Cervical screening interval: costing the options in one health authority
Clare M. Grant

Abstract
Background This is a study of the costs of the cervical screening programme in one health authority with a mixed three and five year, and thus inequitable, cervical screening interval. The costs of three year and five yearly screening are compared, and considered in terms of likely numbers of averted cases of and deaths from cervical cancer.
Methods The study uses an activity-based costing procedure to calculate the component and total costs of the cervical screening programme.
Results The main costs of the cervical screening programme are the costs of taking and processing smears. In 1994–1995 the total cost of a three year recall policy was £768 570 per 100 000 eligible women and that of a five year recall policy was £476 768 per 100 000 eligible women. Best estimates of the numbers of cases of and deaths from invasive cervical cancer averted by three over five yearly screening are 1.4 and 0.7 per 100 000 eligible women, respectively. Because of uncertainty regarding colposcopy costs a sensitivity analysis was carried out, giving a range of cost differences between three and five yearly screening of £278 477 and £351 768.
Conclusions The health service costs of three yearly screening are considerably greater than those of five yearly screening. Despite this, a significant proportion of smear-takers are screening more frequently than five yearly, with implications for anxiety of screened women, as well as health service costs.
Keywords: cervical screening, activity-based costing, sensitivity analysis

Introduction
Despite the fact that a cervical screening programme has been in operation in the United Kingdom for over 30 years, there is a lack of knowledge about the costs of running the programme. In addition, the optimal screening interval at which to carry out cervical smears remains debatable, with no firm national guidance on what it should be except ‘at least every five years’, and with much variation in policy between health authorities around the country. This paper discusses the process and implications of costing the cervical screening programme in one health authority. The impetus to cost the programme in that particular authority was its formation as a result of the merger of two smaller health authorities (HA1 and HA2) each with different cervical screening recall policies. In one (HA1) the recall interval had been three years for women aged 20–34 years and five years for women aged 35–64 years, whereas in the other (HA2) it had been three years for all eligible women aged 20–64 years. This merger resulted in an inequitable situation, with women living in different parts of the same health authority being screened at different intervals. As a result there was a need to consider implementing a single screening interval for the whole new health authority (HA3).

The activity-based approach of the National Coordinating Network report on costings was used to ascertain the cost of the cervical screening programme given different screening intervals. The extra cost of three over five yearly screening was then considered in terms of the number of extra lives saved by three over five yearly screening. In the absence of robust evidence about the mortality reduction associated with different screening intervals, estimates from the IARC Working Group’s evaluation of screening programmes in eight countries were used. Although this costing approach successfully identifies the health service costs of different screening intervals, it does not touch on costs to the patient, for example the discomfort and anxiety associated with cervical screening.

Methods
The National Coordinating Network report on costings provides a framework for costing all parts of the cervical screening programme including the costs of further diagnosis and treatment activities resulting from all non-normal smears to the point of first colposcopic referral, but not including treatment for cancers found. These parts are:

1. the health authority – responsible for GP target payments and programme management;
2. primary care – responsible for the majority of smear-taking;
3. the cytology laboratory – responsible for smear-processing;
4. the histology laboratory – responsible for processing cervical biopsies (taken by the colposcopy service);
5. the colposcopy service – responsible for the follow-up of abnormal smears.
All activities undertaken by each of the above as part of the cervical screening programme were identified. The time spent on each activity was measured and the cost of that time calculated, depending on the grade of experience of the staff involved and their average hourly rates of pay. For each of these activities, the departmental and general overheads were also identified (departmental overhead costs being those directly related to cervical screening programme activities, and general overhead costs being those incurred in maintaining the day-to-day running and maintenance of the parent organizations involved). The costing information was collected by the researcher, but the teams whose activities were being costed at each stage of the screening programme were directly involved in this process.

In addition to the cost involved at each stage of the programme, the numbers of smears expected to be generated given different screening intervals was required to calculate the total cost of the cervical screening programme. These were derived from figures for the cervical screening coverage of the target age group in HA1 and HA2, and assuming repeat of all inadequate, borderline and mild dyskaryosis smears.

Including both target payments and the cost of smear-taking activity based on data collected from primary care sources would appear to be counting costs twice. The latter rather than the former were included in the total cost of the programme for reasons discussed below.

From the total cost of the cervical screening programme the cost per 100,000 eligible women in HA3 (total eligible population 155,038) was then calculated. Using the IARC estimates that five year screening confers 84 per cent protection against invasive cervical cancer and three year screening confers 91 per cent protection, the number of deaths from cervical cancer averted by three over five yearly screening was estimated. The IARC estimates must be interpreted with extreme caution as their study uses a case–control technique estimated. The IARC estimates must be interpreted with extreme caution as their study uses a case–control technique.

### Table 1

<table>
<thead>
<tr>
<th></th>
<th>3 year recall</th>
<th>split 3/5 year recall</th>
<th>5 year recall</th>
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<tbody>
<tr>
<td>Number of smears taken in HA1</td>
<td>30,324</td>
<td>23,270</td>
<td>18,194</td>
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<tr>
<td>(eligible population 90,399)</td>
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<tr>
<td>Number of smears taken in HA2</td>
<td>21,292</td>
<td>15,928</td>
<td>12,776</td>
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<tr>
<td>(eligible population 64,639)</td>
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<td></td>
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<tr>
<td>Number of smears taken in HA3</td>
<td>51,616</td>
<td>39,198</td>
<td>30,970</td>
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<tr>
<td>(eligible population 155,038)</td>
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Results

The number of cervical smears

Table 1 shows the expected number of cervical smears taken for different screening intervals in HA1, HA2 and HA3. In HA1, 90,399 women were eligible for cervical screening, of whom 37,837 were aged 20–34 years and 52,562 were aged 35–64 years. If recall was five yearly, and assuming screening coverage was 88 per cent and all inadequate, borderline and mild dyskaryosis smears (12.3 per cent of all smears) were repeated, the number of smears taken per year would be 18,194. However, with three year recall, the number of smears per year would be 30,324, and with three year recall for women aged 20–34 years and five year recall for women aged 35–64 years (a split recall policy) the number of smears per year would be 23,270. The real number of smears taken on women in HA1 in 1994–1995, when recall was five yearly for all eligible women, was 24,204. That is, an additional 6,010 smears were taken over those expected from the above assumptions. These ‘extra’ smears are probably due to smear-takers not adhering to screening policy, by taking smears more frequently or outside the eligible age range. The recent National Audit Report recommends that extra smears taken not adhering to the agreed screening policy should not be accepted for assessment.

In HA2, 64,639 women were eligible for cervical screening, of whom 23,919 were aged 20–34 years and 40,720 were aged 35–64 years. If recall was five yearly, and assuming screening coverage was 88 per cent and all inadequate, borderline and mild dyskaryosis smears (12.3 per cent of all smears) were repeated, the number of smears taken per year would be 12,776. However, with three year recall the number of smears per year would be 21,292, and with a split recall policy the number of smears per year would be 15,928. As in HA1, the real number of smears taken on women in HA2 in 1994–1995 when the recall interval was three years for all eligible women was greater than would be expected from the above assumptions; the number of ‘extra’ smears was 4,122.
The expected number of smears taken for different screening intervals in HA3 can be determined by summing the numbers for HA1 and HA2. Because the costs of true three, split and five year recall are being compared, calculated rather than actual numbers of smears were used.

The costs of the cervical screening programme

Table 2 shows the individual component and total costs of the cervical screening programme in HA3 for three year, split and five year recall intervals.

Health authority costs

The health authority maintains the cervical screening programme database and runs the call–recall system. These activities relate primarily to the eligible population so a change in the number of smears carried out results in relatively little alteration in cost. The health authority also pays general practitioner (GP) target payments which remunerate practices for taking smears from women aged 25–64 years within the last 5.5 years and remain constant however many smears are taken. The total amount paid to practices in HA1 and HA2 in 1994–1995 was £760 189.

Primary care costs

One of the major costs of the cervical screening programme in HA3 is smear-taking (as also found in a costing of the cervical screening programme in Scotland).\(^8\) Eighty-eight percent of smears taken in 1994–1995 in HA1 and HA2 were taken in primary care,\(^5\) the majority by practice nurses. Information on activity and overhead costs involved in taking a smear in primary care was collected from three general practices in HA3 (with practice populations of women aged 20–64 years ranging from 656 to 3574). An average cost per smear across these practices was then calculated at £10.83. Smaller numbers of smears were taken in community clinics (4 per cent), GUM clinics (1 per cent), NHS hospitals (6 per cent), privately (< 1 per cent) and in other settings (< 1 per cent).\(^5\) It was not possible to calculate the cost of taking a smear in each of these settings, and it has been assumed to be the same as in primary care. (In fact, the cost in these settings may be higher, as more smears will be taken by doctors rather than nurses.)

The cost of taking a smear in primary care and the expected numbers of smears taken (as shown in Table 1) were used to calculate the total cost of smear-taking activity if HA3 followed three year, split and five year recall policies.

Cytology laboratory costs

The other major cost of the screening programme in HA3 is the processing of smears by the laboratory (again as found in the Scottish costing study).\(^8\) The costs of processing a smear test by each of the two cytology laboratories in HA3 were calculated from activity and overhead data collected from those laboratories. The cost per smear processed by one laboratory was £8.75 and by the other laboratory was £9.14. These figures along with the expected numbers of smears were then used to calculate the total cost of smear-processing activity if HA3 followed three year, split and five year recall policies.

Histology laboratory costs

Information was collected from the laboratories about the activity and overhead costs of processing cervical biopsies, as well as the number of cervical biopsies processed per year. In one laboratory, the average cost per cervical biopsy processed was £22.12, and the cervical biopsy rate was 2.6 per 100 smears processed by the laboratory. Thus, with three year recall that laboratory’s cost of processing cervical biopsies would be £17 431, with split recall it would be £13 383 and with five year recall it would be £10 463. For the other laboratory, insufficient information existed to calculate either the cost of processing a cervical biopsy or the rate of cervical biopsies processed. The cost of processing a cervical biopsy was assumed to be that of processing any gynaecological specimen, which could be calculated at £25.00, and the cervical biopsy rate was assumed to be the same as that of the other laboratory. It follows that with three year recall the total cost of processing cervical biopsies in the

<table>
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<th>Table 2</th>
<th>The total and component costs of the cervical screening programme in HA3 given three, split three/five and five year screening intervals</th>
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<tr>
<td></td>
<td>Cost if three year recall (£)</td>
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<tr>
<td>Health authority – GP target payments</td>
<td>760 189</td>
</tr>
<tr>
<td>Health authority – programme management</td>
<td>60 558</td>
</tr>
<tr>
<td>Primary care</td>
<td>559 001</td>
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<tr>
<td>Cytology laboratory</td>
<td>463 466</td>
</tr>
<tr>
<td>Histology laboratory</td>
<td>31 281</td>
</tr>
<tr>
<td>Colposcopy service</td>
<td>77 269</td>
</tr>
<tr>
<td>Total (excluding GP target payments)</td>
<td>1 191 575</td>
</tr>
<tr>
<td>Total (per 100 000 eligible women)</td>
<td>768 570</td>
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second laboratory would be £13 850, with split recall it would be £10 350 and with five year recall it would be £8300.

Colposcopy costs
The cost and activity information collected from the two colposcopy units in HA3 was insufficiently complete to calculate either the cost per colposcopy appointment or the referral rate to colposcopy in terms of the numbers of smears processed by the laboratories. To calculate the total colposcopy costs for different screening intervals the cost per colposcopy was assumed to be the same as that found in Oxford,2 that is £49.90, and the referral rate to colposcopy was assumed to be 3 per cent of all smears taken.

Cost effectiveness of different screening intervals
The IARC study estimates that five year screening confers 84 per cent protection against invasive cervical cancer and three year screening confers 91 per cent protection. Using these figures, which can only be treated as the best guesses available of the difference in mortality reduction expected from three over five yearly screening, the additional number of women who would have a cervical cancer death averted by three compared with five yearly screening was estimated. Assuming that in the absence of any screening programme the incidence of invasive cervical cancer is 20 per 100 000 eligible women,9 five year screening as opposed to no screening will result in an 84 per cent reduction in incidence to 3.2 per 100 000 eligible women. Similarly, three year screening as opposed to no screening will result in a 91 per cent reduction in incidence 1.8 per 100 000 eligible women. In other words, each year an extra 1.4 cases of invasive cervical cancer per 100 000 eligible women are detected by three year screening compared with five year screening. Assuming the overall mortality rate for invasive cervical cancer is 50 per cent,9 0.7 lives are saved per 100 000 eligible women by three compared with five year screening. As can be seen from Table 2, the difference in cost per 100 000 women between running a three yearly screening programme and a five yearly one is £291 802. Thus the best rough estimate of how much three yearly screening costs over five yearly screening to avert 1.4 cases of cervical cancer and prevent 0.7 cervical cancer deaths is £291 802.

Sensitivity analysis of colposcopy costs
Table 3 shows the effects of a sensitivity analysis of colposcopy costs on the total cost of the programme. If the most conservative estimate of colposcopy costs is used the cost difference between three and five yearly screening is £278 477 and if the least conservative one is used that cost difference is £351 768.

Discussion
The cost of running the cervical screening programme in HA3 based on three year recall is £768 570 per 100 000 eligible women, compared with £476 768 per 100 000 eligible women for five year recall. An estimated 1.4 cases of and 0.7 deaths from invasive cervical cancer may be averted per 100 000 women in HA3 by three over five yearly screening.

Although it is believed the components accounting for the majority of the cost of the cervical screening programme have been costed accurately, there was uncertainty around the colposcopy costs. As a result a sensitivity analysis was carried out, giving the lowest cost per life year gained by three year compared with five year screening as £19 894 and the highest as £24 943. There was also some controversy about whether target payments or the cost of smear taking based on data collected from primary care should be included in the total cost of the programme. A decision was made to include the latter, based on the argument that the data collected from primary care represent the actual activity cost of taking smears in all settings and are sensitive to changes in the screening interval and numbers of smears performed. In contrast, target payments are a means of distributing funds within a total remuneration package for GPs, and the sum paid to GPs is independent of numbers of smears taken and whether targets are met.

However, the greatest uncertainty surrounds the reduction in mortality associated with different cervical screening intervals. In the absence of evidence regarding the effect of different

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<th>Low colposcopy costs (£)</th>
<th>Actual colposcopy costs (£)</th>
<th>High colposcopy costs (£)</th>
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<tbody>
<tr>
<td>Total cost per 100 000</td>
<td>735 233</td>
<td>768 570</td>
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<tr>
<td>women (three year screening)</td>
<td></td>
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<tr>
<td>Total cost per 100 000</td>
<td>456 756</td>
<td>476 768</td>
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<tr>
<td>women (five year screening)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost difference per 100 000 women between three and five year screening</td>
<td>278 477</td>
<td>291 802</td>
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intervals from clinical trials the estimates from the IARC Working Group are probably the best evidence available. However, they acknowledge that their study does not take into account non-compliance, nor the fact that the absolute reduction in risk of invasive cervical cancer depends on its underlying incidence in the population, so their figures for reduction in incidence can only be treated as the best guesses available.

Although this costing procedure has determined the health service costs of running the cervical screening programme, it has not attempted to quantify the monetary and other costs to women screened. More frequent screening will not only cost the health service more, but will result in greater anxiety, as the more intense the screening activity the more smears will have to be repeated, resulting in the detection, and possibly treatment, of more abnormalities (including a significant number that may have regressed spontaneously). Nor has the study considered the costs beyond the point of first colposcopic referral, for example the hospital costs of treating the small number of women with cervical cancer which may be avoided by more frequent screening.

The numbers of smears used in the costing procedure assume all smear-takers follow the health authority policy on screening frequency. However, the actual numbers of smears taken in the HA1 and HA2 were greater than would have been expected if screening intervals had been strictly adhered to, suggesting that some smear-takers decide to screen more frequently. This may be because of their own perceptions of risk, in response to pressure from patients or to achieve screening coverage targets by five years. So an extra estimated cost of three year over five year screening will be accurate only if the majority of smear-takers actually follow the health authority recall policy.

Acknowledgements

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References


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