Do economic incentives influence the provision of dental services in a third-party funded dental scheme?

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Abstract

Introduction
The aim of this study was to investigate whether the provision of dental services is influenced by economic incentives in a third-party funded dental service in the Republic of Ireland.

Materials and methods
Four treatment items were identified as outcome variables: extra-oral radiographs, endodontics, prolonged periodontal treatment and surgical extractions. These items were characterised by variation in regulation among administrative regions or variation in regulation over time. Claims data were obtained from the Primary Care Reimbursement Service, formerly known as the General Medical Services Payments Board. Population data were obtained from the Central Statistics Office. Data were obtained from the Principal Dental Surgeons in Ireland who apply local regulatory or price controls for certain items of treatment. The data were analysed to determine the impact of the variation in regulatory approach on claims data among the eight regional health administrative areas while controlling for known clinical or population structural factors.

Results
There was a substantially lower than average provision of extra-oral radiographs in regions where regulation was stringently applied. The provision of prolonged periodontal treatment was positively correlated with price. The dentist-to-population ratio is positively correlated with claims for surgical extractions.

Conclusion
There is evidence from within the funding system that economic incentives, arising from either the contract itself or due to the geographical structure of the dentist workforce in Ireland, lead to variations in certain items of service provision which are potentially inefficient and independent of known treatment need.

Introduction

The Dental Treatment Services Scheme (DTSS) is a publicly funded choice of dentist scheme (budgeted to cost €63 million in 2010) which in the period under review provided basic dental care to less well-off adults (medical card holders) and was free of charge to the recipients. In this scheme, dental services were delivered by private dentists in their own practices and dentists were subsequently remunerated for services provided the more income for the service. Thus, the dentist can both influence demand and supply a service, for which s/he bears little, if any, of the financial burden. Such a situation can lead to overutilisation of services. This type of provider moral hazard occurs for two related reasons. First, on the supply side, a third party bearing the costs of care, dentists have few incentives to moderate the amount of care they supply. They do not bear the costs of their decision-making. Second, on the demand side there is asymmetric information between patients and dentists characterised by an imbalance of power whereby the dentists largely determines the level and the amount of services required. The patient seeks advice on what services to demand from the very person who is supplying the service. Thus, the dentist can both influence demand and supply a service, for which s/he bears little, if any, of the financial burden. Such a situation can lead to overutilisation of services.

Results

The first type of SID effect occurs where an increase in supply of dentists paradoxically may lead to an increase in the income of dentists. Normally, an increase in suppliers in a competitive market leads to increased competition with a reduction in prices charged to the consumer. The SID theory holds that dentists...
use their position as an agent of the patient to inform the patient that they require more treatment than would previously have been deemed necessary. Thus the volume of work increases and, surprisingly, the prices charged increase as dentists become busier. The question of whether this is, in fact, a moral hazard or not depends on whether the extra work induced is of benefit to the patient. For example, inducing patients to have unnecessary checkups or unwarranted diagnostic tests represents moral hazard, whereas offering clinically justified services does not.

A second SID-type effect can occur in a state or insurance system where the relative remuneration for different items of treatment varies. The possibility here is that dentists may over- or underprovide treatments based on the payment they receive. An increase in the level of payment for a specific item on the scheme schedule may lead to a dentist switching their time to preferentially providing that item.

Although the theory of SID is well developed, the published literature works report conflicting findings on the magnitude of the phenomenon. Birch1, Grembowski et al.3, Porter et al.4 and Chalkley and Tilley2 suggest evidence of induced demand by dentists in specific cases. Evidence also exists in the case of physicians, a similar group of professionals, as described by Grytten6, Izumida et al.7, Delattre and Dormont8 and Xirasagar and Lin9. Woods et al.10 found that dentists providing oral health services in the DTSS were influenced by both economic incentives and system changes. However, in contrast, Sorensen and Grytten11 and Madden et al.12 report a failure to find SID effects in specific medical care schemes.

Donaldson and Gerard1 argue that some ‘overuse’ of service may be warranted, implying that some provider moral hazard can be efficient. The implication is that certain types of provider behaviour, such as SID, should not be seen as all ‘bad’. There are neoclassical economic arguments which suggest that, in at least some cases, professional ethical and altruistic motives provide a satisfactory explanation for the observed behaviour. De Vany et al.13, Lambert14, De Jaegher and Jeger15, and Richardson and Peacock16 provide evidence that an observed extra demand may derive from professionals willing to deliver extra benefits to the population, such as the provision of night clinics, domiciliary visits and improved quality of care. In such cases, the observed effect is clearly not a moral hazard.

Methods to control consumer moral hazard in medicine and dentistry tend to be ineffective17–20. As the supplier in this case holds most of the power in the relationship, it is not surprising that efforts to curb moral hazard should concentrate on the provider side. The DTSS service provides an opportunity to study the impact of design of a third-party funded system on claims for payment for service provided and evidence of moral hazard. Although the DTSS is a single system it is administered at regional level, there being eight administrative regions. Thus, single geographic comparisons of the frequency of claims for services where there is no variation in payment or in regulations governing the provision of that service is possible, the example used is surgical extraction. The impact of regional variation in remuneration can be explored using comparison of claims for endodontic treatment and prolonged periodontal treatment as the rates of remuneration varied by region during the reference period. Variation in the requirement for justification of extra-oral radiography among regions allows the study of the impact of regulation.

The aim of this paper is to investigate whether economic incentives influence the provision of third-party funded dental services within the DTSS in the Republic of Ireland.

Materials and Methods

The protocol of this study has been approved by the relevant ethical committee related to our institution in which it was performed.

Data were obtained from a number of existing sources for secondary analysis. Regionally aggregated data for treatment carried out under the DTSS between 2001 and 2006 were assembled in annual report form by the PCRS for the eight administrative regions, the Eastern, Midlands, Midwestern, North Eastern, North Western, South Eastern, Southern and Western. The data provided details of claims for payment submitted by private dentists at the completion of courses of treatment. The PCRS also publish annual reports for each administrative region which include the numbers of contracted dentists, numbers of patients seen, the numbers of each item of treatment provided and the costs for each item of treatment. Data were collected from the published reports from 2002 to 200621–25.

Population structures were derived from the Census reports of 2002 and 2006 from the Central Statistics Office in Dublin26,27. The proportions of the age groups in each region were determined. The population profiles were broadly similar in terms of the percentage distribution across the age categories. The Eastern region had the highest percentage of population aged 16–44 years at 62% and the North West the lowest at 53%. The combination of information on the number of contracted dentists and the number of eligible adults from data obtained from the annual report of the PCRS allowed the estimation of the dentist to population ratio in the service by region (Table 1). The Southern region had the highest number of dentists per 10,000 population and the ratio increased from 15.9 to 17.1 between 2002 and 2006. The second highest density of dentists was in the Eastern region with the lowest in the North West.
To explore the effect of the structure of the third-party funding system on the claiming pattern for the four selected items of treatment following three approaches were adopted:

- Where there was no regional variation in remuneration or regulation a simple comparison across regions was carried out and regional variation was studied and discussed, this approach was adopted for the exploration of surgical extraction claims.
- Where there was regional variation in remuneration the correlation between number of claims per dentist and the level of fees by region was analysed using linear regression and Pearson’s correlation coefficient. This approach was adopted for the exploration of endodontic treatment and prolonged periodontal treatment.
- Where there was regional variation in regulations regarding a treatment, the number of claims per dentist for the regulated treatment item in the highly regulated region was compared with the less regulated regions. This approach was adopted for the exploration of claims for extra-oral radiography.

In each case temporal effects across the regions were also examined because the health service appointed 20 examining dentists in April 2006 to peer review in the DTSS in the Republic of Ireland. The dentists would have anticipated the possibility of direct scrutiny of their work in the months preceding these appointments. Prior to this time probity assurance was carried out in a much more limited fashion and indirectly through the observation of claim patterns.

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Results
In the case of surgical extractions, there was an increase in claims activity between 2002 and 2005 followed by a fall in 2006. This pattern was not related to any price or regulatory mechanism, because the price was fixed and no prior approval is required. Dentist density per eligible patient could explain 32% of the variation ($r^2 = 0.319, P < 0.001$). The decrease in the trend in 2005–2006 may be due to a national probity exercise that began in May 2006, whereby practitioners with very high ratios of surgical extractions were challenged on their claim patterns by the funding agency. Individual dentists who had claimed a large proportion of surgical extractions to total extractions were asked to justify their claim patterns (Table 2).

Endodontic treatment is available in the DTSS for anterior teeth only. As caries in incisors and canines is relatively rare, particularly for the 70% of the population residing in fluoridated areas, it is unsurprising that the average number of endodontic treatments per dentist in a year is quite low. The variation within each region’s time trend is small in absolute terms. The variation between regions is also quite small in absolute terms, being a difference of approximately 1% of all examinations between highest and lowest in each year; and there is a peak of activity in 2003 (Table 3). Endodontic treatment requires prior approval and local price negotiation. The unit fees paid in each region were consistently highest in the Midland Region (e.g. €207.96 in 2006) and lowest in the North Western and Western regions (€156 and €147.75, respectively, in 2006). The highest fee was of the order of 30% greater than the lowest between 2002 and 2006. There was a negative association between magnitude of remuneration and level of provision ($r = -0.538, P < 0.001$) and also between dentist density and mean number of endodontic treatments per annum per dentist ($r = -0.759, P < 0.001$), suggesting that there were fewer claims per dentist in areas where prices were higher and where there were more dentists per head of population. There is a notable peak in 2003 in almost all regions. This coincided with increased dentist availability due to a withdrawal by contracted dentists from a separate State scheme for insured workers. The data do not provide evidence of economic moral hazard in relation to the provision of endodontic treatment on the DTSS.

Claims for prolonged periodontal treatment showed considerable variation across the regions (Table 4). The regions with the highest and lowest claims, North Western and Western, are regions which closely resemble each other geographically and demographically. The correlation between the number of claims per dentist and dentist density was low and not statistically significant ($P = 0.13$). There was wide variation in the average fee paid per course of treatment in this time period (Table 5). There was a positive correlation between the price per course of treatment paid and the number of periodontal treatments claimed by dentists ($r = +0.561, P < 0.001$). This indicates that price may play a role in determining the output of periodontal treatment, explaining approximately 31% of the variation seen ($r^2 = 0.315$). These data suggest that moral hazard may exist in regard to claims for periodontal treatment in the DTSS.

The pattern of OPG prescription across the regions from 2002 to 2006 shows that the North Western region’s rate of provision of this item is notably less than for the other regions. The five-year average is 4%,

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**Table 2 Surgical extractions as a percentage of all extractions (%)**

<table>
<thead>
<tr>
<th>Region</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastern</td>
<td>17.4</td>
<td>20.8</td>
<td>24.6</td>
<td>23.7</td>
<td>16.9</td>
</tr>
<tr>
<td>Midland</td>
<td>10.8</td>
<td>14.5</td>
<td>15.7</td>
<td>14.4</td>
<td>11.8</td>
</tr>
<tr>
<td>Midwestern</td>
<td>10.4</td>
<td>15.1</td>
<td>18.3</td>
<td>19.2</td>
<td>15.9</td>
</tr>
<tr>
<td>North Eastern</td>
<td>10.2</td>
<td>14.4</td>
<td>14.5</td>
<td>15.5</td>
<td>15.2</td>
</tr>
<tr>
<td>North Western</td>
<td>8.7</td>
<td>11.2</td>
<td>11.2</td>
<td>12.4</td>
<td>9.9</td>
</tr>
<tr>
<td>South Eastern</td>
<td>10.6</td>
<td>13.7</td>
<td>17.2</td>
<td>16.2</td>
<td>14.7</td>
</tr>
<tr>
<td>Southern</td>
<td>16.9</td>
<td>20.4</td>
<td>22.4</td>
<td>23.2</td>
<td>20.7</td>
</tr>
<tr>
<td>Western</td>
<td>17.9</td>
<td>22.4</td>
<td>25.7</td>
<td>15.2</td>
<td>20.9</td>
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</tbody>
</table>

**Table 3 Mean number of claims for endodontics per dentist per annum**

<table>
<thead>
<tr>
<th>Region</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastern</td>
<td>2.71</td>
<td>3.03</td>
<td>3.03</td>
<td>2.68</td>
<td>2.85</td>
</tr>
<tr>
<td>Midland</td>
<td>3.04</td>
<td>4.45</td>
<td>3.45</td>
<td>3.78</td>
<td>4.21</td>
</tr>
<tr>
<td>Midwestern</td>
<td>5.27</td>
<td>5.78</td>
<td>5.44</td>
<td>5.55</td>
<td>5.31</td>
</tr>
<tr>
<td>North Eastern</td>
<td>3.21</td>
<td>3.57</td>
<td>3.73</td>
<td>5.01</td>
<td>4.95</td>
</tr>
<tr>
<td>North Western</td>
<td>5.84</td>
<td>8.28</td>
<td>8.07</td>
<td>8.00</td>
<td>7.86</td>
</tr>
<tr>
<td>South Eastern</td>
<td>4.75</td>
<td>5.20</td>
<td>6.04</td>
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<td>5.58</td>
</tr>
<tr>
<td>Southern</td>
<td>3.65</td>
<td>3.55</td>
<td>3.18</td>
<td>3.08</td>
<td>2.72</td>
</tr>
<tr>
<td>Western</td>
<td>5.68</td>
<td>5.50</td>
<td>4.80</td>
<td>4.10</td>
<td>3.99</td>
</tr>
</tbody>
</table>

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Table 4 Mean number of claims for prolonged periodontal treatment per dentist per annum

<table>
<thead>
<tr>
<th>Region</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastern</td>
<td>15.80</td>
<td>21.48</td>
<td>21.61</td>
<td>20.35</td>
<td>18.16</td>
</tr>
<tr>
<td>Midland</td>
<td>23.32</td>
<td>31.85</td>
<td>24.35</td>
<td>32.97</td>
<td>30.25</td>
</tr>
<tr>
<td>Midwestern</td>
<td>21.67</td>
<td>30.24</td>
<td>32.03</td>
<td>34.28</td>
<td>35.93</td>
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<tr>
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<td>24.30</td>
<td>26.41</td>
<td>34.69</td>
<td>35.28</td>
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<tr>
<td>South Eastern</td>
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<td>33.99</td>
<td>44.59</td>
<td>43.11</td>
<td>41.00</td>
</tr>
<tr>
<td>Southern</td>
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<td>19.92</td>
<td>18.11</td>
<td>18.49</td>
<td>18.31</td>
</tr>
<tr>
<td>Western</td>
<td>47.30</td>
<td>47.05</td>
<td>47.62</td>
<td>50.76</td>
<td>49.66</td>
</tr>
</tbody>
</table>

Table 5 Mean price per course of prolonged periodontal treatment (€), converted to net present value in 2007

<table>
<thead>
<tr>
<th>Region</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastern</td>
<td>123.08</td>
<td>128.81</td>
<td>128.38</td>
<td>130.02</td>
<td>123.06</td>
</tr>
<tr>
<td>Midland</td>
<td>116.87</td>
<td>119.26</td>
<td>125.38</td>
<td>121.79</td>
<td>119.64</td>
</tr>
<tr>
<td>Midwestern</td>
<td>95.32</td>
<td>99.30</td>
<td>100.84</td>
<td>102.00</td>
<td>97.86</td>
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<tr>
<td>North Eastern</td>
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<td>119.32</td>
<td>118.87</td>
<td>112.89</td>
</tr>
<tr>
<td>North Western</td>
<td>89.42</td>
<td>95.67</td>
<td>105.29</td>
<td>121.54</td>
<td>132.55</td>
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<tr>
<td>South Eastern</td>
<td>126.79</td>
<td>126.89</td>
<td>130.80</td>
<td>130.87</td>
<td>125.76</td>
</tr>
<tr>
<td>Southern</td>
<td>146.07</td>
<td>147.65</td>
<td>146.38</td>
<td>142.34</td>
<td>135.56</td>
</tr>
<tr>
<td>Western</td>
<td>159.81</td>
<td>175.78</td>
<td>202.50</td>
<td>206.26</td>
<td>189.93</td>
</tr>
</tbody>
</table>

whereas the closest comparisons are the Eastern, Western and Midwestern regions at 12%. The remaining regions average about 14% (Table 6). These data illustrate the impact of putting protocols in place to ensure appropriate use of OPGs. They also indicate that moral hazard may exist with regard to the provision of extra-oral radiographs in the DTSS.

Discussion

Before considering issues of induced demand, it is necessary to consider the factors which can contribute to an automatic variation in treatment demand in the Irish regions. Such factors include personal income, regional demography and regional access to dentists.

Personal income of patients, or ability to afford attendance for treatment, should not be a factor in determining regional variations because eligibility for DTSS services is defined by an income limit, and this income limit is consistent nationally across all regions.

The impact of regional variation in the distribution of ethnic groups or immigrant groups has not been factored into this analysis as the required data were not available, it is unlikely however to account for the differences seen. Regional demographic factors considered were age and gender as treatment needs may vary with age and by gender. The most noticeable demographic variations noted were with regard to gender, notably a majority female population in the two areas with the largest conurbations, Dublin (part of Eastern) and Cork (part of Southern). The male–female ratio varies from 0.97 in the Eastern region at one extreme, to 1.02 in the Midland. Gender balance is very similar in the Midwestern, North Western, South Eastern and Western regions. Although there was variation in the age profiles of the Irish administrative regions, this was a manifestly difference between the Eastern region and the rest, with the Eastern having a higher proportion of younger adults. The variations in claim patterns tended to occur among regions with similar age structures as well as with the East.

In terms of dentist density, the North Western, Midland and Western regions are similar in having the sparsest dentist to population coverage. There is a multiple of 2.7 dentists per patient between the most and least advantaged regions. This is greater than the variation for other professionals contracted to the medical card scheme. Within dentistry, the
Southern and Eastern regions had the highest dentist-to-population ratio while the North Western had the lowest. The two dental schools in the state are located in the Southern and Eastern regions.

Where surgical extraction claims are made as a substitute for ordinary extraction claims, each unit of work commands a significantly higher fee; the surgical extraction fee is a 2.67 multiple of the fee for a simple extraction. Rather than providing extra and unnecessary treatment, with a negative impact on patient welfare as defined in the SID model, this paper’s substitution of claim description is a ‘victimless crime’ (if one does not count the State as a victim). A dentist may feel entitled to claim this fee if an extraction proves to be simply more difficult than the norm. The surgical extraction requires no prior approval and no local price negotiation is involved. Therefore, in theory, there should be no reason why surgical extraction rates should vary among regions, other than, possibly, demographic reasons. However, the literature is silent on the relationship between demography and the need for surgical extractions. Although it might be surmised that an older population might have a greater need for extractions, there is no reason to think that the proportion requiring the surgical approach should vary. Surprisingly, the difference is most marked between the two most similar demographic and dentist-sparse regions with the Western region having roughly twice the rate of claims of the North Western. The total number of extractions, surgical plus ordinary, is remarkably constant across the regions at around 0.44 teeth per person. There is no ready explanation for these findings. There is evidence of simple substitution of surgical extraction claims for extraction claims in some regions, at almost three times the cost to the State per item claimed, suggesting evidence of moral hazard.

In the case of endodontics, there is no evidence of unwanted economic behaviour. The consequences of unnecessary treatment are significant and it seems likely that the vast majority of dentists would be inhibited by their professional ethics from exploiting any potential agency power to induce this item in the DTSS. In addition, the ability of an investigator to demonstrate fraudulent practice is probably greater with this treatment item than most others, as it is easy to determine whether a tooth has been endodontically treated or not, and this in itself is an inhibitor to false claiming.

In the case of prolonged periodontal treatment, the consequences for the patient of induced unnecessary treatment are usually not severe, thus there is not a great deal of inhibition to be expected from the dentists’ professional ethics in risking overtreatment. Also, treatment need is very subjective, thus differences of opinion among dentists are more likely to be present than with other items of treatment. The prices paid in the Western area were by far the highest paid in Ireland, and the number of treatments provided was also the highest. Minor differences in price between other regions produce no clear pattern of effect. This indicates that the price difference probably requires a threshold magnitude before it becomes important. For prolonged periodontal treatment, there is evidence of increased price-inducing increased claims.

Dentists do not receive marginal payments for intra-oral radiographs in the DTSS as the examination fee includes a component for these. Therefore, the taking of an intra-oral radiograph imposes a cost on the dentist with no financial benefit accruing. By contrast, in 2007 a fee of almost €40 was payable for an OPG. There is a financial motive to provide more extra-oral radiographs in cases where they could be positive-income substitutes for zero-income treatment items. In the region where dentists had to comply with evidence-based regulations regarding the use of OPG radiography, the average dentist claimed at about one-third of the rate of dentists elsewhere.

The variation in utilisation of OPGs is not explained by population structures; the North West has a very similar population structure to other areas, while having a far lower level of OPG provision. Another variable to consider is the regional distribution in the availability of OPG machines. Data provided by the Radiological Protection Institute of Ireland indicated that the number of private dentist practices with OPG machines in each region in 2006, the nearest year available for comparison, was highest in the South Eastern at 0.36 machines per contractor, with the lowest in the Western at 0.19 and North Western at 2.0. The distribution of OPG machines does not provide an explanation for the frequency of OPGs per examination ($r = 0.02$). Although it might appear that perhaps 22% of the variation can be explained by dentist densities ($r^2 = 0.223$, $P < 0.001$), this seems to be an artefact due to the North West’s extreme low dentist density and its extreme low OPG utilisation; if the North Western area is excluded from the analysis, there is no relation at all ($r^2 = 0.001$). By a process of elimination, only one variable can satisfactorily explain the observed behaviour, and that is the existence of extra regulation in the North Western area due to the utilisation of its OPG protocol. This finding suggests evidence of moral hazard.

Conclusion

There is evidence to suggest an oversupply of extra-oral radiographs in regions that did not apply an evidence-based OPG protocol regarding the use of OPG radiography. These data suggest that the implementation of effective protocols will ensure that all OPGs taken by contractors can be justified. Considering the radiation dose delivered by an OPG, the...
use of such protocols by third-party funding agencies would appear highly appropriate.

There is a positive relationship between fee level and volume of claims for prolonged periodontal treatment. However, there may be a threshold difference at which price becomes important. Minor price differences are not associated with higher claim rates.

The regional and temporal variations in claim patterns appear to indicate that dentist density is positively related to the rate of claim for fees for surgical extractions, \( r = 0.565, P < 0.001 \) which is in keeping with the classical SID model. The data also suggest that oversight, in the form of a well-publicised probity exercise, was effective in changing practitioner behaviour regarding claims for surgical extractions. There is no evidence for induced demand for endodontic treatment in the DTSS.

SID has been described previously in situations where dentists and doctors have been paid by a third party. The data considered in this paper are consistent with such previous findings. It should be no surprise that dentists should behave as rational economic agents. The findings regarding endodontics suggest that in clear-cut situations, dental ethics dominates economic incentivisation. However, many areas are less clear cut, as with the examples selected, and in such cases it behaves the signers of third-party contracts to carefully crystallise their requirements in such a way as to avoid the ambiguity that might encourage moral hazard. The data also suggest the need for external clinical supervision in such third-party arrangements.

**Abbreviations list**

OPG, orthopantomograph; PCRS, Primary Care Reimbursement Service.

**References**


