Improving the NHS cervical screening laboratory performance indicators by making allowance for population age, risk and screening interval

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Objective: One of the key performance measures in the monitoring of the NHS cervical screening programme is the targeting of laboratories with very high or low percentages (outside the 10th–90th percentile) of adequate smears that have moderate dyskaryosis or worse. These laboratories are assumed to include those laboratories that may have extremes of sensitivity and specificity. A clear limitation with this methodology is that laboratories do not examine smears from women with the same underlying risk, age distribution or screening interval and adjustment for these factors should considerably improve the method.

Methods: This paper describes a method that allows for these confounding variables and a new age-risk-interval adjusted moderate dyskaryosis or worse rate (ARI-adjusted mod+ rate) can be calculated. The adjusted rate is the rate of moderate or worse dyskaryotic smears that the laboratory would have detected had it been screening women with an English 'average' age-risk-interval. All laboratories can therefore be compared using this method.

Results: The methodology is illustrated using data from the NHSCSP South West Region. The particularly low percentage of moderate or worse smears detected by one or two laboratories can be shown to be due to a local screened population with a very low risk because of a high mean age, relatively short screening interval and census variables associated with a low risk, rather than any under-calling by the associated laboratories.

Conclusions: The ARI-adjusted mod+ rate requires to be calculated for all laboratories in England if it is to be used as a primary performance indicator. Alternatively, it can be used to further examine laboratories that are deemed to be outliers using the current methodology.

Keywords: performance, cytology, population characteristics, cytodiagnosis, diagnosis, cytological techniques, laboratory diagnosis, cervical screening

Introduction

Performance of cervical screening laboratories is monitored on an annual basis and detailed monitoring statistics are published annually by the Government statistical service in the cervical screening programme statistical bulletin.[1] Detailed information on performance indicators has been published by the NHS cervical screening programme.[2] Key indicators include the percentages in different smear categories and it is recommended that laboratories with observed values outside the 10th–90th percentile for these indicators be investigated. These indicators and the percentile limits are shown in Table 1 for 2002–2003 and 2003–2004. The guidelines[2] state that laboratories whose performance falls outside the indicated ranges, must, with the assistance of their quality assurance team, investigate and be able to provide evidence to support the explanation for this performance.

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Table 1. 10th–90th percentile ranges for laboratory performance indicators

Indicator	2002–2003	2003–2004
Inadequate as % of all smears*	6.1–12.6	6.3–12.3
Mild/borderline as % of adequate smears*	4.0–9.1	3.9–8.5
Moderate or worse as % of adequate smears*	0.9–1.7	0.8–1.5
PPV for CIN 2 or worse† (%)	65–88	65–87

*Data from KC61 part B age 20–64.
†Data from KC61 part C.

Furthermore, the guidelines state that 'efforts are therefore now concentrated on identifying outliers and subjecting them to scrutiny. This should ensure a more even service across the country and also identify those laboratories at both extremes of sensitivity and specificity where remedial action may be needed'. Whilst the percentage of inadequate smears and the positive predictive value [PPV – the percentage of moderate or worse smears that result in histology of cervical intraepithelial neoplasia II (CIN II) or worse (termed CIN II+)] can work well as performance measures, the investigation of laboratories with high or low percentages of moderate dyskaryosis or worse smears, and high or low percentages of borderline/mild dyskaryotic smears may be of limited value due to confounding. This arises because the underlying populations whose smears are examined by laboratories are at differing risk of CIN II+. Tables 2a and b show data taken from the 2002–2003 statistical bulletin highlighting some of the laboratories with the lowest percentages and highest percentages of moderate or worse smears. As anticipated, a number of those laboratories with low percentages are from more affluent and often more rural areas where the underlying CIN II+ rate is likely to be lower and those with high percentages often in more deprived inner city locations where the CIN II+ rate is likely to be higher. The problem is further compounded by the use of different screening intervals, which vary from 3 to 5 years, the longer intervals being likely to be associated with higher rates of smears with moderate or worse dyskaryosis. Lastly, there is also a problem relating to the statistical instability of 1 year data from some of the smaller laboratories [and Primary Care Trusts (PCTs)]. This problem is illustrated in Table 2c using 95% confidence limits for observed values from two of the larger laboratories compared with data from two of the smaller laboratories. Clearly the data from the smaller laboratories are less statistically stable and the observed values will vary more from year to year because of this. As a consequence, the smaller laboratories will have a higher probability of being outside the 10th–90th percentile with a year's data than the larger laboratories.

This paper describes a method that adjusts for the underlying age, population risk and screening interval of women whose smears are examined by laboratories. This should enable a more useful performance measure to be created where the laboratories investigated are those with a percentage of adequate smears

Table 2a. Some laboratories with very low percentages of smears with moderate or worse dyskaryosis (data from 2002 to 2003)

Laboratory	SHA	% moderate+
Hinchingbrooke	Norfolk, Suffolk & Cambridgeshire	0.7
Pembury	Kent & Medway	0.7
County Hospital Hereford	Coventry, Warwick, Hereford and Worcs	0.7
Dorset County	Somerset & Dorset	0.7
William Harvey Hospital	Kent & Medway	0.7

Table 2b. Some laboratories with very high percentages of smears with moderate or worse dyskaryosis (data from 2002 to 2003)

Laboratory	SHA	% moderate+
Queen Alexandra Hospital	Hants & IOW	1.8
St Thomas's Hospital	South East London	1.9
Scunthorpe General	North & East Yorks & North Lincs	2.3
University College	North Central London	2.5
Colchester Hospital	Essex	2.7

Table 2c. Statistical instability assessed for a sample of larger and smaller laboratories using data from 2003 to 2004

Laboratory	% moderate+	Total adequate samples	95% CI
Hichingbrooke Hospital	1.0	9834	0.81–1.21
St Mary's Hospital	0.9	8853	0.72–1.12
Leeds Teaching Hospitals	1.0	68897	0.93–1.08
Royal Victoria Infirmary	1.5	47 604	1.39–1.61

that have moderate dyskaryosis or worse (described in the rest of this paper as the moderate + rate) outside the 10th–90th percentile after adjustment for these factors.

Methods and description of the variables used in the model

The method requires laboratories to estimate the underlying population of women at the PCT level whose smears are being examined by that laboratory. A model is produced which estimates the relative risk of women from each PCT having a moderate or worse dyskaryotic smear based on the age-population-interval characteristics for that PCT. A weighted relative risk is then calculated using the population numbers and risk for each PCT that sends smears to the laboratory. The observed percentage of smears with moderate or worse dyskaryosis (the moderate + rate) is then divided by the weighted relative risk to produce an Age-Risk-Interval adjusted moderate dyskaryosis or worse rate (the ARI moderate + rate). The ARI moderate + rate can be interpreted as the rate the laboratory would have obtained had it been screening a population of women with the English average age, population risk and screening interval. The adjusted rates can therefore be legitimately compared and the laboratories with ARI mod+ rates outside the 10th–90th percentiles targeted for further investigation. These are the laboratories with very high or low observed rates that are 'out of keeping' with the estimated risk of their local population of women as judged by the results from all other laboratories. The laboratory is then either relatively under or over-calling or for some specific local reason the model inadequately describes the risk in the local population of women.

A model has been developed at the PCT level that links the percentage of moderate dyskaryotic or worse smears (taken from KC53 part D) for each PCT with explanatory variables related to population risk and screening interval. The variables for consideration for inclusion in the model are mean age, screening interval, deprivation, census variables and ethnic minority composition. In the final model deprivation has been replaced by a number of variables taken from the 2001 census. This is because deprivation is a summary statistic and the model is improved by using individual variables from the census some of which are combined to produce measures of deprivation e.g. Townsend or Carstairs Indices. The variables in the model can be further classified as demographic population characteristics (e.g. age and ethnic minority composition), local screening programme characteristics (e.g. screening interval) and socio-economic characteristics (e.g. census variables such as the percentage of people working in hotel and catering or the percentage of all household spaces which are detached). Age and screening interval have been determined using information from the KC53 itself, ethnic minority and deprivation from the National Database for Primary Care Groups and Trusts, and 2001 census data from the National Statistics Area Classification for Health Authorities. Details of some of the variables in the model are illustrated by using data from the 2002–2003 and 2003–2004 PCT (KC53) returns either for each year separately or added together. The final model uses data from the two years combined to increase the statistical power.

Mean age

The mean age of screened women at PCT level has been estimated for women aged 20–64 from KC53 part D, which gives the woman's most severe test result during the year so that each woman is recorded only once. The total number of women in each age band is multiplied by the midpoint of each age group (e.g. women aged 30–34 will have a midpoint age of 32.5) and then divided by the overall total to give a weighted mean age. The variation in weighted mean age for all PCTs using data from England in 2003–2004 in shown in Figure 1. During this year whilst the majority of mean ages were around 40 or 41 the mean age varied from 35.9 to 43.6 years. We would expect a much smaller moderate + rate for older women and a

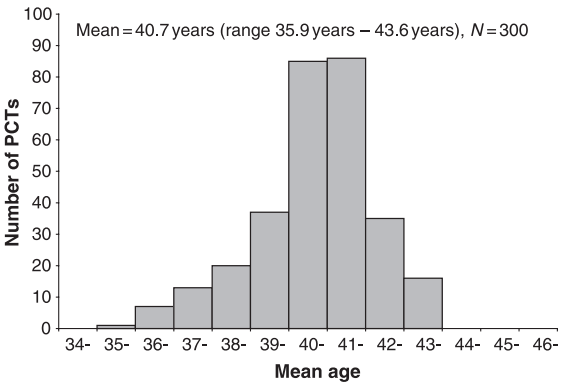

Figure 1. Histogram of mean age of screened women by PCT (2003/4).

higher rate for younger women which is why age is a confounding factor in interpreting the crude moderate + rates.

Screening interval

The observed screening interval at PCT level has been estimated from data provided by the KC53 part A3. The screening interval (actint) is estimated as: 8 − 5P where P is the proportion of women last screened within 3 years divided by the proportion of women last screened within 5 years for women aged 25–64. If the proportion is 0.6 the interval is 5 years and if the proportion is 1 then the interval is 3 years. The actual measured screening interval ranges from about 3.75 to 4.75 years with a clustering of PCTs around 3.8 years probably related to 3-yearly screening. Figure 2 shows a graph of the moderate + rate for women aged 20–64 against the observed screening interval using data from 2002–2003. Five yearly screening in practice may be rare because of the role of opportunistic smear tests and some GPs inviting women every 3 years in an area with a 5 yearly policy. The actual screening interval is complicated due to the role of both opportunistic and Exeter invitation smears as well as the rather simple estimate. However, the method does give a useful estimate of the screening interval and shows that the percentage of moderate or worse smears increases with screening interval ($P < 0.001$) as would be expected. However, relatively little of the variation in the moderate + rate is explained by screening interval on its own (Adj-$R^2 = 6.3\%$) and this is not increased very much after allowing for size of PCT by weighting by the number of adequate smears in each PCT (Adj-$R^2 = 7.0\%$). If both mean age and screening interval are included in the weighted multiple regression model then nearly 13% of the variation in moderate + rates is explained by these two variables (Adj-$R^2 = 12.7\%$).

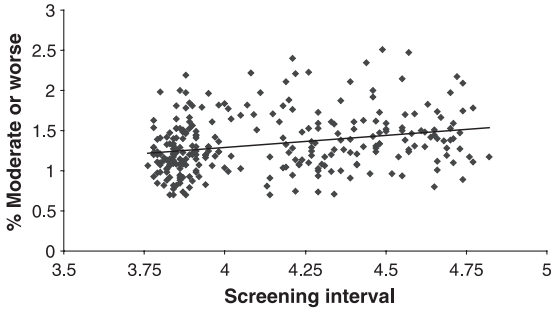

Figure 2. Graph of moderate + rate versus observed screening interval for PCTs (2002/3).

Deprivation and census-derived variables

The third variable of interest is deprivation, which has been related to cervical cancer incidence using the Carstairs Index.[3] We have used the Townsend Index of deprivation, which for many purposes can be considered as almost identical. Figure 3 shows the graph of the moderate + rate against deprivation, there is a highly significant statistical association between the two ($P < 0.001$). This graph does not include PCTs with an Indian subcontinent (Indian, Pakistani and Bangladeshi) ethnic minority population greater than 5%, because PCTs with such populations have a low risk and confound the association with deprivation seen for the (mostly) white and black Caribbean populations. Nearly 11% of the variation in the moderate + rate is explained by deprivation measured by the Townsend Index and this increases to 14% when allowance is made for PCT size (numbers of women screened). If a weighted multiple regression model is constructed with mean age, screening interval and deprivation for all PCTs with an Indian subcontinent population of less than 5% then 23% of the variation in moderate + rates is explained (Adj-$R^2 = 22.6\%$). However, deprivation itself is a summary statistic made of census-derived variables and the best fitting model uses the individual census (2001)-derived explanatory variables.

Ethnic minority composition

Two of the most common ethnic minority populations are the black Caribbean population and the Indian

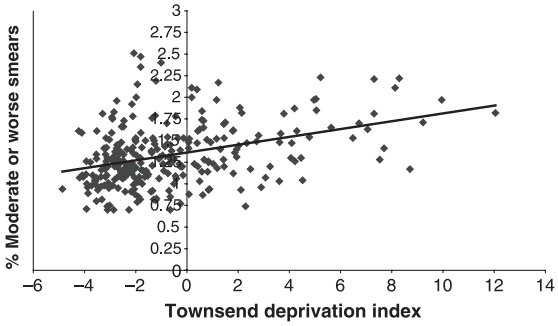

Figure 3. Graph of moderate + rate versus Townsend Index (2002/3) excluding PCTs with Indian sub-continent pop > 5%.

subcontinent population (Indian, Pakistani and Bangladeshi ethnicity). The black Caribbean population has been previously associated with a higher risk and the Indian subcontinent population with a lower risk.[4] This is also seen by modelling the moderate + rate against percentage of Indian subcontinent population for each PCT or by modelling with the black Caribbean population. However, the high risk seen in the black Caribbean population is not seen after allowance for deprivation is made.

Estimating the moderate + rate and relative risk from the model

The final model was constructed using the statistical package STATA version 8 (StatCorp. 2003, College Station, TX, USA) by a two-stage process. First, all 39 explanatory variables, including screening interval, age, ethnic minority composition and other census variables, were modelled against the moderate + rate using stepwise regression to discover which were the most important predictor variables. The selected variables were then modelled against the moderate + rate using a grouped logistic regression model using the glogit command. A two-stage process was necessary because the glogit command does not support stepwise regression.

For the first stage the stepwise regression model, using the sw regress command, used automatic backward elimination with a *P*-value of less than 0.2 required to retain a variable. As the PCTs have different population sizes, the total number of women screened at each PCT was used to weight the model using analysis weights. The stepwise regression procedure eliminated 23 of the 39 variables leaving 16 explanatory variables with the strongest evidence of being associated with the moderate + rate to be used in the final model. The final model was then constructed with these explanatory variables using the grouped logistic regression command (glogit) in STATA. The final model with 16 explanatory variables (Table 3) explained just under 40% of the variation in moderate + rates ($R^2 = 42.7\%$ and Adj-$R^2 = 39.4\%$).

For ease of use a simplified (reduced from 16 to 10 explanatory variables) model has also been produced using a multiple regression model weighted by the total number of adequate smears for each PCT and is shown in Table 4. The model uses mean age and screening interval as well as the percentage Indian subcontinent population in each PCT and seven variables from the

Table 3. Grouped logistic regression model of odds of smear having moderate or worse dyskaryosis for 300 PCTs against 16 most important explanatory variables using summed data from 2002–2003 and 2003–2004

Explanatory variable (Unit)	Odds ratio, less than 1 risk decreased, more than 1 risk increased	Comment
Mean age (years)	0.971*	Range 35.9–43.7 years
% Indian subcontinent (%)	0.994	
Measured screening interval (years)	1.211*	Range 3.5–4.8 years
% pop limiting long term illness (%)	0.984	
% single person households (%)	1.040*	
% household 2 adults no children (%)	0.983	
% working in Hotel & Catering (%)	1.054*	
% households no central heating (%)	0.996	
People per room (%)	3.554	Ranges from 0.39 to 0.63, hence large coefficient
% HE qualifications (%)	0.974*	
% proff or managerial (%)	1.046*	
% routine occupation (%)	1.029*	
% provided unpaid care (%)	1.088*	
% men working part time (%)	0.925*	
% pop working in health & social work (%)	1.044*	
% % working in finance (%)	0.977*	

*$P < 0.05$. Odds below 1 indicates explanatory variable associated with lower risk, odds above 1 indicated higher risk after adjustment for all other variables in model. $R^2 = 42.7\%$, Adj-$R^2 = 39.4\%$.

Table 4. Simplified regression model of the moderate + rate of 300 PCTs against 10 explanatory variables (with weighting by total number of adequate smears) using summed data from 2002–2003 and 2003–2004

Explanatory variable	Coefficient (−ve risk decreased, +ve risk increased)	Comment
Mean age (years)	−0.0546	Range 35.9–43.7 years
% Indian subcontinent (%)	−0.0044	Range 0.1–51.7
Measured screening interval (years)	+0.2351	Range 3.5–4.8 years
% Students (%)	−0.0250	Range 3.8–26.9, risk in pop of women in PCT – mostly not of course students themselves
% Working in Hotel & Catering (%)	+0.0555	Range 2.9–12.9
% Working in finance (%)	−0.02647	Range 1.4–17.2
% Men working part time (%)	−0.1481	Range 2.4–6.3
% Pop working in health and social work (%)	+0.0433	Range 6.6–16.3, risk in pop where high numbers of people employed in health & social work
% Single person households (%)	+0.0510	Range 9.1–35.3
% Pop renting privately (%)	−0.02360	Range 5.3–36.2
Constant = 2.283		

Example estimate for PCT with values as shown Explanatory variable	Coefficient	PCT value	Coeff × value
Mean age (years)	−0.0546	42.31	−2.310
% Indian subcontinent pop (%)	−0.0044	2.23	−0.01
Measured screening interval (years)	+0.2351	3.66	+0.8605
% students (%)	−0.0250	5.73	−0.143
% working in Hotel & Catering (%)	+0.0555	3.35	+0.1859
% working in finance (%)	−0.02647	8.01	−0.2120
% men working part time (%)	−0.1481	3.21	−0.4754
% pop working in health and social work (%)	+0.0433	9.75	+0.4222
% single person households (%)	+0.0510	12.21	+0.6227
% renting privately (%)	−0.02360	9.3	−0.2195
Constant			+2.283
Total			*1.004

Estimated % mod or worse = (−0.0546 × mean age (years)) + (−0.0044 × % Indian ethnic minority) + (0.2351 × actual screening interval) + (−0.0250 × % pop students) + (0.0555 × % in Hotel & Catering) + (−0.02647 × % working in finance) + (−0.1481 × men working part time) + (0.0433 × % working in health & social work) + (0.0510 × % single person households) + (−0.02360 × % renting privately) + 2.283. [Adj-R^2 of model = 37%].
*Estimated moderate + rate for women aged 20–64 in table KC53 part D.

2001 census. The calculated expected percentage of moderate + smears is given using this model as:

Estimated % mod or worse = (−0.0546 × mean age (years)) + (−0.0044 × % Indian ethnic minority) + (0.2351 × actual screening interval) + (−0.0250 × % pop students) + (0.0555 × % in Hotel & Catering) + (−0.02647 × % working in finance) + (−0.1481 × men working part time) + (0.0433 × % working in health & social work) + (0.0510 × % single person households) + (−0.02360 × % renting privately) + 2.283.

The model, which explains 37% of the variation can be used to demonstrate the effects of factors such as mean age (range 35.9–43.7 years) and screening interval (range 3.5–4.8 years). The average moderate + rate is around 1.4%. If we compare a population of women screened on average every 4.8 years and with a mean age of 35.9 (higher risk) with a population of women screened on average every 3.5 years with a mean age of 43.7 (lower risk) then the additional percentage increase in the moderate + rate if all other variables were the same can

easily be calculated. The contribution from the age is $(43.7 - 35.9) \times (-0.05462) = -0.426$ and the contribution from the shorter interval is $(3.5 - 4.8) \times (0.2351) = -0.306$. The two together would produce an expected rate that is 0.73% less, which is a substantial reduction in the moderate + rate and clearly shows the importance of making allowances for such factors.

Whether a logistic regression model or weighted multiple regression model is used the amount of variation in the observed moderate + rates explained by the model is not particularly high but is likely to be sufficiently adequate to be useful provided users are aware of the limitations of the model. The Adj-R^2 for the full 16 variable model is almost 40% and therefore 60% of the variation in mod+ rates is not explained by the explanatory variables in the model. Of that 60% some will be because of relative levels of under- or over-calling by the associated laboratories, which we are interested in, and some will be from other factors associated with an increased risk but which we either do not know about or know about but do not have data for at the PCT level (e.g. smoking). Further development of the model is anticipated.

The relative risk can also be calculated. One method is to divide the modelled moderate + rate for all PCTs by the mean modelled rate to obtain a relative risk for each PCT. The modelled moderate + rate and the relative risk for all the PCTs included in the final 16 variable model is shown in Appendix B. The relative risk ranges from 0.64 to 1.58 amounting to nearly a threefold variation in risk. The low-risk PCTs tend to be those with populations that are on average, affluent, marginally older and screened with a 3-yearly policy, or those with high Indian subcontinent ethnic minority populations. The high-risk PCTs tend to be on average those with younger populations, less affluent populations and populations screened at longer intervals. Whilst many PCT populations could easily be predicted to have a high risk, such as some of the inner city areas in London, Manchester and Liverpool, some of the high-risk PCTs predicted by the model appear to be from traditional seaside resorts such as Blackpool and Great Yarmouth. Further examination of these PCTs shows that the risk derives principally from some of the census variables and in particular census variables such as the percentage of the population working in Hotel and Catering. For every 1% increase in the percentage of the population working in the Hotel and Catering industry the modelled moderate + rate is increased by 0.08%. With a mean modelled rate of 1.44% and with some PCTs having as many as 10% or 12% of the population working in Hotel and Catering this can be seen to be an important explanatory variable.

The model can also be used to estimate a theoretical relative risk if all PCTs had a uniform screening interval. If, for example, we assume that uniform interval to be 4 years the estimated percentage of moderate or worse smears becomes:

Estimated % mod or worse = (−0.0546 × mean age (years)) + (−0.0044 × % Indian ethnic minority) + (−0.0250 × % pop students) + (0.0555 × % in Hotel & Catering) + (−0.02647 × % working in finance) + (−0.1481 × men working part time) + (0.0433 × % working in health & social work) + (0.0510 × % single person households) + (−0.02360 × % renting privately) + 3.224, where the constant is now $2.283 + (0.2351 \times 4) = 3.224$.

To use the relative risk estimates we need to relate laboratories to their underlying PCT populations. The relative risk can then be used to adjust the observed moderate + rate from each laboratory providing the information shown in Appendix C is known. For example if a fictional laboratory took 40% of its smears from women resident in PCT A (RR = 0.80) and 60% from PCT B (RR = 0.92) then the overall relative risk is given by the weighted average: $[(40 \times 0.80) + (60 \times 0.92)]/100 = 0.87$.

The adjusted moderate + rate (ARI-adjusted moderate + rate) would then be given by the observed rate divided by 0.87. If the fictional laboratory had an observed rate of say 0.98% (relatively low) then the adjusted rate would be 1.13%. This is the rate the laboratory would have observed if the smears were from women with an English average age, risk and screening interval. We can further multiply this percentage by the laboratories PPV to obtain an estimate of the CIN 2+ rate that the laboratory would have detected as a result of direct referral to colposcopy from a smear with moderate dyskaryosis or worse. We can term this measure the 'ARI CIN 2+ | mod+ rate' and laboratories' with the very lowest values may be candidate laboratories for investigation of potential low sensitivity. However, there are a number of other explanations for this including poor fit of the model, statistical instability, i.e. wide confidence limits, and under-calling histology amongst others.

The direct practical application of this methodology to the South West Region of the NHSCSP is shown in Appendix A. The methodology is able to show that the particularly low moderate + rates detected by one or two laboratories in the region are most likely due to a local screened population with a particularly low risk and not likely to be the result of under-calling.

Discussion

The above methodology should have the potential to improve the current performance indicators by allowing some adjustment to be made for underlying risk and screening interval. The methodology, whilst likely to be practically useful, is far from perfect and the measurement of for example screening interval is limited. The model uses data from the PCT returns (KC53), which is then used to adjust data from the laboratory return (KC61). These returns have not designed to be used together and a number of inconsistencies arise because of this. In particular, the moderate + rate used in the model is from KC53 part D which refers to all women, but the final application is to the KC61 return information relating the moderate + rate of women from GP and NHS community clinics only. Whilst the vast majority of women are from these two sources there is still the potential for some error if some PCTs have smears from women from GUM clinics and NHS hospitals which have unusually high or low risk for moderate or worse smears relative to other PCT populations. It should however be possible to produce correction factors to allow for this. Inevitably some of the laboratories outside the adjusted moderate + rate 10th–90th percentiles will not be under- or over-calling but the result of the model not adequately describing the local population risk. Another minor problem is that the age adjusted for is the average age of the PCT population screened and not the age of the women whose smears are actually examined at the laboratory. It would be useful in practice to compare the age used in the model to the weighted mean age that can be obtained from the laboratory data (from KC61 part B). However, in most cases these are likely to be similar, if not an adjustment could be made.

The predicted moderate + rates for the 300 PCTs from the model will be influenced by any potential over- or under-calling from the approximately 150 or so laboratories that examine smears. In theory the estimation of a laboratories expected percentage of moderate or worse smears would be optimally conducted by excluding the PCTs that send women to that laboratory and then by estimating those PCT moderate + rates based on all other PCTs not influenced by the specific laboratory. This will be of most importance for very large laboratories that cover a number of PCTs. However, at present the geographical relationship between laboratories and PCTs is not generally available and such an approach would require 150 different models to be produced. However, when the relationship between the laboratories and PCT populations has been estimated for all laboratories such an approach could be undertaken.

To use this methodology it is necessary to relate laboratories with underlying PCT populations and this information could usefully be included on the KC61 return itself. This information could, for example, be amended to the front page of the KC61 return form as shown in Appendix C. Other useful information would relate to the use of liquid-based cytology and the management of a woman following borderline or mild dyskaryotic results. This information would then link laboratory information to the underlying population of women.

In this paper we focus on the moderate + rate rather than the percentage of borderline or mild dyskaryotic smears. The evaluation of the latter is likely to be further complicated by different underlying management where some women may be referred to colposcopy following different numbers of consecutive smear results. The completion of the information suggested in Appendix C will be useful in determining if this is happening.

Further work needs to be undertaken to improve the model and some feedback in determining its practical value would be useful. The model itself will need to be updated on a regular basis as the age distribution and screening interval for individual PCTs will change over time. The same arguments apply to using an equivalent model to examine the borderline/mild rate. Finally any application of the model would need to be conducted with all available supporting evidence. For example a particularly high ARI mod+ rate could be suggestive of over-calling. If this high rate were also in conjunction with, for example, a low PPV then this would add further to the potential conclusion of relative over-calling. It is intended to explore such relationships further when all the appropriate data are available.

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Appendix A: Application of methodology to the NHSCSP South West Region

The South West Region uses both 3 yearly screening and 5 yearly screening and has some laboratories with very low observed percentages of moderate or worse smears. The percentages of moderate or worse smears from each laboratory using published data for 2002–2003 and 2003–2004 is shown below in Table A1.

Table A1. Percentage of adequate smears that are moderate or worse for 2002–2003 and 2003–2004 and for both years combined

Laboratory	Lab Iden	Mod+ rate (%) 2003–2004	Moderate + rate (%) 2002–2003	Mean for both years*
Royal United Hospital	A	1.2	1.5	1.35
Derriford Hospital	B	1.1	1.2	1.15
Royal Devon & Exeter	C	1.2	1.4	1.30
Royal Bournemouth	D	0.9	1.0	0.95
Southmead Hospital	E	1.3	1.3	1.30
Grt Western Hosp (Swindon)	F	1.5	1.5	1.50
Torbay	G	1.6	1.3	1.45
Royal Cornwall	H	1.4	1.4	1.40
Gloucestershire Royal	I	1.2	1.6	1.40
Salisbury District	J	0.9	1.0	0.95
Musgrove Park	K	1.1	1.2	1.15

*The number of adequate smears reported by each laboratory is very similar for each year.

It is useful to add together two years data because some of the laboratories are relatively small and the data therefore not very statistically stable. For example in 2003–2004 Salisbury (Lab J) had 10 836 adequate smears with 1.0% (108) with moderate or worse dyskaryosis. The 95% confidence limits are 0.82–1.20% which illustrates a considerable level of uncertainty as to the true underlying population proportion. With 2 year data there were 22 340 adequate smears and an estimated proportion of 0.95% (212) the 95% confidence limits for the 2 year data being 0.83–1.08%. Thus with 2 year data we are considerably more certain that the percentage of moderate or worse smears from this laboratory is really lower than average.

The South West region has PCTs where women between 20 and 64 have significantly different mean ages. Table A2 shows details of two PCTs at the extremes of the age distribution range. SE Dorset has an older population of screened women with a mean age of 43.7 and Bristol S & W has a mean age of only 37.4.

Table A2. Variation in age distribution of screened women from two PCTs

Ageband	Midpoint	Total women screened; SE Dorset PCT (%)	Total women screened; Bristol S &W (%)
20–24	22.5	654 (6.3)	1436 (13.5)
25–29	27.5	919 (8.8)	1975 (18.6)
30–34	32.5	1173 (11.2)	1833 (17.2)
35–39	37.5	1488 (14.2)	1539 (14.5)
40–44	42.5	1422 (13.6)	1148 (10.8)
45–49	47.5	1253 (12.0)	907 (8.5)
50–54	52.5	1234 (11.8)	708 (6.7)
55–59	57.5	1324 (12.7)	666 (6.3)
60–64	62.5	979 (9.4)	419 (3.9)
Total		10446	10631

SE Dorset weighted mean age = 43.65, Bristol S &W = 37.38.

There is also a substantial difference in screening interval between the two PCTs. SE Dorset has a policy of 3 yearly screening and the measured screening interval is 3.56 years whereas Bristol S &W has a local policy of 5 yearly screening with a measured mean age of 4.63 years.

Table A3 shows the estimated percentage of moderate or worse smears from each PCT within the South West region. The majority of PCTs have a risk slightly above 1 rather than below and this is likely to the result of the longer screening interval used in many parts of the region rather than the result of factors such as deprivation.

Table A3. Estimated percentage of adequate smears that are moderate or worse smears from model using 2-year data (2002–2004) for each PCT

PCT		Estimated % mod+*	Relative risk†
1	Bath & NE Somerset	1.52	1.05
2	Bournemouth	1.30	0.90
3	Bristol North	1.68	1.17
4	Bristol S & W	1.71	1.19
5	Central Cornwall	1.60	1.11
6	Cheltenham & Tewkesbury	1.61	1.12
7	Cotswold & Vale	1.43	1.00
8	East Devon	1.26	0.88
9	Exeter	1.51	1.05
10	Kennet & North Wiltshire	1.26	0.87
11	Mendip	1.48	1.03
12	Mid Devon	1.14	0.80
13	N & E Cornwall	1.32	0.92
14	North Devon	1.44	1.00
15	North Dorset	0.82	0.57
16	North Somerset	1.51	1.05
17	Plymouth	1.56	1.09
18	Poole	1.34	0.93
19	Somerset Coast	1.58	1.10
20	S & E Dorset	0.96	0.66
21	South Gloucestershire	1.60	1.11
22	South Hams & West Devon	1.22	0.85
23	South Somerset	1.49	1.04
24	South West Dorset	1.31	0.91
25	South Wiltshire	1.39	0.97
26	Swindon	1.51	1.05
27	Taunton Deane	1.63	1.13
28	Teignbridge	1.29	0.89
29	Torbay	1.75	1.10
30	West Gloucestershire	1.59	1.10
31	West of Cornwall	1.47	1.02
32	West Wiltshire	1.56	1.09

*Estimated % mod+ for KC53 part D age 20–64.
†Risk relative to theoretical 'average' PCT for England. Note that relative risks are calculated from an earlier model than the final model shown in the main text, but the results are very similar to that produced by the final model.

The most striking results from the model are the particularly low relative risks seen in the Dorset PCTs. This occurs because this area of the South West uses 3 yearly screening and has a population that is affluent but crucially also one of the populations with the oldest mean age. South and East Dorset, for example, has close to the highest mean age in England for screened women aged 20–64 for 2002–2004 of 43.7 years, one of the shortest screening intervals and other socio-economic factors that are associated with a reduced risk.

The highest risks in the South West are from Bristol North, Bristol S & W and from Torbay. The two Bristol PCTs both have a younger mean age (39.1 and 37.5 years respectively) and use closer to a 5-year screening interval, which explains the higher risk of a moderate or worse smear. Torbay is more complicated. The mean age is not low and the screening interval is short, so why does the model suggest a higher risk? Closer inspection of the model shows that at least part of the explanation is that in common with other major seaside resorts such as Blackpool and Great Yarmouth there is a high percentage of the population working in the Hotel and Catering industry which the model suggests is a socio-economic population characteristic strongly associated with a higher risk of moderate or worse dyskaryosis after allowance for all other factors in the model.

The laboratories have to be linked to the population base PCTs by estimating what percentage of smears are derived from a particular PCT population. This can be illustrated by Royal Cornwall (Table A4), which has been estimated to cover 100% of the Central Cornwall PCT population, 100% of the West of Cornwall population and 30% of the North & East Cornwall population.

Table A4. Example of linkage between laboratory and catchment PCTs to calculate the weighted relative risk

PCT	% pop covered	Pop screened* multiplied by percentage covered (approx % of smears from each PCT)	RR of PCT	RR × % pop
Central Cornwall	100	11 400 (50.4)	1.11	55.94
North & East Cornwall	30	2640 (11.6)	0.92	10.67
West of Cornwall	100	8600 (38.0)	1.02	38.76
Total		22 640 (100.0)		105.37

*Taken from Table 12 of Statistical bulletin 2003–2004.

The weighted relative risk for Royal Cornwall Hospital is 105.37/100 = 1.05. Note that in a fuller analysis the relative risk for the Royal Cornwall could be calculated for the three PCTs after removing them

Table A5. Calculation of the age-risk-interval (ARI) adjusted mod+ rate for all laboratories from the South West Region

Laboratory	Lab Iden	Adequate smears 2002–2004*	Mean mod+ rate (%) 2002–2004*	Catchment population relative risk	ARI-adjusted mod+ rate (%) (95% CI)
Royal United Hospital	A	49444	1.35	0.99	1.39 (1.26–1.47)
Derriford Hospital	B	52971	1.15	1.02	1.13 (1.04–1.22)
Royal Devon & Exeter	C	50125	1.30	0.94	1.38 (1.28–1.49)
Royal Bournemouth	D	70840	0.95	0.84	1.13 (1.05–1.21)
Southmead Hospital	E	86392	1.30	1.12	1.16 (1.09–1.23)
Grt Western Hosp (Swindon)	F	29483	1.50	1.01	1.49 (1.35–1.63)
Torbay	G	35852	1.45	1.02	1.42 (1.30–1.55)
Royal Cornwall	H	50896	1.40	1.05	1.33 (1.23–1.43)
Gloucestershire Royal	I	72349	1.40	1.07	1.31 (1.23–1.40)
Salisbury District	J	22340	0.95	0.88	1.08 (0.95–1.22)
Musgrove Park	K	49184	1.15	0.98	1.17 (1.08–1.27)

A 95% confidence interval can be simply calculated as $p \pm 1.96\sqrt{[p(1-p)/n]}$, where p is proportion and n the number of observations. In the case of Lab A this is 0.0139 and 49444 respectively.
*From KC61 part B women aged 20–64.

from the model. This would reduce the number of PCTs in the model from 300 to 297. The explanatory variables from the three PCTs would be used to estimate the moderate + rate and then the new relative risk. This is to ensure that the relative risk estimates are not inflated or deflated from any potential under-calling by the laboratory itself. In practice, for most PCTs, any difference is likely to be very small as there about 300 PCTs and 150 laboratories.

All laboratories are linked to the catchment population PCTs in the same manner as Royal Cornwall example shown above. The range of catchment population relative risks varies from the lowest risk of 0.84 for the Royal Bournemouth to the highest risk of 1.12 for Southmead Hospital Laboratory. The ARI-adjusted mod+ rate is obtained by dividing the observed moderate + rate by the catchment population relative risk. The ARI-adjusted mod+ rate is then the rate the model calculates the laboratory would have obtained had it been screening a population of women with the English 'average risk'. This rate is therefore more appropriate to use to compare laboratories. Table A5 shows that after the calculation of the ARI rate there is much less suggestion that laboratories such as the Royal Bournemouth have a particularly low moderate + rate, merely that they have a very low-risk population.

The methodology is therefore able to provide reassurance that the low percentages of adequate smears that are moderate or worse from the laboratories with the Dorset population in their catchment area are in keeping with the very low risk associated with that area. Whether the South West Region has any laboratories with ARI-adjusted moderate + rates outside the 10th–90th percentile is not known. However, as can be seen from the data, the ARI-adjusted mod+ rate does not suggest any laboratories in the South West are likely to be major outliers as the values are clustered around the mean of 1.27 with no obvious outliers. As the ARI moderate + rate is a more sophisticated measure than the crude moderate + rate there could be some advantage in targeting those laboratories in England outside the 5th–95th percentile rather than the 10th–90th percentile to reduce the number of laboratories being investigated and potentially intensify any investigations. Finally the ARI moderate + rate can be combined with the PPV to calculate an ARI CIN 2+ rate derived from moderate or worse smears (ARI CIN 2+ | mod+) which is shown in Table A6.

Table A6. Calculation of the age-risk-interval (ARI) CIN 2 + rate for all laboratories from the South West Region

Laboratory	Lab Iden	Adequate smears 2002–2004	ARI-adjusted mod+ rate (%) (95% CI)	PPV 02/03	ARI CIN 2+ | mod+(95% CI)†
Royal United Hospital	A	49444	1.39 (1.26–1.47)	0.795	1.11 (1.02–1.20)*
Derriford Hospital	B	52971	1.13 (1.04–1.22)	0.734	0.83 (0.76–0.91)
Royal Devon & Exeter	C	50125	1.38 (1.28–1.49)	0.771	1.06 (0.97–1.15)
Royal Bournemouth	D	70840	1.13 (1.05–1.21)	0.773	0.87 (0.80–0.94)
Southmead Hospital	E	86392	1.16 (1.09–1.23)	0.796	0.92 (0.86–0.99)
Grt Western Hosp (Swindon)	F	29483	1.49 (1.35–1.63)	0.743	1.11 (0.99–1.24)
Torbay	G	35852	1.42 (1.30–1.55)	0.842	1.20 (1.09–1.32)
Royal Cornwall	H	50896	1.33 (1.23–1.43)	0.729	0.97 (0.89–1.06)
Gloucestershire Royal	I	72349	1.31 (1.23–1.40)	0.837	1.10 (1.03–1.18)
Salisbury District	J	22340	1.08 (0.95–1.22)	0.714	0.77 (0.66–0.89)
Musgrove Park	K	49184	1.17 (1.08–1.27)	0.818	0.96 (0.88–1.05)

*A 95% confidence interval can be simply calculated as $p \pm 1.96\sqrt{[p(1-p)/n]}$, where p is proportion and n the number of observations. In the case of Lab A this is 0.011 and 49444 respectively.
†Approximate confidence interval because assumes PPV known with no error.

This is the percentage of smears showing moderate dyskaryosis or worse which are subsequently confirmed by a biopsy showing CIN 2 or worse corrected for an average population age/risk/interval. If a laboratory were over-calling i.e. over-grading cytology and the model fitted the local population well, then we would expect to see a combination of a high ARI mod+ rate and a low PPV which reduces the ARI CIN 2+ | mod+ rate. A very good laboratory where the model estimates the local population risk well would be expected to have a higher than average PPV leading to ARI CIN 2+ | mod+ rate. For the methodology to be properly used all laboratories in England should be examined together and the ARI CIN 2+ | mod+ outliers identified for further investigation. The method is less useful for regional data as shown here but can still be useful. As shown in Table A7 there are a number of possible explanations that require to be considered and interpretation will require information from all sources to be considered.

Table A7. Possible explanations for low and high ARI CIN 2+ | mod+

	Low ARI CIN 2+ | mod+	High ARI CIN 2+ | mod+
Model does not describe population well	Model overestimates risk in population	Model underestimates risk in population
Real effect	Laboratory has a relatively low sensitivity compared with other laboratories or other explanation	Laboratory has a relatively high sensitivity compared with other laboratories or other explanation

Appendix B: Estimated relative risk of smear having moderate dyskaryosis or worse by PCT, arranged in alphabetical order (based on data from 2002–2004)

Table B1.

pct_title	pct_code	RR
Adur, Arun and Worthing PCT	5L8	1.03
Airedale PCT	5AW	0.90
Amber Valley PCT	5ED	1.03
Ashfield PCT	5FA	0.98
Ashford PCT	5LL	0.86
Ashton, Leigh and Wigan PCT	5HG	1.06
Barking and Dagenham PCT	5C2	1.10
Barnet PCT	5A9	0.85
Barnsley PCT	5JE	1.24
Basildon PCT	5GR	1.20
Bassetlaw PCT	5ET	0.93
Bath and North East Somerset PCT	5FL	1.07
Bebington and West Wirral PCT	5F8	0.92
Bedford PCT	5GD	1.09
Bedfordshire Heartlands PCT	5GE	1.13
Bexhill and Rother PCT	5FH	0.76
Billericay, Brentwood and Wickford PCT	5GP	0.81
Birkenhead and Wallasey PCT	5H2	1.18
Blackburn With Darwen PCT	5CC	0.79
Blackpool PCT	5HP	1.60
Blackwater Valley and Hart PCT	5G6	0.92
Bolton PCT	5HQ	0.94
Bournemouth PCT	5CE	0.93
Bracknell Forest PCT	5G2	1.32
Bradford City PCT	5CF	0.72
Bradford South and West PCT	5CG	1.04
Brent PCT	5K5	0.83
Brighton and Hove City PCT	5LQ	1.01
Bristol North PCT	5JF	1.16
Bristol South and West PCT	5JG	1.17
Broadland PCT	5JL	0.95
Bromley PCT	5A7	0.80
Broxtowe and Hucknall PCT	5EV	0.90
Burnley, Pendle and Rossendale PCT	5G8	0.96
Burntwood, Lichfield and Tamworth PCT	5DQ	0.95
Bury PCT	5JX	1.10
Calderdale PCT	5J6	0.96
Cambridge City PCT	5JH	0.89
Camden PCT	5K7	1.29
Cannock Chase PCT	5MM	1.03
Canterbury and Coastal PCT	5LM	0.83
Carlisle and District PCT	5D4	0.98
Castle Point and Rochford PCT	5JP	0.77
Central Cheshire PCT	5H4	0.90
Central Cornwall PCT	5KT	1.13
Central Derby PCT	5AL	1.02
Central Liverpool PCT	5HA	1.37
Central Manchester PCT	5CL	1.09
Central Suffolk PCT	5JT	0.74
Charnwood and North West Leicestershire PCT	5JC	0.95
Chelmsford PCT	5JN	0.97
Cheltenham and Tewkesbury PCT	5KW	1.04
Cherwell Vale PCT	5DV	0.86
Cheshire West PCT	5H3	0.83
Chesterfield PCT	5EA	1.27
Chiltern and South Bucks PCT	5G4	0.69
Chorley and South Ribble PCT	5F2	0.99
City and Hackney PCT	5C3	1.12
Colchester PCT	5GM	1.09
Cotswold and Vale PCT	5KY	0.95
Coventry PCT	5MD	1.09
Craven, Harrogate and Rural District PCT	5KJ	0.82
Crawley PCT	5MA	1.18
Croydon PCT	5K9	1.14
Dacorum PCT	5GW	1.02
Darlington PCT	5J9	1.06
Dartford, Gravesham and Swanley PCT	5CM	0.91
Daventry and South Northamptonshire PCT	5AC	0.82
Derbyshire Dales and South Derbyshire PCT	5H7	0.91
Derwentside PCT	5KA	1.11
Doncaster Central PCT	5CK	0.96
Doncaster East PCT	5EK	0.78
Doncaster West PCT	5EL	0.95
Dudley Beacon and Castle PCT	5HV	0.98
Dudley South PCT	5HT	0.99
Durham and Chester-LE-Street PCT	5KC	0.86
Durham Dales PCT	5J8	0.94
Ealing PCT	5HX	0.83
Easington PCT	5KD	0.96
East Cambridgeshire and Fenland PCT	5JK	0.88
East Devon PCT	5FT	0.84
East Elmbridge and Mid Surrey PCT	5KP	0.69
East Hampshire PCT	5FD	0.94
East Kent Coastal PCT	5LN	1.02
East Leeds PCT	5HK	1.08
East Lincolnshire PCT	5H9	0.88
East Staffordshire PCT	5ML	0.89
East Surrey PCT	5KQ	0.85
East Yorkshire PCT	5E3	0.85
Eastbourne Downs PCT	5LR	1.04
Eastern Birmingham PCT	5MY	1.05
Eastern Cheshire PCT	5H5	0.88
Eastern Hull PCT	5E5	1.15
Eastern Leicester PCT	5EY	0.80
Eastern Wakefield PCT	5E7	0.96
Eastleigh and Test Valley South PCT	5LY	0.98
Eden Valley PCT	5D5	0.85
Ellesmere Port and Neston PCT	5H6	1.03
Enfield PCT	5C1	1.00

Epping Forest PCT	5AJ	1.02
Erewash PCT	5ER	1.01
Exeter PCT	5FR	1.05
Fareham and Gosport PCT	5LX	1.02
Fylde PCT	5HE	1.03
Gateshead PCT	5KF	1.11
Gedling PCT	5EC	0.98
Great Yarmouth PCT	5GT	1.44
Greater Derby PCT	5EX	1.06
Greenwich PCT	5A8	1.09
Guildford and Waverley PCT	5L5	0.73
Halton PCT	5J1	1.09
Hambleton and Richmondshire PCT	5KH	0.74
Hammersmith and Fulham PCT	5H1	1.11
Haringey PCT	5C9	1.09
Harlow PCT	5DC	1.55
Harrow PCT	5K6	0.65
Hartlepool PCT	5D9	1.08
Hastings and St Leonards PCT	5FJ	1.35
Havering PCT	5A4	0.91
Heart of Birmingham Teaching PCT	5MX	0.85
Herefordshire PCT	5CN	0.80
Hertsmere PCT	5CP	0.88
Heywood and Middleton PCT	5F4	1.19
High Peak and Dales PCT	5HN	0.92
Hillingdon PCT	5AT	1.01
Hinckley and Bosworth PCT	5JA	1.09
Horsham and Chanctonbury PCT	5MC	0.89
Hounslow PCT	5HY	0.95
Huddersfield Central PCT	5LJ	1.08
Huntingdonshire PCT	5GF	1.09
Hyndburn and Ribble Valley PCT	5G7	0.92
Ipswich PCT	5JQ	1.02
Isle of Wight PCT	5DG	0.95
Islington PCT	5K8	1.28
Kennet and North Wiltshire PCT	5K4	0.92
Kensington and Chelsea PCT	5LA	0.92
Kingston PCT	5A5	0.91
Knowsley PCT	5J4	1.12
Lambeth PCT	5LD	1.28
Langbaurgh PCT	5KN	0.91
Leeds North East PCT	5HJ	0.99
Leeds North West PCT	5HM	1.15
Leeds West PCT	5HH	1.05
Leicester City West PCT	5EJ	1.35
Lewisham PCT	5LF	1.17
Lincolnshire South West Teaching PCT	5D3	0.95
Luton PCT	5GC	1.15
Maidstone Weald PCT	5L2	0.81
Maldon and South Chelmsford PCT	5GL	0.84
Mansfield District PCT	5AM	1.10
Medway PCT	5L3	0.97
Melton, Rutland and Harborough PCT	5EH	0.84
Mendip PCT	5FX	1.00
Mid Devon PCT	5FV	0.80
Mid-Hampshire PCT	5E9	0.88
Mid-Sussex PCT	5FK	0.96
Middlesbrough PCT	5KM	1.13
Milton Keynes PCT	5CQ	1.05
Morecambe Bay PCT	5DD	1.13
New Forest PCT	5A1	0.84
Newark and Sherwood PCT	5AP	0.86
Newbury and Community PCT	5DK	0.93
Newcastle PCT	5D7	1.18
Newcastle-Under-Lyme PCT	5HW	1.02
Newham PCT	5C5	0.91
North and East Cornwall PCT	5KR	0.91
North Birmingham PCT	5MW	0.92
North Bradford PCT	5CH	0.96
North Devon PCT	5FQ	1.02
North Dorset PCT	5CD	0.61
North East Lincolnshire PCT	5AN	1.07
North East Oxfordshire PCT	5DT	1.03
North Eastern Derbyshire PCT	5EG	1.00
North Hampshire PCT	5DF	1.00
North Hertfordshire and Stevenage PCT	5GH	1.25
North Kirklees PCT	5J7	0.88
North Lincolnshire PCT	5EF	1.05
North Liverpool PCT	5G9	1.12
North Manchester PCT	5CR	1.32
North Norfolk PCT	5JM	0.90
North Peterborough PCT	5AF	1.22
North Sheffield PCT	5EE	1.16
North Somerset PCT	5M8	1.07
North Stoke PCT	5ME	1.04
North Surrey PCT	5L6	0.94
North Tees PCT	5E1	1.00
North Tyneside PCT	5D8	1.18
North Warwickshire PCT	5MP	1.04
Northampton PCT	5LW	1.06
Northamptonshire Heartlands PCT	5LV	1.04
Northumberland Care Trust	TAC	0.96
Norwich PCT	5A2	1.20
Nottingham City PCT	5EM	1.23
Oldbury and Smethwick PCT	5MG	1.02
Oldham PCT	5J5	0.96
Oxford City PCT	5DW	0.89
Plymouth PCT	5F1	1.14
Poole PCT	5KV	0.91
Portsmouth City PCT	5FE	1.21
Preston PCT	5HD	1.00
Reading PCT	5DL	0.96
Redditch and Bromsgrove PCT	5MR	1.09
Richmond and Twickenham PCT	5M6	0.92
Rochdale PCT	5JY	1.01
Rotherham PCT	5H8	1.24
Rowley Regis and Tipton PCT	5MH	1.15
Royston, Buntingford and Bishop'S Stortford PCT	5GK	1.01

Rugby PCT	5M9	1.08
Rushcliffe PCT	5FC	0.81
Salford PCT	5F5	1.36
Scarborough, Whitby and Ryedale PCT	5KK	0.88
Sedgefield PCT	5KE	1.06
Selby and York PCT	5E2	0.84
Sheffield South West PCT	5EP	0.87
Sheffield West PCT	5EN	1.12
Shepway PCT	5LP	0.92
Shropshire County PCT	5M2	0.87
Slough PCT	5DM	1.10
Solihull PCT	5D1	0.88
Somerset Coast PCT	5FW	1.05
South and East Dorset PCT	5FN	0.69
South Birmingham PCT	5M1	1.15
South Cambridgeshire PCT	5JJ	0.94
South East Hertfordshire PCT	5GJ	0.97
South East Oxfordshire PCT	5DX	0.78
South East Sheffield PCT	5EQ	1.07
South Gloucestershire PCT	5A3	1.06
South Hams and West Devon PCT	5CV	0.80
South Huddersfield PCT	5LK	0.98
South Leeds PCT	5HL	1.16
South Leicestershire PCT	5JD	0.95
South Liverpool PCT	5HC	1.14
South Manchester PCT	5AA	1.37
South Peterborough PCT	5AG	1.07
South Sefton PCT	5M5	0.89
South Somerset PCT	5K1	0.96
South Stoke PCT	5MF	1.10
South Tyneside PCT	5KG	1.04
South Warwickshire PCT	5MQ	0.89
South West Dorset PCT	5FP	0.90
South West Kent PCT	5FF	0.74
South West Oxfordshire PCT	5DY	0.83
South Western Staffordshire PCT	5MN	0.94
South Wiltshire PCT	5DJ	1.05
South Worcestershire PCT	5MT	1.06
Southampton City PCT	5L1	1.10
Southend ON Sea PCT	5AK	1.14
Southern Norfolk PCT	5G1	0.93
Southport and Formby PCT	5F9	0.99
Southwark PCT	5LE	1.24
St Albans and Harpenden PCT	5GX	0.84
St Helens PCT	5J3	1.11
Staffordshire Moorlands PCT	5HR	0.86
Stockport PCT	5F7	1.12
Suffolk Coastal PCT	5JR	0.83
Suffolk West PCT	5JW	0.90
Sunderland Teaching PCT	5KL	1.16
Sussex Downs and Weald PCT	5LT	0.75
Sutton and Merton PCT	5M7	0.99
Swale PCT	5L4	0.86
Swindon PCT	5K3	1.04
Tameside and Glossop PCT	5LH	1.04
Taunton Deane PCT	5K2	1.13
Teignbridge PCT	5FY	0.87
Telford and Wrekin PCT	5MK	1.00
Tendring PCT	5AH	1.03
Thurrock PCT	5GQ	1.15
Torbay PCT	5CW	1.27
Tower Hamlets PCT	5C4	0.91
Trafford North PCT	5F6	1.22
Trafford South PCT	5CX	1.05
Uttlesford PCT	5GN	0.85
Vale of Aylesbury PCT	5DP	0.84
Wakefield West PCT	5E8	1.02
Walsall PCT	5M3	0.87
Wandsworth PCT	5LG	1.01
Warrington PCT	5J2	1.05
Watford and Three Rivers PCT	5GV	0.97
Waveney PCT	5JV	0.89
Wednesbury and West Bromwich PCT	5MJ	0.95
Welwyn Hatfield PCT	5GG	1.04
West Cumbria PCT	5D6	0.98
West Gloucestershire PCT	5KX	1.10
West Hull PCT	5E6	1.15
West Lancashire PCT	5F3	0.96
West Lincolnshire PCT	5D2	1.09
West Norfolk PCT	5CY	0.83
West of Cornwall PCT	5FM	1.03
West Wiltshire PCT	5DH	1.09
Western Sussex PCT	5L9	0.97
Westminster PCT	5LC	1.18
Windsor, Ascot and Maidenhead PCT	5G3	0.87
Witham, Braintree and Halstead Care Trust	TAG	1.09
Woking PCT	5L7	0.85
Wokingham PCT	5DN	0.82
Wolverhampton City PCT	5MV	1.04
Wycombe PCT	5G5	0.86
Wyre Forest PCT	5DR	1.19
Wyre PCT	5HF	0.93
Yorkshire Wolds and Coast PCT	5E4	0.78

Appendix C: Suggested additional information to include on front page of KC61 return

C1. Use of liquid-based cytology (LBC)

Yes/no	LBC LBC type

C2. Estimated most common management

Management	Tick
Referral to colposcopy after three borderline smears	☐
Referral to colposcopy after two borderline smears	☐
Referral to colposcopy after one borderline smear	☐
Not possible to estimate	☐
Referral to colposcopy after two mild smears	☐
Referral to colposcopy after one mild smear	☐
Not possible to estimate	☐

C3. Estimate of the most common PCTs of residence of women whose smears are analysed at laboratory

PCT name	Code	*Approx % of all smears analysed by lab

*If possible to make estimate otherwise leave blank.

