



Payment systems and oral health in Swedish dental care: Observations over six years

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Objective: The aim of this longitudinal study of patients in regular dental care was to compare the findings of manifest caries and fillings after a 6-year adherence to either of two optional payment models, the traditional fee-for-service (FFS) model, or the new capitation model 'Dental Care for Health' (DCH). **Material and methods:** Data on manifest caries lesions, the number of fillings and a number of background variables were collected from both a register and a questionnaire completed by 6,299 regular dental patients who met the inclusion criteria. The influence of payment system adherence and background variables on the number of manifest caries lesions at study end was examined by the means of negative binomial regression analysis. **Results:** The incidence rate ratio of manifest caries lesions after six years in FFS was 1.5 compared to DCH, after controlling for age, gender, education and pre-baseline caries incidence. The number of fillings was higher in FFS than in DCH at study start and at study end, and was also described by a steeper slope. **Conclusions:** At group level, this study showed a statistically significant difference between the caries situation after six years in DCH compared with FFS, when some important background factors, including pre-baseline caries, were kept constant in a regression model.

Key words: capitation, dental caries, fee-for-item, oral health, Sweden

Introduction

Since 2007 in Region Västra Götaland and since 2009 in all Swedish County Councils, capitation payment for dental care has been an option, used in parallel with the traditional fee-for-service payment system (FFS), for patients attending the Swedish Public Dental Service. This new payment system has been named Frisktandvård, 'Dental Care for Health' (DCH). The scheme features a risk-based fixed-fee agreement covering all basic dental care needed during a three-year contract period, and also involves a tailored self-care protocol to be complied with by the patient (Andås *et al.*, 2013; Zickert *et al.*, 2000).

DCH as a capitation payment system and FFS as a payment system based on per item-of-care are distinguished by their different units of remuneration to the respective caregiver. As such, they carry economic incentives in opposite directions. The conceived mechanism for the impact of economic incentives on patient demands and actions and on the recommendations by care providers has been described in previous papers (Andås *et al.*, 2013; Andås and Hakeberg, 2014). Due to the impact of such economic incentives, the resulting type and amount of dental care that will be provided out may differ in the two payment systems (Grytten *et al.*, 2009). A Cochrane review reports, for instance, on the use of more fissure sealants in children by dentists in FFS remuneration than in a capitation system, due to the greater clinical activity in the former system; however, no conclusions could be drawn regarding patient outcomes (Brocklehurst *et al.*, 2013). Other studies have shown more preventive care

and fewer restorations in a capitation scheme compared with FFS (Andås *et al.*, 2013; Johansson *et al.*, 2007).

The emphasis on preventive care in the DCH including the agreement may have an enhancing effect on the preventive actions performed by the patient and the caregiver. As beneficial oral health development has been shown to be strongly dependent on the thoroughness of own oral self-care measures (Axelsson *et al.*, 2005), the capitation arrangement may have an impact on oral health development. To our knowledge, only one randomized trial comparing dental insurance options has been published in the literature. The RAND study included different co-payment rates, and reported that the free plan showed improved oral health, in terms of fewer decayed teeth and a lower periodontal index for patients aged 35 years or younger, compared with plans involving larger out-of-pocket shares (Bailit *et al.*, 1987). A study on payment systems and oral health found that Oral Health-Related Quality of Life (OHRQoL) was higher in a capitation scheme, compared with a FFS system (Johansson *et al.*, 2006). However, there are very few studies reporting on clinical measures of oral health in relation to payment systems over time.

Consequently, the aim of the present study was to observe, longitudinally over six years, the occurrence of caries findings in patients who choose either DCH or FFS. The hypothesis was that patients who choose to pay for regular dental care according to DCH had a lower caries incidence after six years compared with patients who choose to remain in the traditional FFS payment scheme. A secondary hypothesis was that fewer fillings are performed in DCH than in FFS over time.

Materials and methods

The patients in the study were a subset of 13,719 consecutively recruited general dentistry patients from the Public Dental Service's (PDS) 111 general clinics in the Västra Götaland Region (VGR), Sweden, when they came to the clinics for their ordinary scheduled examination. These 13,719 patients attended one of 20 clinics in the Region, systematically selected to cover urban/rural area, large/small clinic, socioeconomically favorable/less favorable area. The targeted population was approximately half of the adult population, about 485,000 individuals. Inclusion started in the spring of 2007, on the first possible occasion for the PDS patients in the VGR to choose between the traditional FFS payment system and the new DCH capitation payment scheme. For this study, 6,299 patients matched the inclusion criteria: age 20 years or older, able to read Swedish and accepting to participate and maintaining either DCH or FFS during the whole study period, and reported examination/treatment time ≥ 180 minutes (total time attending any treatment at the clinic during the 6-year period, as recorded by digital appointment register), to assure full adherence to recall. For a more detailed description of the material, see reference (Andås and Hakeberg, 2014).

Data were collected at each treatment occasion during the six years that followed upon the first possible choice between payment models forming the baseline registration. Data were also retrieved from patient records for the examinations during the preceding two years (2005 and 2006). Patients in both payment systems were scheduled for examinations and complete dental treatment, including suggestions for preventive as well as restorative treatment options, according to identical health-promoting objectives and recall intervals. An obvious difference between DCH and FFS was the contract/agreement, which included a self-care protocol. However, before being eligible for the DCH scheme, patients had to go through treatment for any disease detected at the initial examination.

The data comprised chart entries from the operative digital chart system T4 (T4 Practice Management Software, Carestream Dental, Stockholm, Sweden), recorded at the respective clinics. A questionnaire was completed at the clinic just before the patients had their first opportunity to choose between the payment systems, at baseline. The questionnaire has been described in detail elsewhere (Andås and Hakeberg, 2014).

FFS refers to the traditional payment system; i.e., one fee for each item of received dental care. The cost of each item of care was specified in a price list common to all the included PDS dental care clinics. The recall plan was determined on an individual basis.

Each patient was given the option to enter into the DCH capitation agreement at a premium corresponding to an individual risk group determined at the examination. The agreement covered all basic dental care needed during the next three-year period at a predetermined and prepaid cost common to all the clinics, combined with adherence to an individually designed oral self-care program. Recall was scheduled according to the present risk group classification and was mandatory in order to comply with the agreement.

The patients were consecutively included in the study from April 2007 to April 2009. Caries registrations in the patients' records from the regular examination at the time of inclusion were used as baseline registration data. In the same way, the six-year examination in 2013 or 2015 was used as the final registration in the study. Previous manifest caries registrations were also retrieved from patient examinations in 2005 or 2006; i.e., pre-baseline.

Register data were extracted on manifest caries lesions and questionnaire data on background variables. Caries lesions at pre-baseline and at the final registration were defined as manifest caries lesions; i.e., extending beyond the enamel-dentin junction, as determined clinically or from radiographs. The number of caries lesions at pre-baseline was trichotomized as 0/1-2/ ≥ 3 . Educational level was presented dichotomously, either as university level (≥ 13 yrs) or up to, but below, university level (≤ 12 yrs).

The dependent variable was number of caries lesions at final registration. There were five independent variables: payment system was either DCH or FFS; number of pre-baseline caries lesions; age in years, gender, education dichotomized as less than 13 years or 13 or more years.

The dependent variable of *manifest caries lesions* consisted of count data, showed a non-normal distribution and was over-dispersed (i.e. variance > mean value). Thus, the statistics were calculated using non-parametric methods to determine the statistical significance of differences. A negative binomial regression model was built to describe the influence of pre-baseline caries, age, education, gender and payment system on the number of manifest caries lesions after six years. The model was determined a priori and the enter technique was used with the above mentioned independent variables. The enter technique means that all independent variables were analyzed simultaneously in one model. Since epidemiological data on caries, based on count data, usually display an inverse J-shaped distribution with the majority of individuals showing no caries (i.e. zeros), then fewer with 1 – 2 caries lesions, and finally only scarce number of individuals having 3 or more manifest lesions, then the multiple regression analysis method of choice should be Poisson or negative binomial regression. And in the case where the variance is greater than the mean value then negative binomial regression is the preferred choice. Thus, the a priori decision was based on the type of data, count data and the distribution which was acknowledged from analysis of pre-baseline data. The chosen level of significance was 0.05. The statistical computer program SPSS v.22 was used for the analysis.

The study was approved by the Regional Ethical Review Board in Gothenburg (323-07).

Results

The study included 6,299 participants, 26.6 % of whom chose to change their payment system in favor of DCH at baseline. Thus, 73.4 % chose the traditional FFS system. The gender distribution between payment systems was almost the same as for the whole study population (Table 1), but the DCH patients were considerably younger. The difference between individuals in the two payment systems concerning education was significant ($P=0.039$), with the DCH patients having the lower level of education.

The distribution of pre-baseline manifest caries lesions between categories differed between the payment systems, with the largest difference in the ≥ 3 category and the lower frequency among the DCH patients (Table 1). The mean value of manifest caries after six years was 0.56 (S=1.29) and 0.37 (S=0.86) for FFS and DCH, respectively ($P < 0.01$). Concerning the number of filled surfaces, the patients in FFS had a larger number at baseline as well as at the final registration compared with the DCH patients. Furthermore, the difference increased over the six-year study period (Figure 1). The mean increase in the difference was statistically significant ($P = 0.006$).

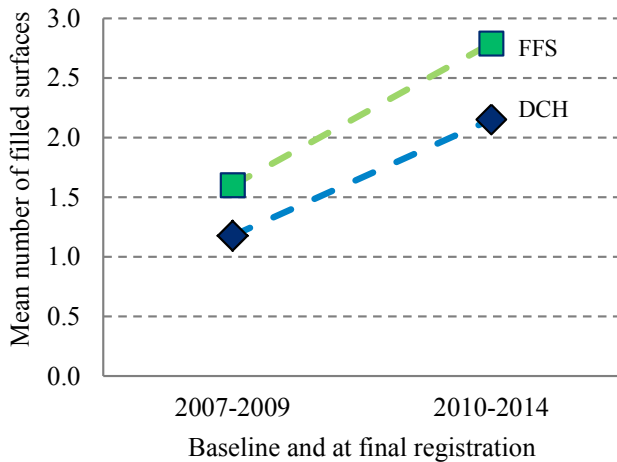


Figure 1. Mean number of filled surfaces at baseline and after six years, in the two payment systems: Fee For Service (FFS) and Dental Care for Health (DCH)

According to Table 2, the multivariate analysis showed that the manifest caries incidence rate ratio was more than 1.5 times higher for individuals in FFS than in DCH after six years. Pre-baseline caries registrations showed a gradient of an increasing IRR: IRR=2.63, if ≥ 3 lesions, and IRR=1.40, if 1-2 lesions (Table 2). Both these covariates had a statistically significant influence on the dependent variable in the regression model. Age had a significant, although minor, impact on the number of manifest caries lesions after six years. The effect of education was small but significant, and indicated more manifest caries in patients with lower-than-university education. There was no effect of gender on manifest caries lesions after six years (Table 2).

The subset of 6,299 individuals showed no statistically significant difference concerning payment system choice (DCH: 26.6%/26.2%, FFS: 73.4%/ 73.8%), education level (≥ 13 yrs: 33.0%/32.7%), gender (women 53.2%/52.7%) compared to the 13719 included in the baseline registration of the DCH data collection. There was, however, a statistically significant difference in age (mean: 44.0/40.3yrs) with the patients in the present study's subset being slightly older. When regarded as fulfilling inclusion criteria, the study—which could be seen as a register study—had no individuals lost to follow-up. However, compared to the baseline registration of the DCH data collection, the sample in this study had 54% less participants due to the inclusion criteria, i.e. due to a minimum registered treatment time of 180 minutes, as well as to the need to adhere to same payment scheme for the six-year period.

Table 1. Background variable distribution for all individuals, and by payment system

	N	Age \bar{x}^1 years	Gender %		Education %		Pre-baseline caries % lesions			Filled surfaces \bar{x} (s)	
			male	female	≥ 13 yr	≤ 12 yr	0	1-2	≥ 3	Baseline	End
All	6,299	44.0	53.2	46.8	33.0	67.0	65.7	25.8	8.5	1.49 (2.10)	2.62 (2.85)
DCH ²	1,675	36.3	53.0	47.0	30.9	69.1	71.9	23.6	4.5	1.18 (1.91)	2.15 (2.63)
FFS ³	4,624	46.8	53.2	46.8	33.7	66.3	63.5	26.6	9.9	1.60 (2.15)	2.79 (2.91)

¹ At baseline; ² New capitation payment scheme 'Dental Care for Health'; ³ Traditional Fee-For-Service payment system

Table 2. Negative binomial regression analysis describing the influence of covariates on manifest caries incidence at final study registration, i.e. after six years

	Referent	B	SE	IRR ¹	95%CI ²	P	
Constant		-0.87	0.093	0.42	0.35-0.50	<0.001	
Payment system	FFS ³	DCH ⁴	0.41	0.057	1.51	1.35-1.69	<0.001
Pre-baseline caries incidence	1-2 lesions	0 lesions	0.34	0.050	1.40	1.27-1.54	<0.001
	≥ 3 lesions	0 lesions	0.97	0.067	2.63	2.31-3.00	<0.001
Age, years		-0.01	0.002	0.99	0.98-0.99	<0.001	
Education	≤ 12 years	≥ 13 years	0.11	0.048	1.12	1.02-1.23	0.021
Gender	male	female	-0.02	0.044	0.98	0.90-1.07	0.649

¹ Incidence Rate Ratio; ² 95% confidence interval; ³ Traditional Fee-For-Service payment system; ⁴ New capitation payment scheme 'Dental Care for Health'

Discussion

The results from this study, and especially from the multivariate regression analysis, showed that the incidence rate ratio of manifest caries was 50 % higher in FFS than in DCH patients after six years, when the effect on manifest caries at the pre-baseline examination and the other independent variables were included in the full model. The effect on manifest caries after six years from the pre-baseline caries registration was larger than the effect of the payment system, if the number of pre-baseline lesions was large (≥ 3), but not if the number was moderate (1-2). The effect of age and education was small but significant. There was no effect of gender on the outcome. Thus, a significant and specific effect of the payment system on caries was found in this study.

As previously mentioned, there are few earlier studies discussing the impact of different payment systems on oral health-related outcomes. Another report from the same data collection shows that individuals who choose DCH differ from those who do not, in terms of characteristics that, by themselves, indicate a lower risk of ill health in DCH (Andås and Hakeberg, 2014). In this report, additional information on health development in the two payment systems is presented by means of a clinical measure while controlling for background factors, of which previous caries experience might be considered the most important prognostic indicator (Chaffee *et al.*, 2015).

Some of the objectives of the DCH payment system are more preventive care, less restorative treatments and greater patient self-involvement. The agreement between the patient and the caregiver regulates the opportunities and responsibilities of both parties, thereby facilitating improved communication and role definition between caregivers and patients: The contract clearly states when, and to whom, recall will be scheduled—to which individual caregiver and caregiver category—and also specifies the self-care measures required to maintain or improve individual oral health.

Our earlier study on a pilot DCH scheme further suggested that the greater emphasis on preventive care in DCH may be attributable to features in the local approach at the clinic, together with the payment system itself (Andås *et al.*, 2013). Possibly, the reason-behind-the-reason for fewer fillings and less caries may be found in an advantageous use of the preventive elements of the DCH contract described above. Since the individuals choosing differently between the two payment systems also differ with regard to a number of demographic and socioeconomic factors, it may be suggested that those who choose DCH may also be those who benefit most from the caregivers' efforts to share the health responsibility with their patients. In a recent study on adherence to periodontal instructions, individualized risk communication was shown to have an advantageous impact (Asimakopoulou *et al.*, 2015). This is important to address, as there is evidence indicating that oral health behavior displays the same socioeconomic disparities as oral health itself (Sabbah *et al.*, 2009). It is, however, noteworthy that the share of patients in this study with education at university level was higher in the FFS group than in the DCH group, which marks a difference compared with

reports concerning dental insurance (Stancil *et al.*, 2005).

This study shows that patients who adhered to DCH for six years had fewer fillings both at start and at study end, but also showed a statistically significant change over time compared with FFS. This result correlates with results from a study on received treatments in a pilot version of DCH (Andås *et al.*, 2013).

The measures *caries lesions* and *number of fillings* may be considered as two sides of the same coin, but also offer different possible interpretations. Lower numbers on both measures either accurately represent the true situation and, as such, indicate better health; however, lower numbers may also represent a disadvantageous influence from economic incentives, and, in that case, indicate underdiagnosing or undertreatment (Grytten *et al.*, 2009). Higher figures may consequently indicate poorer health or overtreatment. Arguably, a slower increase rate in the number of fillings, *together with* fewer carious lesions after six years in DCH compared with FFS, strengthen the conclusion that better health is the underlying mechanism rather than undertreatment, specifically taking into account previous caries experience. Holding a private dental insurance (capitation payment scheme) has been associated with better oral health status for adults, measured clinically, compared with not holding such an insurance, in a nationally representative US study (Stancil *et al.*, 2005).

Caries has been described as having a considerable impact on quality of life and to constitute a heavy disease burden globally by being a common disease (Kassebaum *et al.*, 2015; Sheiham and Croog, 1981). Thus, caries was chosen as the outcome, or dependent variable, in the regression model. In this study, manifest caries was used as the measure of caries, for several reasons. Firstly, cavitated lesions into the dentin are widely used as an indication of caries, as recommended by the WHO (World Health Organization, 2013). Secondly, DMFT was not obtainable from this register. Thirdly, in this setting, primary and secondary manifest lesions were assessed as the most reliably reported measure, as well as the most consistent measure concerning the need for restorative treatment. Manifest caries (pre-baseline) was also used as an independent variable and confounder to adjust the outcome of the regression model, on account of being a highly predictive factor for future caries, as described earlier in the discussion section. Any pre-baseline caries lesions were treated before study start, and were thus not considered influential on the outcome caries variable in any other way than as a confounder.

This study benefits from a large sample, extracted from real-life implementation and a natural experiment. The time for follow-up is reasonable with respect to caries development. A quasi-experimental study was the design of choice, as it was not possible to allocate individuals to groups through a random process, given that the patients themselves had to make the choice of payment system. Nevertheless, this design made it possible to detect the patients' system preferences with regard to several individual parameters, such as age, gender, socioeconomic status and perceived oral health. However, one possible disadvantage was the risk of selection bias due to this quasi-experimental design. Moreover, there was a large variety of data collectors, due to the multi-center arrangement,

potentially resulting in some misclassification of caries; however, the large number of caregivers and patients can be assumed to rule out a systematic error due to the risk of under- or over-diagnosis of caries. Since the data were retrieved from a register, the specific causes for the restorative treatments, i.e. fillings is not known. Thus, there are several possible reasons such as esthetical, caries, and fractures that might have been the decision behind the actual treatment. It might further be argued, that the large number of clinics involved, comprising an even larger number of data collectors, reduces the loss of power in data that otherwise might become the result of a cluster effect. Even if a risk of too small estimated variability measures may be discussed, the results show very low p-values and narrow confidence intervals indicating a very small risk of altered results due to a cluster design.

Conclusions

In this longitudinal study, patients in regular dental care who chose and adhered to a new capitation payment scheme during a six-year period were compared with patients who stayed in the traditional fee-for-service payment system for the same period of time, with regard to changes in caries lesions. The number of manifest caries lesions was found to differ significantly between the two groups, even if pre-baseline caries, age, gender and education were controlled for. The patients with DCH were less likely to have manifest caries, compared with FFS patients. There was also a difference concerning the number of fillings received by patients in the two payment systems, both at baseline and after the six-year study period.

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