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Willingness to pay for dental fear treatment

Is supplying dental fear treatment socially beneficial?

Introduction

Dental phobia, or extreme dental fear, is a condition that affects approximately 5% of the population [10, 36]. Patients with extreme dental fear are characterized by intense physiological arousal and feelings of fear before and during dental treatment. Dental fear has been shown to be a major determinant of both dental health and mental well-being [10, 16]. For example, in a recent epidemiological study [30], the median number of functional teeth in the age group 55–64 years was 7.5 for individuals with severe dental fear compared to 22 for individuals without dental fear. This makes a substantial difference to oral health, both chewing ability and aesthetics. Furthermore, Aartmann [1] found that patients with dental fear have a higher score on general psychological distress tests than the general population. According to Scott et al.[29], the most common reasons for not seeing a dentist were the cost of the treatment and fear of the dentist. A major problem when treating patients with dental fear is to motivate them for treatment. Many of them have not been to the dentist for years or avoid dental treatment completely. Their latest dental treatment experiences have often been unpleasant extractions after long-standing infections with severe pain. The thought of receiving regular dental treatment without an urgent need for treatment is inconceivable.

There are numerous reports of dental fear treatment showing significant reductions in dental fear levels (see e.g. [4, 5, 6, 11, 13, 15, 17, 18, 19, 20, 21, 22, 23, 27, 33, 34, 35]). Even in long-term follow-ups from 2–10 years, the results are favourable [2]). Thus, treatment outcome concerning dental fear is obviously beneficial for the patients. The question remains whether the cost of the treatment exceeds the benefits. None of the studies mentioned above discuss the efficient allocation or social desirability of supplying dental fear treatment; they only focus on treatment outcome.

In order to investigate the benefits to dental fear patients, and to evaluate the desirability of supplying dental fear treatment, an experiment was conducted at the Institute for Clinical Odontology, Dental Faculty at the University of Oslo, testing three different dental fear treatments: nitrous oxide sedation, cognitive therapy and applied relaxation. To evaluate the patients' demand for fear treatment, we applied a Contingent Valuation survey. The patients were, among other things, asked to state their maximum willingness to pay (WTP) for the treatment they received. These WTP statements were then compared with the actual cost of the treatment to evaluate how these patients would act if this treatment were to be offered to them in a market. This information was used to evaluate the optimal provision of dental fear treatment if it were to be supplied by an ordinary dentist in combination with dental treatment.

Fear of going to the dentist will most probably result in a low WTP, in particular before uncertainty about the benefits of the dental fear treatment is revealed. If the dental aversion is great, it may seriously influence the social desirability of supplying the treatment, as patients who benefit from it *ex post* may not purchase it without knowing the outcome. In order to investigate how robust our conclusions are with respect to uncertainty, we asked the patients to state their maximum WTP both before and after they received the treatment. This information was used to discuss how non-rational fear may affect the provision of dental fear treatment in the market before the patients knew the effect of the treatment. We also asked the respondents to distribute their maximum WTP for the total treatment on WTP for dental treatment and dental fear treatment separately. Finally, we investigated whether receiving the dental fear treatment in this experiment increased the patients' ability to cope with a normal treatment situation, asking them after receiving the treatment if they expected to be able to cope with an ordinary dental appointment in the future.

The reminder of this paper is organized as follows: in Section 2, we describe in further detail the design of the experiment and the valuation survey. In Section 3, we outline the theoretical foundation for the analyses presented in this paper, modelling the patients' decision problem and discussing how to evaluate the profitability of different dental fear treatments. In

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Section 4, we present the results from our analyses, and in Section 5, we make some concluding remarks.

The experiment

The fear treatment

From February 1995 to June 1996, dental fear patients were invited to attend a research programme, if they met two inclusion criteria: i) They were adults with severe dental fear,[1] and ii) they were willing to accept all the practical arrangements of the experiment, which included answering several questionnaires and paying a fee of NOK 1,000 (€111) before attending the experiment. The fee was used to prevent dropout, which is a common problem in such surveys. The fee included all psychological, pharmacological and dental treatment offered during the trial. The patients were informed that if they skipped one or more treatment sessions, no substitute sessions would be offered and no money would be refunded.

Three patients were referred from dentists and two from other health workers, but the majority of patients made contact on their own initiative or through relatives or friends. In total, 65 patients met the inclusion criteria and were assigned to a dental fear treatment programme. Most of the patients attended all appointments and only two patients dropped out of the programme. Half the patients had not been to the dentist for the last 10 years or more. The average number of years since the last dental visit was 12 years, with a maximum of 30 years for one patient and a minimum of 1 year for five patients. The need for dental treatment also varied considerably, from no surfaces needing treatment (one patient) to 53 surfaces needing treatment. The mean number of surfaces needing treatment was 13. The typical patient was a young (33-year-old) female (64.62%) with a low gross income (NOK 170,463 €18,340). For more information about the clinical results and the experiment, see Willumsen [39] and Willumsen et al. [40, 41, 42].

[1] Clinical evidence shows that a score on the Corah Dental Anxiety Scale of 15 or above indicates this condition [3].

All patients went through a 10-week treatment programme with the focus on controlling pain, increasing predictability, controlling the situation, increasing self-efficacy and dealing with fear reactions. They also had access to soft music during exposure to dental situations. The programme also focussed on the behaviour of the dental staff. The patients were then given dental treatment and dental fear treatment (either nitrous oxide sedation, cognitive therapy or applied relaxation). The patients were randomly assigned to the different dental fear treatments. During the experiment, the patients were asked to answer several questionnaires: an assessment of dental fear, a general distress survey, an assessment of personality, a willingness-to-pay questionnaire and a follow-up survey. The patients were asked to answer the first three questionnaires three times during the experiment: at enrolment, before attending treatment and after receiving treatment.

The measure used to assess dental fear in this study was Corah's Dental Anxiety Scale, (CDAS) (Corah 1969). This is a four-item test measuring anticipatory dental fear on a scale from 4 (no fear) to 20 (extreme fear). It is considered to be a coarse but valid and reliable instrument for assessing dental fear. The Symptom Checklist 90 Revised questionnaire (SCL-90-R) was used to measure the patients' emotional distress. It consists of 90 items, each rated on a five-point scale where 0 is *not relevant* and 4 is *very important* [8]. The patient's mean score for all 90 items is called *the global severity index*. At enrolment in the study the patients had significantly higher scores on the global severity index than people in the Norwegian population [37]. During the treatment programme, the patients' mean score for both the CDAS and the global severity index of SCL-90 were significantly reduced (see [39, 40, 41, 42]).

The contingent valuation survey

After the end of the treatment programme, a valuation survey was conducted in order to measure the patients' benefits from the treatment. To ensure neutrality, a person unknown to the patients conducted the interviews. This was a telephone survey. One patient was unavailable on the telephone, and 64 patients were interviewed. Sixty-two of these patients had finished the trial, and two had dropped out of treatment. The aim of the valuation survey was to elicit the patients' WTP for treatment and their expectations prior to the experiment. To elicit the patients' WTP, we applied the contingent valuation method (see e.g. Mitchell and Carson [25] for more information), where the respondents, among other things, were asked an open-ended contingent valuation question concerning their maximum WTP for treatment. Before the WTP question, the respondents were informed that the dentist would be regulated so that he would not profit from supplying the fear treatment. That is, they were to pay the actual cost of carrying out the fear treatment. They were then asked for the highest price they would be willing to pay in order to receive the treatment. This was done in order to avoid respondents answering the WTP questions strategically, as some patients expressed concern that their dentist would profit from their dental fear. In order to analyse the effect of uncertainty on social desirability, the patients were also asked to state their maximum WTP for treatment prior to the experiment. In order to evaluate the net benefits of the dental fear treatment, we needed to decompose the total WTP for the experiment into WTP for dental treatment and dental fear treatment separately. This was done by asking the patients to distribute 100 points between the two motivations according to their importance for total WTP. We used a simultaneous approach to decompose total WTP in order to avoid ordering effects. Ordering effects occur when the sequence of valuation questions affects the WTP estimates when a set of goods is valued in a sequence (see e.g. Halvorsen [12] for more information). Finally, we asked the patients whether they expected to be able to cope with a normal dental appointment without additional dental fear treatment in the future.

The use of Contingent Valuation Method (CVM) in health care studies has been discussed in several recent articles (see e.g. [7, 28, 31, 32]). In his 2003 article in Health Economics, Smith discusses various aspects of a good CVM survey, in par-

ticular with respect to health care issues. He mentions several factors of importance in constructing and presenting the contingent market, focusing on a behavioural market design where the good, the payment vehicle and time frame is well defined. In our survey, the patients have experience consuming the good in question. The description of the good is thus not hypothetical, but related to an actual treatment that the patient has received. Furthermore, the market is constructed within the already exciting market for dental treatment, which is known to the respondents. In Norway, patients' pay for dental treatment by the hour, making the payment vehicle in the CVM survey realistic and the time period for the payment well defined. The survey also explicitly handles uncertainty in the patients' WTP-responses, asking the respondents to state their WTP both before and after receiving the fear treatment. This makes it possible to analyse how risk aversion influences the social desirability of supplying the treatment.

Theoretical framework

In this section, we model the relationship between the patients' expressed WTP and the benefits from treatment, both dental treatment and dental fear treatment, before and after uncertainty is revealed. Then, we discuss the econometric specification of the model and how to use the data to obtain an estimate of the WTP-function. Finally, we discuss how to use this information to evaluate the desirability of the project.

Benefits from the treatment

We used a two-period model, before and after the experiment, for the patient's benefit from treatment. We assumed that a patient gains utility from the consumption of goods conditional on his dental health and mental health, represented by the utility function:

$$U^t = U\left(\vec{X}^t; H_D^t, H_P^t\right) \qquad (1)$$

where $\vec{X}^t$ is a vector of private goods consumed in period t $(t = 1, 2)$, H_D^t is the patient's dental health at period t *and* H_P^t is the patient's mental health at period t. The utility is assumed to increase with diminishing returns in both the consumption of private goods and the health capital in all periods.

The patient has the ability to improve both his dental health and his mental health capital in the second period by investing in dental treatment and dental fear treatment in the first period. We denote the consumption of dental treatment in the first period X_D^1 and the consumption of dental fear treatment in period 1 X_P^1. The health capital in the second period is assumed to be a function of the initial health capital and the investments in health in the first period $\left(H_j^2 = H_j\left(H_j^1, X_j^1\right),\ j = D, P\right)$. The investments in both dental health and mental health are given from the experimental design, represented by the type of dental fear treatment offered and the number of treated surfaces. Thus, the quantity of the health investment is exogenous to the patient after deciding whether to participate or not.

We assume that the patient's main motivation for participating is to improve his dental health, but that he also wants to reduce his anxiety in order to cope with an ordinary dental appointment in the future. The patient is assumed to be able to go to a normal dentist if his mental health capital exceeds a critical limit $\left(\tilde{H}_P\right)$. Here we assume that none of the patients attending this experiment had sufficient mental health capital to go to a normal dentist in the first period.[2] Furthermore, we assume that the patient did not know *exactly* how much his or her investment in dental fear treatment in the first period would affect his or her mental health capital in the second period. The patient's investment will, however, increase the probability of being able to cope with an ordinary dental appointment in the second period, given by $\pi = P\left(H_P^2 \geqslant \tilde{H}_P\right)$.The probability of *not* being able to go to the dentist in the second period, evaluated in the first period, is thus 1–π. In the second period, after uncertainty is revealed, the patient will ei-

[2] The participants were, however, sufficiently motivated to volunteer for the experiment. That is, their mental health capital exceeded a lower limit for deciding whether or not to attend this experiment.

Abstract

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Abstract
The aim of this paper is to discuss the social desirability of supplying dental fear treatment in addition to dental treatment using the results from a treatment programme for patients with severe dental fear. The programme consisted of three different dental fear treatments: Cognitive therapy, applied relaxation and nitrous oxide sedation, in addition to dental treatment. To evaluate the effects of uncertainty on the patients' benefits from the programme, we elicited their willingness to pay, both before and after receiving treatment, since we expected patients to be uncertain about the outcome of the dental fear treatment. We found that the social desirability of the treatment was very sensitive to uncertainty. While only 24% of the patients were willing to pay the actual cost of the treatment before attending, 71% were willing to pay afterwards. This implies that many patients who would benefit from the treatment *ex post* are not willing to pay the cost of the treatment *ex ante*, and will thus not receive any treatment unless it is subsidized.

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Dental fear treatment · Willingness to pay

ther be able to cope $(H_P^w \; if \; H_P^2 \geqslant \tilde{H}_P)$ or not $(H_P^s \; if \; H_P^2 < \tilde{H}_P)$ The expected mental health capital in the second period, evaluated in the first period, is thus defined as: $E(H_P^2) = \pi H_P^w + (1-\pi)H_P^s$.[3]

Since the patients are not certain how their investment in health will affect them when deciding on participating in the experiment in the first period, they are also uncertain about their benefits from dental fear treatment. The expected utility in the second period, as evaluated in the first period, is thus the weighted utility of the patient being able to go to the dentist or not, given by:

$$E(U^2) = \pi U\left(\vec{X}^2; H_D^2, H_P^w\right) + (1-\pi)\, U\left(\vec{X}^2; H_D^2, H_P^s\right) \qquad (2)$$

To measure the patient's benefits from investments in dental health and mental health, we apply the compensating variation (CV),[4] which is defined as the difference in expenditure necessary to be indifferent about receiving treatment or not. The expenditure function (C) is defined as the minimum expenditure necessary to achieve a given utility level ($\bar{U}$) discounted over the two periods, for a given set of prices:

$$C(p_X^1, p_X^2; H_P, H_D, \pi) \equiv \min_{X_i^1, X_i^2} \sum_{i=1}^{I^1} p_i^1 X_i^1 + \sum_{i=1}^{I^2} p_i^2 X_i^2$$
$$s.t. \left\{ U\left(\vec{X}^1; H_D^1, H_P^1\right) + \delta\left[\pi U\left(\vec{X}^2; H_D^2, H_P^w\right) + (1-\pi)\, U\left(\vec{X}^2; H_D^2, H_P^s\right)\right] = \bar{U} \right\} \qquad (3)$$

where p_X^t is a vector of all prices in period t, p_i^t is the price on good i in period t, X_i^t is the consumption of good i in period t and δ is the discount rate ($t=1, 2$ and $i=1, 2, ..., I^t$).

Since the outcome of the treatment is uncertain, the CV measure for the treatment, evaluated in the first period, will also be uncertain for several reasons. If the patients do not receive treatment, they are assumed to know the state of their mental health capital in the second period, but assumed to be uncertain of their dental health capital, since they are not able to cope with an ordinary dental appointment. If the patients attend the experiment, we assume that they do not know for certain if they are able to cope with a normal dental appointment in the second period, but they will know the state of their dental health capital. That is, we assume all decayed surfaces to be fixed in the experiment. Evaluated in the first period, we denote the expected dental health capital and the mental health capital in the second period without any treatment $E(H_D^2)^0$ *and* $H_P^{2^0}$ and the dental health capital and the expected mental health capital with treatment $H_D^{2^1}$ *and* $E(H_P^2)^1$. The CV for the experiment evaluated in the first period is given by:

$$CV^1 = C\left(p_X^1, p_X^2; H_D^1, E(H_D^2)^0, H_P^1, H_P^{2^0}, \bar{U}\right) - C\left(p_X^1, p_X^2; H_D^1, H_D^{2^1}, H_P^1, E(H_P^2)^1, \bar{U}\right) \qquad (4)$$

This is the patient's maximum WTP for the total treatment (both dental treatment and dental fear treatment) evaluated in period 1. In the second period, there is no uncertainty about the effect of the dental fear treatment if the respondent has participated. The patient's CV in the second period for participating in the experiment is thus given by:

$$CV^2 = C\left(p_X^1, p_X^2; H_D^1, E(H_D^2)^0, H_P^1, H_P^{2^0}, \bar{U}\right) - C\left(p_X^1, p_X^2; H_D^1, H_D^{2^1}, H_P^1, H_P^{2^1}, \bar{U}\right) \qquad (5)$$

Whether the maximum WTP for the total treatment in the first period (CV^1) exceeds the maximum WTP in the second period (CV^2) depends on the patients' expectations about the benefits from dental fear treatment, their attitude towards dental treatment and their *ex post* evaluation of the treatment in the second period.

Since all these patients have dental fear, it is reasonable to believe that they are reluctant to attend dental treatment programmes. If patients with dental fear and risk aversion have rational expectations, their CV for treatment in the second period after uncertainty is revealed will exceed their CV in the first period. This is because uncertainty about the outcome of treatment and dental fear reduces their expected utility and thus their CV in the first period. If the patients exaggerate the positive effects of dental fear treatment and the negative state of their dental health, it will reduce the effects of dental fear and risk aversion on their CV in the first period, making the difference smaller.

Econometric specification

We approximate the patients' expected CV in the first period (Eq. 4) by a linear function of the patients' annual gross income (Y), the patients' dental health and mental health capital in period one before receiving any treatment $(H_D^1 \; and \; H_P^1)$ and a stochastic error term (ω). We also assume that the patients' stated WTP before the treatment reflects their CV in the first period, and that the stochastic error term (ω) is normally distributed with a zero expectation and a heteroscedastic variance. The expected WTP-function in the first period before treatment is given by:

$$WTP^1 = \beta_0 + \beta_2 Y + \beta_3 H_D^1 + \beta_4 H_P^1 + \omega \qquad (6)$$

As a measure of the patients' mental health capital, we apply the results from the Symptom Checklist 90 Revised questionnaire, which is used to assess emotional distress. It consists of 90 items; each rated on a five-point scale, where 0 is *not relevant* and 4 is *very important* [8]. The state of the patient's dental health was recorded on the first session as the number of decayed, missing and filled surfaces in all 28 permanent teeth. Both these measures were recorded at enrolment to the experiment and before and after the treatment took place. These variables indicate the effect on WTP of the stock and investments in health capital.

Furthermore, we assume the WTP-functions for the total treatment, the dental fear treatment and the dental treatment in the second period after all uncertainty is revealed (see Eq. 5) is given by:

$$WTP_j^2 = \alpha_0^j + \alpha_1^j CT + \alpha_{21}^j Y + \alpha_3^j \Delta H_D + \alpha_4^j \Delta H_P + \alpha_5^j B_D + \alpha_6^j B_P + \varepsilon^j \qquad (7)$$

where WTP_j^2 is the patient's stated WTP for good j *(j= total, dental treatment and dental fear treatment)* after receiving the treatment, CT is a dummy for receiving

[3] Here, we assume all factors affecting the patient's dental fear, other than participating in the experiment, to be constant.

[4] See Varian [38], Mas-Colell et al. [24] or Mitchell and Carson [25] for more information on the CV measure.

cognitive therapy, Y is the patient's annual gross income and ΔH_D and ΔH_P are the patient's change in health capital from the first to the second period. The number of surfaces treated by the dentist measures the change in dental capital, and change in mental capital is measured as the difference in the global severity index before and after treatment. We also included two dummy variables, which measure the perceived benefits from both dental treatment and dental fear treatment (B_D, B_P). These variables equal 1 if the patient reported the benefits from the treatment to be low, 2 if the benefits are medium and 3 if the patient reported the benefits from the treatment to be high. Finally we included a stochastic error term (ε^j), which we assume is normally distributed with a zero expectation and a heteroscedastic variance.

Evaluating social desirability

The major concern of this experiment was to evaluate whether supplying dental fear treatment in a market was socially desirable. Since investments in health capital must be considered a private good, a competitive market ensures an efficient allocation when all externalities are reflected by the WTP and/or production cost.[5] It is reasonable to believe that the patients include most positive effects to themselves of increased dental health and mental health in their expressed WTP for treatment. There might, however, be some positive external effects for other family members, friends, the labour marked, etc., that are not captured in the WTP statements.

The socially optimal provision of the service is where the socially weighted marginal utility and cost of providing the good are equal for all consumers and producers. Since an investment in health capital is a private good, the social desirability is evaluated by comparing the socially weighted CVs and the cost of supplying the treatment to the marginal consumer. The social welfare weights equal the marginal utility of income times the marginal welfare weights (see e.g. Johansson [14], Chapter 7). Since the social welfare weights consist of two unobservable components, we cannot evaluate whether the project represents a socially optimal allocation of dental fear treatment, regardless of the choice of welfare function. Thus, when discussing the optimal provision of the good, we mainly focus on an efficient allocation and not the optimal distribution between patients (as measured by the social welfare function). We will, however, indicate in which direction including social welfare weights will affect the conclusions.

Assuming that all externalities are included, it would not be economically efficient to supply more than what the marginal patient is willing to pay before the treatment has started, even if the number of patients who are willing to pay the costs increases *ex post* after uncertainty about the benefits from dental fear treatment are revealed. However, if we are concerned with the distribution of well-being in addition to an efficient allocation of resources, it might be optimal to subsidize dental fear treatment in order to increase demand. First, one may argue that applying standard rules for economic efficiency, assuming both rational behaviour and rational preferences, is not meaningful in cases concerning treatment of mental suffering. Thus, the desired level of supply may be where the CV *ex post* (as measured by the marginal patient's WTP after the treatment) equals the cost, since this is the patient's CV under full certainty about the effects of dental fear treatment and with reduced mental distress. Second, the high score on general psychological distress tests often seen in this patient group [1, 39] may be an indication of reduced ability to function in the workplace. Thus, dental fear may have external effects on the patients' productivity and may reduce their income. In our sample, the mean private income is very low, less than 43% of mean Norwegian private income in 1994. If this is the case for dental fear patients in general, this has several impacts on the evaluation of both the efficiency and the social desirability of dental fear treatment. If all external effects in the workplace are not reflected in the patients' expressed WTP for treatment, the cost of dental fear is underestimated, and it may be economically efficient to subsidize the supply of dental fear treatment. Furthermore, the low income in this patient group implies that they have a large marginal utility of income as compared with more wealthy groups, since the marginal utility of income decreases with income. For this reason, the social desirability of treatment is likely to be underestimated, and it will be beneficial for society to subsidize dental fear treatment. This is both because of the high marginal utility of income in this patient group and because society often wants to redistribute resources to less wealthy consumers.

The patients participating in this experiment were able to locate and contact the staff in order to attend. It is thus reasonable to believe that this sample of patients was highly motivated and actively seeking help for their dental fear condition. Not all dental fear patients will be this open and resourceful. It is reasonable to believe that this group of patients with a lower WTP would be more averse to dental treatment than the sample participating in our experiment. One may argue that this self-selection mechanism may have caused bias in our study. However, since the study aims to discuss allocation of dental fear treatment within a market framework, we have reason to believe that this problem is not severe. This is because the market is a selection mechanism in itself, allocating the good to the most motivated consumers with the highest WTP. Thus, our sample of dental fear patients probably represents consumers who would participate in the market more than the average dental fear patient. By using the market mechanism, not all dental fear patients are expected to take part, only those with a WTP exceeding the treatment costs. However, for the patients who participate, the market secures an efficient allocation of treatment. In order to reach and help those who are not expected to participate, it might be beneficial for the government to target these patients in particular, e.g. by using the primary health service.

Results

The treatment outcome for the patients who finished the experiment was very good. All patients were able to receive regular dental treatment within the experiment. On average, the patients received treatment amounting to 13 filled tooth sur-

[5] See Myles [26] for a definition of private and public goods.

faces during the treatment programme. Their scores on dental fear assessment and the general psychological distress test dropped significantly during and after the treatment (see Willumsen [39] for more information).

The probability of coping with dental treatment

For most of the patients, their motivation for attending the experiment was both to fix their teeth and to increase their mental health capital. It is thus interesting to compare the effects of the different types of dental fear treatment on the patients' ability to cope with an ordinary dental appointment after the experiment. In **Table 1**, we present the proportion of patients for the total sample and for the different treatment groups who reported that they expected to be able to go to a dentist by themselves after completing the treatment.

We see from the table that 69% of the patients expected to be able to go to a dentist after the treatment, but the results in the different treatment groups differ considerably. Nitrous oxide sedation has a much lower success rate than treatments focusing on the patient's ability to handle the situation. The types of dental fear treatment with a significant effect on the patient's probability of being able to go to the dentist afterwards are cognitive therapy and applied relaxation training.

Willingness to pay for dental treatment and dental fear treatment

In **Table 2**, we present the mean WTP responses for the total treatment, dental treatment and dental fear treatment separately, and the expected total WTP before the treatment started. We also present the T-values under the null hypothesis of a zero WTP for treatment. This information is given separately for each of the three treatment groups (nitrous oxide sedation, cognitive therapy and applied relaxation) and for all patients combined.

We see from **Table 2** that total WTP for both dental treatment and dental fear treatment is higher after uncertainty is revealed in the second period than the expected WTP before treatment. This is true for all treatment groups and for all patients combined. The expected WTP amounts to approximately 50% of the WTP after uncertainty is revealed. The relative share of the maximum WTP before and after the treatment is highest for the group that received cognitive therapy (56.5%) and lowest for the group that received nitrous oxide sedation (46.4%). This is probably because uncertainty concerning the benefits from dental fear treatment is likely to be larger for treatment forms using psychological techniques than sedatives. Due to a lack of degrees of freedom, this difference was not significant for any of the groups.

Determinants of willingness to pay

Looking at the decomposition of the maximum WTP into WTP for dental treatment and dental fear treatment, it seems that, on average, the patients have divided their WTP equally between the two treatments. In order to reveal whether there were any systematic differences, we estimated a WTP-function for both the maximum WTP before and after receiving the treatment and the WTP for the dental treatment and dental fear treatment separately.

Expected WTP

We estimated the expected WTP-function in Eq. 6 applying ordinary least squares (OLS) corrected for heteroscedasticity. The results from this estimation are pre-

Table 1

Proportion of the patients for total sample and for the different treatment groups

	Total sample	Nitrous oxide sedation	Cognitive therapy	Applied relaxation
Proportion of the sample who expect to be able to go to an ordinary dentist after the treatment	0.69	0.46	0.86	0.77
(T-value)	(1.47)	(0.90)	(2.49)	(1.83)

Proportion of the patients expecting to be able to cope with an ordinary dental appointment after receiving dental fear treatment, according to treatment group and for all patients combined. T-value in parentheses

Table 2

Maximum willingness-to-pay (WTP) before and after receiving treatment

	Nitrous oxide sedation		Cognitive therapy		Applied relaxation		All patients	
	Mean	(T-value)	Mean	(T-value)	Mean	(T-value)	Mean	(T-value)
WTP before treatment	2,706	(0.964)	3,618	(0.959)	2,890	(1.128)	3,061	(1.010)
WTP after treatment	5,833	(2.045)	6,405	(1.691)	5,591	(1.495)	5,938	(1.720)
WTP dental fear treatment	2,680	(1.531)	3,126	(1.545)	2,987	(1.525)	2,931	(1.548)
WTP dental treatment	2,991	(1.625)	3,279	(1.423)	2,870	(1.221)	3,047	(1.418)

WTP for dental fear treatment and WTP for dental treatment, according to treatment group and for all patients combined. T-values in parentheses. NOK (€1≈NOK 9)

sented in **Table 3**. In the first column, the explanatory variables are listed. In the second column, we present the estimated coefficient and in the last column we present the T-values.

We see from **Table 3** that the only variable with a significant influence on the expected WTP is household income. If household income increases by NOK 1,000 (approximately €111), the expected WTP for treatment increases by NOK 9 (approximately €1). If we calculate the income elasticity, that is the estimated coefficient divided by the budget share, we find that a 1% increase in income gives a 0.5% increase in expected WTP for treatment. The treatment is thus considered to be a necessity good by the patients before the treatment is carried out. We also see from **Table 3** that the expected WTP increases with increased mental stress and damage to the teeth, even though these effects are not significant at an acceptable level. One reason for the lack of significance and explanatory power is the small sample. Of the 62 patients responding to the questionnaire, only 54 answered the expected WTP question and only 41 of these had observations for all explanatory variables.

Table 3

Estimated determinants of expected WTP *before* treatment. NOK (€1≈NOK 9)

	Coefficient	T-value
Constant	194	0.2933
Income (in 1,000 NOK)	9.2	7.6476
Dental health capital in period one, holes and tooth decay	18	1.4366
Mental health capital in period one, psychological strain	509	0.7977
	R^2 =0.26	*R^2–adj=0.20*

Table 4

Estimated determinants of total WTP and WTP for dental treatment and dental fear treatment *after* the experiment was concluded. NOK (€1≈NOK 9)

	Total WTP	WTP for dental treatment	WTP for dental fear treatment
Constant	4,290***	815	3,909***
Cognitive therapy	84	–164	426
Income (in NOK 1,000)	8.6***	4.2***	2.0
Benefits from dental treatment	1,041**	871**	324
Benefits from dental fear treatment	513	–901**	1,385***
Change in dental health capital, treated surfaces	165***	91***	76***
Change in mental health capital, reduction in strain	1,651	1,356*	210
R^2	*0.53*	*0.46*	*0.45*

**** Implies that the coefficient differs significantly from zero with a probability of falsely rejecting the zero hypothesis of less than 1%. **Implies that the coefficient differs significantly from zero with a probability of falsely rejecting the zero hypothesis of less than 5%. *Implies that the coefficient differs significantly from zero with a probability of falsely rejecting the zero hypothesis of less than 10%*

WTP after the treatment

We now turn to the estimation of the total WTP, and the WTP for dental treatment and dental fear treatment after the experiment was over. Of the 64 respondents who answered the WTP question, 52 had observations on all explanatory variables. The results from this analysis are reported in **Table 4**. First, we look at WTP for the total treatment, presented in the first column of **Table 4**.

As we see from **Table 4**, several variables have a significant impact on WTP after the treatment was concluded, in spite of the low degrees of freedom. First, income still influences WTP significantly, where an increase in income of NOK 1,000 (€111) results in an increase in WTP of NOK 8.6 (€0.96). Since the mean WTP after all uncertainty is revealed exceeds the expected WTP by approximately 50% (see **Table 2**), the estimated income elasticity is halved to 0.25. That is, a 1% increase in income results in a 0.25% increase in the stated WTP. Thus, investments in dental capital and mental capital are less income elastic after treatment than before treatment. The stated WTP also increases with the benefits from dental treatment, with the number of treated surfaces, with benefits from dental fear treatment and with a reduction in the global severity index, although the last two effects were not significant. Whether the patient received cognitive therapy as opposed to nitrous oxide sedation or applied relaxation does not have a significant effect on the stated WTP.

In order to examine if there are any systematic differences in the factors determining the stated WTP for dental treatment and dental fear treatment, we have estimated the model for WTP for dental treatment and dental fear treatment separately. The results from these estimations are presented in the second and third columns of **Table 4**. First, we look at the results from the WTP estimation for dental treatment. We see from the table that most explanatory variables have a significant effect on WTP for dental treatment. The only exception is the coefficient for receiving cognitive therapy. First, looking at the income sensitivity, the estimated income elasticity for demand for dental treatment is 0.24. This is approximately the same income elasticity as for total WTP. Second, we see that patients with high benefits from dental treatment have a higher WTP for dental treatment than patients who reported the benefits to be low. We also found that patients who reported high benefits from dental fear treatment had a lower WTP for dental treatment than patients who reported low benefits from dental fear treatment. This indicates that these patients have allocated a larger share of their total WTP to dental fear treatment than to dental treatment. Third, we found that WTP for dental treatment increases

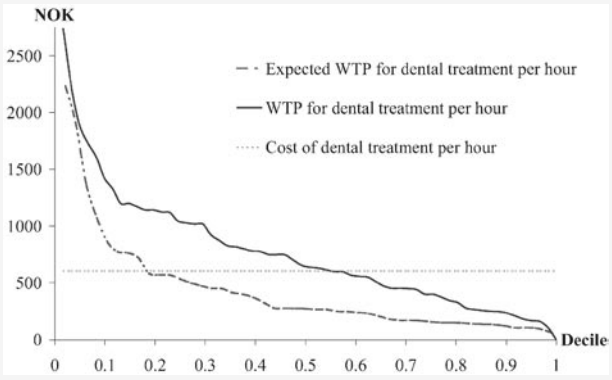

Fig. 1 ◀ **WTP before and after treatment and the cost of dental treatment per hour. Ranked according to WTP. Deciles, NOK (€1≈NOK 9)**

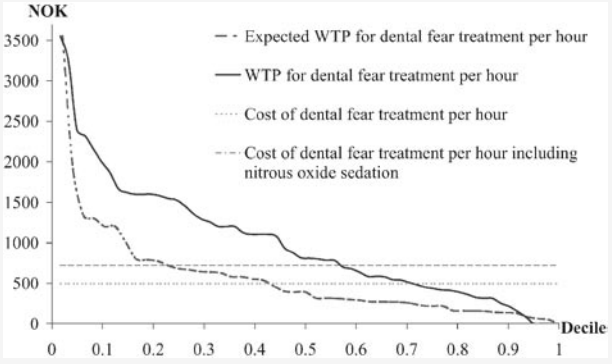

Fig. 2 ◀ **WTP before and after treatment and the cost of dental fear treatment (including nitrous oxide sedation) per hour, ranked according to WTP. Deciles, NOK (€1≈NOK 9)**

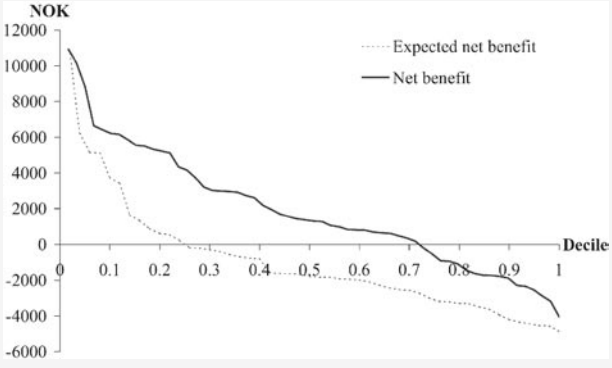

Fig. 3 ◀ **Expected and total consumers surplus (WTP net of costs) for both dental treatment and dental fear treatment by income groups. Deciles, NOK (€1≈NOK 9)**

with both the number of treated surfaces and the measured reduction in mental strain. That is, patients who have benefited most from the treatment, both with regard to reduction in distress and work done on their teeth, are willing to pay more for dental care than other patients. Finally, we see that this model has relatively good explanatory power, as almost 40% of the total variation in WTP for dental treatment is explained by the estimation. The explanatory power of the model is, however, less than for the estimation of total WTP.

Finally, we turn to the estimation results for WTP for dental fear treatment, reported in the last column of **Table 4**. We see from the table that the level of significance is not as good as in the previous estimations. Only the coefficients for reported benefits from dental fear treatment and the number of treated surfaces differ significantly from zero at the 10% level. We also see that patients who reported high benefits from dental fear treatment had a substantially greater WTP for dental fear treatment than other patients. As for WTP for the dental treatment, this model explains almost 40% of the total variation in the expressed WTP for dental fear treatment.

Is the treatment socially beneficial?

In Norway, dental treatment for adults is privately financed. The Public Dental Service offers treatment to children 0–18 years, all mentally handicapped people and groups of institutionalised, chronically ill and elderly people. This treatment is offered free of charge or at a reduced rate. Until 1995, fees were regulated by a fixed fee schedule negotiated between the Norwegian Dental Association and the national authorities. The fees for adult patients in the Public Dental Service are still regulated by these annual negotiations. In 1996, the official price tariff had two levels, depending on what kind of treatment was performed: One high tariff of NOK 604 per hour (€67) and one low tariff of NOK 497 per hour (€55). The cost of nitrous oxide sedation was NOK 224 per hour (€25).

In this paper, we assume that supply of dental fear treatment is regulated by a set of recommended prices in order to make it a non-profit business. Since we do not have information on the actual cost of producing dental treatment and dental fear treatment, we assume that these price recommendations are set equal to the official price tariffs. If these prices do not clear the market, we will experience excess demand for and/or supply of treatment of dental fear, and the good will not be efficiently allocated. Thus, we have to assume that supplying dental services is profitable at the official tariffs and that the tariff equals the costs at the margin.

In **Fig. 1**, we have plotted the patients' maximum and expected WTP per hour for *dental treatment*, by the rank in the WTP distribution. Here, we assume that the patients have the same distribution of their expected WTP for dental treatment and dental fear treatment as for their maximum WTP. The curve to the left of point 0.1 shows the expressed WTPs for the 10% of patients with highest WTP per hour, that is the first decile of the WTP distribution. The median WTP, which divides the sample in two, may be read off at point 0.5. We have also plotted the cost of dental treatment, using the high price tariff for active treatment.

We see from **Fig. 1** that patients with dental fear did not have a high WTP per

hour for dental treatment as compared to the cost. Only 54% of the patients had a WTP exceeding the cost per hour for dental treatment after all uncertainty is revealed, and a little less than 17% were willing to pay the cost before the treatment started.

In **Fig. 2**, we have plotted the patients' maximum and expected WTP per hour for *dental fear treatment*, by the rank in the WTP distribution. We have also plotted the cost of dental fear treatment, assuming it to be at the low rate, and the cost including nitrous oxide sedation. We see from the figure that the profitability of supplying dental fear treatment is better than for dental treatment, partly because the cost of providing dental treatment is assumed to be lower. A little more than 70% of the patients had a WTP that exceeded the cost of providing 1 hour of dental fear treatment, whereas 42% of the patients were willing to pay the cost before the treatment started. If we include the cost of nitrous oxide sedation, the proportions are reduced to 56 and 23%.

It seems that the social desirability per hour of supplying dental treatment and dental fear treatment differs considerably when supplied to patients with dental fear. We have also calculated each patient's net benefit from the experiment in order to evaluate the social desirability of the total treatment when differences in need for dental treatment and dental fear treatment between patients are accounted for. The net benefit is defined as the patient's maximum WTP for the total treatment, net of the cost of his or her individual treatment. The cost of the treatment was calculated based on the recorded time used for different parts of treatment. The mean cost for the total treatment (both dental treatment and dental fear treatment) was NOK 4,344 (€483).

In **Fig. 3** we have plotted the net benefits and expected net benefits from the total treatment by the rank in the distribution. If the patient's WTP exceeds the price he or she has to pay for treatment, the net benefit is positive, and vice versa. We see from the figure that 71% of the patients had a WTP that exceeded the cost of the total treatment *ex post*, whereas only 24% of the patients were willing to pay this cost before the treatment started.

Concluding remarks

In conclusion, we found that a very small proportion of the patients participating in the experiment were willing to pay what it actually costs to get their teeth fixed before they knew the effect of the dental fear treatment. If a combination of dental treatment and dental fear treatment were offered to the public at the official price tariffs, only one out of four patients with dental fear would be expected to make use of this offer. This is because the investment decisions are made in the first period under uncertainty. After treatment, seven out of ten patients are willing to pay what the treatment costs.

As discussed in the section under the heading *Evaluating social desirability*, the existence of external effects not included in the stated WTP for treatment and concerns of applying standard rules for economic efficiency when evaluating treatment of mental suffering, suggest that the *ex ante* demand for treatment is too low. All these effects indicate that supply of dental fear treatment should be subsidized to some degree by the government. Since we are not able to measure the external effects through the labour market, the marginal utility of income, or the individual welfare weights, it is not possible to determine the exact subsidy level that secures either economic efficiency or the socially optimal allocation of resources. However, we do know that some level of subsidies will increase both allocative efficiency and social welfare.

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Conflict of interest: No information supplied

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Book review

F. Porzsolt, A.R.Williams, R.M. Kaplan

Clinical Economics

Effectiveness & Efficiency of Health Services

Landsberg: ecomed 2003, 372 S.,
(ISBN 3-609-16148-5), brochure, 39.00 EUR

Clinical Economics – a catchphrase serving as the title of a book, who would not become curious. Especially if it focuses on effectiveness and efficiency of health services. The authors Franz Porzsolt, Arthur Williams and Robert M. Kaplan come from different professional backgrounds (internal medicine, evidence-based medicine, public health, epidemiology, statistics, economics). Together, they successfully approach the complex issue of how to measure and appraise the value of health services.

The first chapter deals with problems concerning the evaluation of medical services in detail and explains the difference between health care economics and clinical economics. Health care economics is per se a subject of economic studies. Its approaches and strategies for solutions follow the laws of economic science, for instance comparing costs and benefits of alternative actions.

Certainly, clinical economics also deals with the costs of health services. But, clinical economics primarily tries emulate the patients' view while appraising the value and consequences of a given service. In this context the authors put forward the hypothesis that certain decisions concerning the health care system would have taken a different course, if the principles of clinical economic had been applied.

In this book, the authors question the current standards of choosing and generating health care services, as well as decision making and provision of services in hospital and private practices. The current situation in health care is analysed and the effectiveness and efficiency of health services and their extensive consequences for the patient are scrutinized from various perspectives.

Ethical issues, e.g. matters of fairness and distribution of medical services, are discussed, while at the same time demanded quality and quality management are closely assessed. Risk management and strategies for the prevention of mistakes are impressively demonstrated using examples from aviation – a similarly security sensitive enterprise as medicine – followed by an analysis of possible common goals.

The part on Evidence-based Medicine (EbM) constitutes an important chapter on the effectiveness and efficiency of health services. What is EbM? Why is EbM important, helpful and sensible and how is EBM applied? Commonly used statistical and epidemiological terms are explained, solutions used in practice are offered in tables, references to literature and data bases as well as internet links.

The part of the book covering reports from daily practice includes a variety of examples how EbM is applied in areas such as nursing, surgery, oncology, orthopaedics, internal medicine, gynaecology. Especially the gynaecological clinical scenarios may be suited to help the interested reader understand the process of EbM and apply EbM in his or her own clinical work.

The central aim of clinical economics is to estimate the value and consequences of services for the patient, the methodological part of the book focuses on quality of life. What is quality of life and how is one supposed to measure it? Which data must be obtained? How would, for instance, a cancer patient define this idea? Moreover, the methodological part introduces evaluation methods used in health care economics (e.g. cost-effectiveness-analyses, cost-benefit-analyses) and explains their theoretic foundations (e.g. discounted costs, QALY).

Conclusion: For practitioners, this book offers important ideas to reconsider and critically question their approach toward the „patient and his problem" enabling actions based upon a concept of "value added". Analysing the effectiveness and efficiency of health services from different perspectives, the authors succeed in making this book a pleasurable reading experience. Also the price of 39 EUR seems very fair, the quality of the paperback edition seems good and suitable and the graphical elements, figures and tables are well thought-out and structured

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