding weight gain as estimated by Guimarães et al. (2009b) and Hauber et al. (2009). Finally, failure to swing the preparation might be a worry for patients at the beginning of the treatment. With increasing experience permitting them to save time and effort, WTP for this attribute is predicted to go to zero. Recall that diabetics participating in the DCE had been subject to the condition for six months or more.

Hypothesis H3:
THERE IS SIGNIFICANT HETEROGENEITY OF WTP VALUES BETWEEN DIABETICS AND NON-DIABETICS AND BETWEEN DIABETES SUBGROUPS.
The difference in experience with using insulin might be the key reason for heterogeneity in preferences (as found in Guimarães et al. (2009b)). Whereas type 1 and insulin-treated type 2 diabetics have used insulin before, non-diabetics and insulin-naive type 2 diabetics have not. For instance, they do not know what a hypoglycemic situation feels like and how it can be handled.

Hypothesis H4:
NON-AFFECTED RESPONDENTS AND DIABETICS NOT TREATED WITH INSULIN PREFER FINANCING THROUGH PATIENTS THEMSELVES IN THE GUISE OF COPAYMENT, WHEREAS INSULIN-TREATED PATIENTS PREFER FINANCING THROUGH HEALTH INSURANCE CONTRIBUTIONS.
Both diabetics and non-diabetics are predicted to have positive WTP for insulin analogue. However, WTP values of non-diabetics and insulin-naive diabetics are expected to be higher when financing occurs through copayment by patients themselves than jointly by the whole population through health insurance contributions. Conversely, WTP values of type 1 and insulin-dependent type 2 diabetics should be higher when financing occurs jointly through health insurance contributions.

6 Data: Descriptive Statistics

Table 2 gives an overview of the sample. Approximately 50 % of the respondents are female. Average age is higher for type 2 diabetics than for the rest of the sample because this disease occurs primarily among the elderly (although the number of children suffering from type 2 diabetes has been increasing substantially). Respondents were asked to mark their subjective health status on a visual analog scale ranging from 0 (very bad health) to 100 (very good health). Non-diabetics reported the highest average value of 73, insulin-treated type 2 patients the lowest of 53. On average, type 2 diabetics have the highest BMI with 28 (insulin-treated) and 27 (insulin-naive), respectively. This matches the findings of the UK Prospective Diabetes Study (UKPDS) Group (1998) stating that obesity is highly prevalent among type 2 diabetics. The difference in BMI between type 2 and non-diabetics is statistically significant.

Average net household income is €1,904 per month. Insulin-naive diabetics of type 2 have a lower income (€1,783) than non-diabetics (€1,975). This difference is in accordance with Häussler et al. (2005) who found a negative correlation between prevalence of type 2 diabetes and income. Because contributions to statutory health insurance GKV are defined as a percentage of (labor) income, higher incomes lead to higher contributions. While the function is nonlinear because the percentage varies between sick funds and regions, non-diabetics do pay higher contributions on average than the others. Some 41 % of them also have at least one supplementary insurance contract, compared to 30 % for type 1 diabetics and 31 % for insulin-treated diabetics. This reflects the fact diabetics treated with insulin present high risks to private health insurers offering supplementary coverage, causing high premiums or exclusion clauses to be applied.

The lower part of Table 2 contains information about duration of illness and incidence of diabetic complications. Type 1 diabetics on average have been suffering for 17 years from the disease at the time of the DCE. For type 2 diabetics this value drops to 8 to 9 years. Only 18 % of type 2 diabetes patients with insulin treatment do not suffer from any complication. For insulin-naive type 2 diabetics, this number is 23 % and for type 1 diabetics, 27 %. High blood pressure is the most common complication, followed by diabetic neuropathy, diabetic feet, and diabetic retinopathy. Strokes, hearth attacks, as well as amputations, are most common among type 2 diabetics with insulin therapy.

Table 2: Descriptive statistics

Variable	All respondents		Non-diabetics		Type 1 diabetics		Type 2 diabetics insulin-treated		Type 2 diabetics insulin-naive	
n	1,110		602		202		154		152	
Socioeconomic variables and health status										
Age	51.10	(16.18)	47.70	(16.54)	44.67	(15.17)	61.99	(9.74)	62.11	(9.44)
Female*	51.49		52.25		50.49		50.65		50.65	
Subjective health status[1]	66.46	(23.27)	72.56	(22.46)	62.06	(22.63)	53.70	(21.95)	61.33	(20.74)
BMI[2]	26.17	(4.54)	25.26	(4.16)	26.45	(5.32)	28.18	(4.50)	27.35	(3.98)
Health insurance										
Income[3]	1903.75	(1,014.85)	1,974.55	(1,055.40)	1,814.07	(1,022.41)	1,866.67	(918.88)	1,783.22	(918.07)
GKV contribution[4]	1,879.60	(703.91)	1914.77	(727.90)	1,832.82	(719.00)	1,894.09	(630.44)	1,787.76	(650.30)
Supplementary insurance*	37.03		40.51		30.20		31.17		38.16	
Duration of illness and incidence of diabetes complications										
Years of illness					17.32	(14.40)	8.60	(5.78)	8.03	(8.21)
Diabetes complication*					72.87		81.82		76.97	
High blood pressure*					43.07		63.64		59.21	
Diabetic foot*					20.30		30.52		16.45	
Diabetic neuropathy*					32.67		35.06		27.63	
Diabetic retinopathy*					10.89		14.94		7.24	
Stroke / heart attack*					8.91		12.39		5.26	
Amputation*					1.49		3.90		1.32	

* In % of the respective subsample
[1]: Subjective health status, 0 = "very bad" to 100 = "very good"
[2]: Body Mass Index
[3]: Net per household income per year in €
[4]: Health insurance contribution per year in €
Standard deviations in parentheses.

7 Empirical Results

7.1 Willingness-To-Pay

As a first step, it is important to know whether the attributes retained are relevant and have the expected impacts on utility. Table 3 presents the estimation results of eq.(9). All coefficients are highly significant and have the expected signs. The positive value of the constant can be interpreted as follows. If the specification of the utility function had been perfect, then the difference between the alternative and the status quo would be entirely due to the differences in attributes. There would be no reason to expect a constant different from zero. However, there may be individual characteristics not accounted for that give rise to a bias in favor or against the status quo (Salkeld et al. (2000)). In the present case, the positive constant points to a preference in favor of the alternative and hence a bias against the status quo.

Table 3: Results of a random-effects probit estimation, aggregate sample

Attribute	Expected sign	Coefficient	z-value	Marginal effect
Constant		0.7632	15.77	
Hypoglycemia[1]	+	0.0065	14.07	0.002
Weight[2]	+	0.1380	13.27	0.051
Swing[3]	±	0.2947	8.41	0.108
Flexibility[3]	+	0.1704	4.94	0.063
Copayment	–	−0.0055	−39.97	−0.002
Contribution	–	−0.0047	−5.23	−0.002
σ_u		0.51		
ρ		0.20		

[1]: Decrease of the risk of hypoglycemia
[2]: Avoiding weight gain
[3]: Dummy-variable, 0 = status quo, 1 = alternative

Using eqs.(5) and (10), marginal WTP values depending on the mode of financing (copayment and increase in contributions, respectively) can be estimated. The upper part of Table 4 shows the results for copayment, the lower, for contributions. According to eq.(10) WTP values for the latter must be probability-weighted for deriving estimates that apply to GKV members in general, who would pay increased contributions. Estimates weighted by the average subjective probability of coming down with insulin-treated diabetes are displayed in the last two columns of Table 4. Subjective probabilities (π_i) were measured in the questionnaire using a visual analog scale from 0 % (will never become insulin-treated diabetic) to 100 % (will become insulin-treated diabetic with certainty). For diabetics already treated with insulin, π_i is equal to one. The average value ($\bar{\pi}$) over all respondents is 53 %.

For both modes, preference for the alternative is very high, viz. €262 and €162 per year. In most DCEs, status quo bias is negative, indicating resistance against change (see e.g. Zweifel et al. (2007), Telser & Zweifel (2002)). In the case of diabetes treatment, respondents seem to be willing to pay for a shift away from the status quo.

Table 4: Marginal WTP for product attributes, aggregate sample

Attribute	MWTP	Standard error		z-value	MWTP · $\bar{\pi}^*$
		Delta Method[4]	Bootstrap[5]		
Financing through copayment					
Constant	261.50	8.54	9.11	30.62	
Hypoglycemia[1]	1.19	0.09	0.10	13.48	
Weight[2]	25.15	1.90	2.19	13.23	
Swing[3]	53.69	6.34	6.31	8.47	
Flexibility[3]	31.04	6.29	6.37	4.94	
Financing through health insurance contribution					
Constant	161.75	29.20	41.11	5.54	161.75
Hypoglycemia[1]	1.39	0.28	0.40	4.87	0.74
Weight[2]	29.25	5.79	8.80	5.05	15.55
Swing[3]	62.46	13.87	18.48	4.50	33.21
Flexibility[3]	36.11	10.20	13.31	3.54	19.20

*: Except constant
1: Decrease of the risk of hypoglycemia by 1 percentage point
2: Avoiding weight gain
3: Dummy variable, 0 = status quo, 1 = alternative
4: Standard errors calculated using the Delta Method
5: Standard errors calculated using bootstrapping with 1,000 replications
All MWTP values are in €per year, €1 = $ 1.4 $ at 2008 exchange rates.

As to the risk of hypoglycemia, respondents are willing to pay an estimated €1.19 per year for a 1 percentage point reduction through copayment and €1.39 through contributions. The second amount decreases to €0.74 per year when weighted by average probability $\bar{\pi}$ (see lower part of Table 4). To avoid 1 kg of weight gain, respondents are willing to pay €25 through copayment or €16 through higher yearly contributions, respectively.

To compare the importance of the attributes, consider a 100 % change. Although unrealistic in the case of hypoglycemia, it allows to compare WTP directly with the (0,1) attributes. For the risk of hypoglycemia, a 100 % decrease has an approximate WTP of €119 (copayment) and €139 (contribution), respectively. For fully avoiding the average weight gain of 2.5 kg (see Section 3), which also amounts to a 100 % change, the WTP value is €63 (= 2.5 · 25.15, copayment) and €39 (= 2.5 · 15.55, contribution). Hence, regardless of mode of financing, respondents value lowering the risk of hypoglycemia two times more than avoiding weight gain, corroborating H2.1. As to WTP for increased flexibility with regard to the timing of the injection, the values amount to €31 (copayment) and €19 (contribution), respectively. This is much less than the €63 and €39 for avoiding weight gain, in accordance with H2.2.

Table 5: WTP for product attributes, aggregate sample

Attribute	Financing through copayment WTP	z-value	Financing through contribution WTP · $\bar{\pi}^*$	z-value
Constant	261.50	16.29	161.75	5.54
Hypoglycemia[1]	35.74	13.48	22.20	4.87
Weight[2]	62.87	13.23	38.88	5.05
Swing[3]	53.69	8.47	33.21	4.50
Flexibility[3]	31.04	4.94	19.20	3.54
Total	444.84		275.24	
Total net of constant	183.34		113.49	

*: Except constant
1: Decrease of the risk of hypoglycemia by 30 %
2: Avoiding a 2.5 kg weight gain
3: Dummy variable, 0 = status quo, 1 = alternative

All WTP are in €per year.

The possibility to inject insulin without swinging before every injection is worth €54 (copayment) or €33 per year (contribution), respectively. Since these values differ from zero, they constitute evidence against H2.3. A seemingly minor innovation (from the medical point of view) is clearly valued by consumers. However, it is valued less than avoidance of either hypoglycemia or weight gain. For instance, the difference between €119 (100 % change in hypoglycemia, copayment) and €54 (swing, copayment) has statistical significance in view of the small standard errors displayed in Table 4.

To test H1 (positive value of the new pharmaceutical) total WTP values need to be calculated. As described in Section 3, insulin analogue corresponds to the following changes in attributes. Risk of hypoglycemia decreases by 30 % in comparison to treatment with human insulin NPH. Whereas patients gain 2.5 kg on average with human insulin, there is no weight change with insulin analogue. The preparation does not need to be swung, and the timing of injection is more flexible. Following Hanemann (1983), WTP associated with these non-marginal changes is computed as the marginal WTP multiplied by the change of the attribute's value. These component values are then summed up to obtain total WTP for the product (see Johnson & Desvousges (1997)). The results of these calculations are shown in Table 5. Total WTP for the new drug amounts to €445 per year if financed through copayment and €275 (probability-weighted) if financed through an increase in contributions. Approximately 60 % of this WTP comes from bias in favor of the alternative. Even if this component is subtracted, the resulting values of €183 and €114, respectively, are still significantly positive in view of the small estimated standard errors displayed in Table 5. Therefore, H1 is confiremd.

7.2 Willingness-To-Pay across Subgroups

To obtain group-specific WTP values, eq.(9) is estimated separately for non-diabetics, type 1 diabetics, type 2 insulin-naive as well as for insulin-treated diabetics. Group-specific MWTP values (not shown) are multiplied by the changes in attribute levels due to insulin analogue and summed, in full analogy to Table 5. The subjective probability of acquiring insulin-treated diabetes is 26.2 % on average for non-diabetics and 56.4 % for insulin-naive patients. The resulting non-marginal WTP values across subgroups are presented in Table 6. Sum I comprises all component WTP values, sum II only the significant ones. Standard errors (z-values shown) are small enough to conclude that there is preference heterogeneity between these four groups, confirming H3.

Table 6: WTP for product attributes, stratified by diabetes type

	Non-Diabetics		Diabetics Type 1		Type 2 Insulin-treated		Type 2 Insulin-naive	
Attribute	WTP	z-value	WTP	z-value	WTP	z-value	WTP	z-value
Financing through copayment								
Hypoglycemia	38.53***	10.76	27.95***	4.56	29.25***	4.02	43.98***	5.69
Weight	71.80***	11.23	37.49***	3.39	71.53***	5.35	50.16***	3.69
Swing	56.62***	6.67	48.28***	3.28	72.17***	4.03	25.85	1.43
Flexibility	25.22***	3.00	24.37*	1.65	50.71***	2.89	46.45***	2.57
Constant	597.47***	13.58	106.90***	5.50	94.62***	4.08	286.55***	6.42
Sum I	789.63		244.99		318.29		452.99	
Sum II	789.63		244.99		318.29		427.14	
Financing through health insurance contributions								
Hypoglycemia	11.32***	3.88	34.11*	1.89	100.11	0.63	17.65***	2.51
Weight	21.09***	4.00	45.75*	1.88	244.76	0.65	20.13***	2.38
Swing	16.63***	3.55	58.92*	1.80	246.97	0.64	10.38	1.28
Flexibility	7.41**	2.41	29.74	1.28	173.53	0.62	18.64*	1.87
Constant	175.51***	4.38	130.46**	2.20	323.79	0.67	115.00***	2.93
Sum I	231.96		298.99		1089.16		181.80	
Sum II	231.96		269.25		0.00		171.43	

* Significant at the 10 % level, ** at the 5 % level, and *** at the 1 % level

[1]: Decrease of the risk of hypoglycemia by 30 percentage point

[2]: Avoiding a 2.5 kg weight gain

[3]: Dummy-variable, 0 = status quo, 1 = alternative

[4]: Only significant values

All WTP values are in €per year.

Moreover, comparison of the upper and the lower part of Table 6 shows that the mode of payment matters, but not entirely in the way predicted by H4. As stated by H4, WTP values among diabetics should be higher when the new pharmaceutical is financed through increased GKV contributions rather than copayment, while among the non-affected, it should be the other way round. Now non-diabetics indeed exhibit a higher total WTP value when financing is through copayment. They are joined by the insulin-naive diabetics who apparently deem themselves not to be affected. On the other hand, type 1 diabetics do have higher WTP when financing occurs through increased contributions, but the difference is not statistically significant. For insulin-treated type 2 diabetics, the ordering is as expected at first sight (sum I). Their WTP is extremely high when they envisage financing through increased contributions rather than copayment. However, not a single component value is significantly different from zero, causing sum II to be zero as well. Apparently, opinions concerning insulin analogue are very divided among these patients as soon as it were to be paid for by increased contributions.

The high WTP values estimated for non-diabetics in the case of copayment also merit discussion. It is doubtful that they would be verified in a real purchase decision. Rather, being importantly due to a high constant, they point to a strong bias in favor of the alternative - provided those affected pay for the new drug themselves.

Finally, the entries of Table 6 can also be interpreted in the following way. The high copayment-related WTP values of non-diabetics and insulin-naive diabetics suggest that they prefer financing through patients themselves. Conversely, insulin-treated patients prefer financing jointly through health insurance contributions. However, whatever the group considered and regardless of mode of payment, WTP for insulin analogue measured by Sum I exceeds its cost of treatment (estimated at €226 per year). If measured by Sum II, this is also true, with the only exception of type 2 insulin-treated patients whose preferences are too heterogeneous. Therefore, by a benefit-cost criterion, including this product in the GKV list of benefits appears to be justified.

8 Conclusions

This study revolves around the issue of whether a particular new pharmaceutical should be included in the benefit list of a social health insurer. From a cost-benefit perspective and neglecting distributional concerns, inclusion is justified if the insured have a willingness-to-pay (WTP) that exceeds the cost of treatment with the new product. The case in question is modern insulin therapy, using the long-acting insulin analogue "insulin detemir". Preferences for this preparation in comparison to conventional therapy (using human insulin) are derived with the help of a discrete-choice experiment. It involved 1,110 members of German statuary health insurance (GKV) in 2007, of whom 202 suffer from type 1 diabetes, 154 from type 2 diabetes treated with insulin, 152 are insulin-naive type 2 diabetics, and 602 are non-diabetics. The novelty of the experiment lies in two aspects. First, distinguishing these groups allows to estimate both ex-ante WTP for non-diabetics and ex-post WTP for diabetic patients. Second, including the mode of payment (copayment vs. increased GKV contribution) permits to test whether the new drug has a favorable benefit-cost ratio regardless of the way it is financed. Based on the results reported in the text, four research questions can be answered.

(1) Is there positive WTP for the long-acting insulin analogue? The evidence suggests there is, compared to the conventional therapy using long-acting human insulin NPH (Table 5). Components of this total value are WTP for reduction of the risk of hypoglycemia by 30 %, no weight gain rather than 2.5 kg during the first six months of the therapy, relief from the need to swing the preparation before each injection, and flexibility with regard to the timing of the injection.

(2) Which product attributes contribute to total WTP? All product attributes have positive estimated WTP values. For comparison purposes, a hypothetical 100 % reduction of the risk of hypoglycemia and of the weight gain are considered because the other attributes are (0,1) variables. In accordance with expectations, the maximum WTP value comes from risk reduction with respect to hypoglycemia, followed by avoiding weight gain. The other attributes are less highly valued, as predicted.

(3) Is there preference heterogeneity across morbidity groups, viz. non-diabetics, type 1 diabetics, insulin-treated type 2 diabetics, and insulin-naive type 2 diabetics? Estimates do point to heterogeneity. Total WTP values differ significantly between subgroups. Non-affected insulin-naive type 2 and non-diabetics have similar preferences, as do affected type 1 and insulin-treated type 2 diabetics.

(4) Is the benefit-cost ratio of the new pharmaceutical favorable regardless of whether it is financed jointly through increased GKV contributions or by patients themselves through copayment? The evidence suggests this to be the case, with the one exception of type 2 insulin-treated diabetics, whose WTP values are very high but lack statistical significance. Also, whereas non-diabetics and insulin-naive diabetics exhibit higher WTP values if financing is through copayment, insulin-treated diabetics have higher values if financing is through insurance contributions. This can be interpreted as a preference for financing through copayment on the part of the non-affected non-diabetics and insulin-naive diabetics and through insurance of the part of the affected insulin-treated diabetics. However, since even non-diabetics' WTP is higher than the actual treatment cost of insulin analogue regardless of mode of payment, its inclusion in the German statutory health insurance GKV list of benefits can be justified.

These conclusions are subject to a number of reservations. First, the WTP estimates may be biased upward because participants in the experiment may not be representative of the GKV population. Indeed, the average net household income in the sample is below average, which may result in a general dissatisfaction with the status quo. This might drive up WTP for alternative treatment of diabetes as well. Second, in spite of differentiating between disease-specific groups, there still may be hidden heterogeneity that could correlate with error terms, causing bias in estimates. Finally, one may judge the cost-benefit standard adopted here as inappropriate. On the one hand, benefits should be measured in terms of Quality Adjusted Life Years rather than money should be measured according to some writers (see e.g. Williams & Cookson (2000), Culyer (1990), or Drummond et al. (2005)). On the other hand, average WTP values neglect distributional issues.

While these concerns may well be valid, they are unlikely to overthrow the major findings of this study. First, there is clear evidence suggesting that not only the avoidance of hypoglycemia and

weight gain but also attributes that typically are judged medically irrelevant such as no need for preparation (swinging) and flexibility with regard to the timing of the injection are valued attributes of insulin therapy. In addition, these attributes have positive WTP values among diabetes patients and potential patients alike. Second, these valuations add up to total amounts that exceed the marginal cost of the new drug, with the only exception of type 2 insulin-treated diabetics whose WTP estimates, while sizable, cannot be distinguished from zero due to excess heterogeneity. It is difficult to conceive of biases so strong and distributional weightings so skewed to conclude that WTP values of GKV members likely fail to justify inclusion of this new pharmaceutical in the benefit list.

Disclaimer

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