

## ECONOMIC ANALYSIS OF OUTREACH ASSESSMENT CLINICS IN BREAST SCREENING PROGRAMMES

M. M. VAN DER POL<sup>1\*</sup>, J. A. CAIRNS<sup>1</sup>, F. J. GILBERT<sup>2</sup> AND P. J. HENDRY<sup>3</sup>

<sup>1</sup>*Health Economics Research Unit, University of Aberdeen, Scotland*

<sup>2</sup>*North East Scotland Breast Screening Centre, Aberdeen, Scotland*

<sup>3</sup>*North of Scotland Breast Screening Centre, Inverness, Scotland*

### SUMMARY

A model is developed for the economic evaluation of outreach assessment clinics following screening and used to identify the cost-minimizing strategy for assessing women from three island communities in the Scottish Breast Screening Programme (SBSP). There are four options of interest depending on: whether the women are assessed on the mainland or at outreach assessment clinics; and whether all women have two view screening rather than only those being screened for the first time. The benefits of outreach assessment are assumed to be solely in terms of convenience to women and reductions in the time and travel costs of women recalled for assessment. The costs are modelled in order to compare outreach and no outreach options. The results show that for the numbers of women currently screened outreach assessment is the cost-minimizing strategy. The model provides useful guidance with respect to screening policy and is readily applied to the case of outreach assessment in mainland communities outwith major population centres and to breast and other screening programmes in other countries. Copyright © 1999 John Wiley & Sons, Ltd.

KEY WORDS: breast screening; outreach assessment; economic analysis

### INTRODUCTION

One way of making health care more accessible to patients is through the introduction of outreach clinics. There has, for instance, been a growth in the number of outreach clinics in the UK where hospital consultants hold outpatient clinics in general practices (Gosden *et al.*, 1997). Outreach clinics are also an issue for the delivery of screening services, such as breast screening. Review and assessment of women for whom their mammogram showed an abnormality can either take place at a main breast screening centre or at an outreach clinic closer to the women. The latter option may be especially relevant in sparsely populated areas.

\*Correspondence to: M. M. van der Pol, Health Economics Research Unit, University of Aberdeen, Foresterhill, Aberdeen AB25 2ZD, Scotland. Email: m.m.vanderpol@abdn.ac.uk

Contract grant sponsor: Chief Scientist Office of the Scottish Office Department of Health.

In this paper a model is developed for the economic evaluation of outreach assessment clinics. If it is assumed that health outcomes for women are the same with and without outreach clinics, and that there are no other relevant differences in benefit to the women themselves or to those providing the service, the economic issue is reduced to one of cost minimization. Outreach clinics will incur additional health services cost in terms of travel costs of staff and less efficient use of their time. But it will reduce the cost of travel incurred by the women. Whether and when outreach assessment is cost-minimizing will depend on the relative costs and the relative numbers of staff and women.

The model is then applied to the Scottish Breast Screening Programme (SBSP), in particular to the delivery of breast screening services to island communities. The economic evaluations of outreach clinics in the UK published to date (Gosden *et al.*, 1997; Gillam *et al.*, 1995; Helliwell, 1996) have all examined outreach clinics where hospital consultants hold outpatient clinics in general practices. There have been no economic analyses of outreach clinics with respect to breast screening.

## METHOD

Different options are of interest when developing a model for the economic evaluation of outreach assessment clinics. Examples include the following: whether there is single or double reading of mammograms by radiologists, whether there is single (oblique) or two view (oblique + craniocaudal) screening, the frequency of screening etc. All these options can be included in the model. The number of views appears to be most relevant, at least in the case of Scotland, because the breast screening programme has a two view screening policy for prevalent rounds only. Two view screening of all women (both prevalent and subsequent rounds) in sparsely populated areas might be appropriate since this reduces the rate of recall (Blanks *et al.*, 1998).

There are four options of interest depending on whether outreach clinics are used or not and on screening policy with respect to number of views (Table 1). Option A involves two view screening of all women and outreach assessment where possible. Option B also involves two view screening of all women but all assessment is in the main centre. Option C involves single (oblique) view screening of women who have previously been screened and outreach assessment where possible. Finally, option D involves single view screening of women who have previously been screened and no outreach assessment.

Table 1. Assessment options.

	Screening	
	Two view	Single view
Outreach assessment	A	C
No outreach assessment	B	D

There are four potential comparisons of outreach with no outreach assessment. The comparisons of A with B and of C with D assume the same screening policy (two view and single view respectively) while the comparisons of A with D and B with C involve different screening policies. The most relevant comparison for the SBSP is between A and B since A is the current policy while B is the most likely policy in the absence of outreach assessment.

#### *Perspective to be adopted*

There are a number of different perspectives which might be appropriate: (1) cost to the Breast Screening Programme (BSP); (2) cost to the BSP and the rest of the health service; and (3) cost to the SBSP and the rest of the health service and to the women being screened. The choice of perspective is very important. For example, in Scotland the BSP does not bear the cost of travel for women from the island communities and outreach assessment is unlikely to be cost-minimizing from their perspective. In this study the travel cost of women is included in the model.

#### *Benefits of outreach assessment*

It is assumed that the benefits of outreach assessment (compared with mainland assessment) are solely in terms of convenience to women and reductions in the time and travel costs of women recalled for assessment. Thus, the model assumes that there are no differences in terms of health outcome. While this may be a reasonable assumption, there are a number of potential benefits from outreach clinics which should be noted. First, involvement of the local surgeon who will be following up the patients with breast cancer could increase. Similarly, the nursing staff who will meet the women at the time of diagnosis of their cancer, rather than once the women have been treated, could become more involved. Generally, there may be greater ownership of the screening programme by the local community and local Health Board. Set against this some loss of benefit to women may result from not having the opportunity to visit the main centre and because women may also have to wait longer for their outreach assessment as opposed to assessment in the main centre.

#### *Costs of outreach assessment*

The relevant costs include not only those associated with holding outreach assessment clinics but also those resulting from the additional cost of two view screening. The cost of outreach clinics includes: staff travel, subsistence and accommodation cost; time costs of the assessment team; any difference in cost of conducting the assessment on an outreach basis as compared with on the mainland. The time costs of the assessment team are relevant as they will spend more time travelling than if no outreach clinics were being held. Also, it is possible that the members of the assessment team are less able to make

productive use of their working time than if the assessment had taken place at the breast screening centre.

### *Modelling of costs*

The approach followed is to calculate the total costs of screening, review and assessment of the relevant group of women with (options A and C) and without outreach assessment (options B and D). A number of assumptions are made. First, the fixed costs of screening can be ignored as they will be the same under all options. Second, there is a proportion of women for whom outreach assessment is not feasible since specialist equipment is required. Third, there are no differences in procedures between outreach clinic and main centre clinics.

Given these assumptions the cost of screening, review and assessment in the absence of outreach assessment will be  $x F_m + (e + t)R + cS$ . Where  $x$  is the number of clinics and  $F_m$  is the fixed cost per clinic,  $e$  is the marginal cost of main centre assessment,  $t$  is the cost of travel of women to the main centre,  $R$  is the number of women recalled,  $c$  is the marginal cost of screening, and  $S$  is the number of women screened.  $R$  and  $c$  depend on whether there is single view screening ( $R_s, c_s$ ) or two view screening ( $R_t, c_t$ ). When there is outreach assessment these costs change as follows. There will be an additional cost  $x_0 F_0$  depending on the number of outreach clinics (where  $x_0$  is the number of clinics and  $F_0$  is the fixed cost per clinic). Also those women seen at an outreach clinic will cost  $b$  rather than  $(e + t)$  where  $b$  is the marginal cost of outreach assessment. There will also be an additional cost for women from the outreach clinic who require a second review in the main centre  $(e + t)R_{os}$ . Appendix 1 describes the variables used and their notation.

Table 2 shows the total cost (TC) for the four options and the additional total cost (ATC) as a result of outreach assessment. ATC will be a function of the number of women screened. There are three main possibilities. ATC could be always negative which indicates that no matter how many women are screened outreach assessment is always cost-minimizing (line 1 in Figure 1). ATC could be always positive which indicates that no matter how many women are screened assessment in the main centre is always cost-minimizing (line 3 in

Table 2. Total and additional cost of screening review and assessment.

A	$TC_A = x_{to}F_o + bR_{to} + x_{tm}F_m + (e + t)(R_{tm} + R_{tos}) + c_tS$
B	$TC_B = x_tF_m + (e + t)R_t + c_tS$
C	$TC_C = x_{so}F_o + bR_{so} + x_{sm}F_m + (e + t)(R_{sm} + R_{sos}) + c_tS_F + c_sS_S$
D	$TC_D = x_sF_m + (e + t)R_s + c_tS_F + c_sS_S$
A vs. B	$ATC_{AB} = x_{to}(F_o - F_m) + (b - e - t)R_{to} + (e + t)R_{tos}$
A vs. D	$ATC_{AD} = x_{to}F_o + (x_{tm} - x_s)F_m + bR_{to} + (e + t)(R_{tm} + R_{tos} - R_s) + (c_t - c_s)S_S$
C vs. B	$ATC_{CB} = x_{so}F_o + (x_{sm} - x_t)F_m + bR_{so} + (e + t)(R_{sm} + R_{sos} - R_t) + (c_s - c_t)S_S$
C vs. D	$ATC_{CD} = x_{so}(F_o - F_m) + (b - e - t)R_{so} + (e + t)R_{sos}$

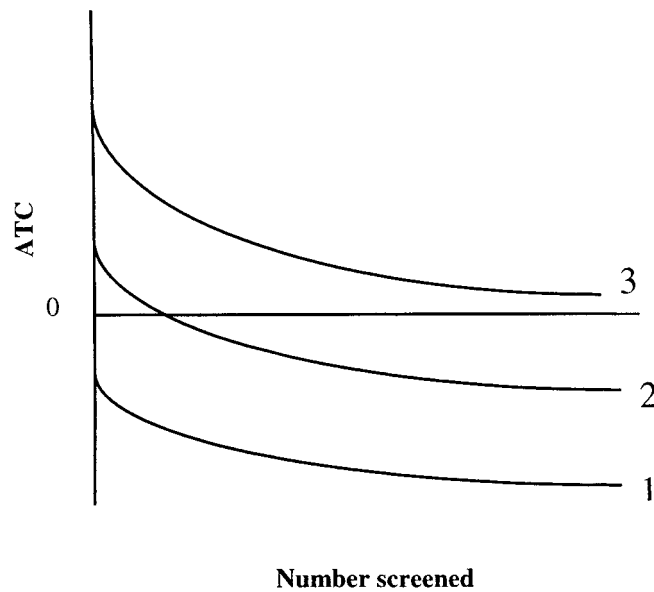


Figure 1. Relationship between additional total cost and number of women.

Figure 1). Or ATC can be either positive or negative depending on the number of women screened (line 2 in Figure 1).

#### OUTREACH ASSESSMENT IN ISLAND COMMUNITIES

The model is applied to three islands communities in Scotland, namely: Orkney; Shetland; and the Western Isles. Orkney is situated 120 miles north of Aberdeen with a total population of 20,000. Shetland is 189 miles north of Aberdeen and has a total population of 23,000. The North East Scotland Breast Screening Programme (NESBSP) which is based in Aberdeen covers both these islands. The Western Isles are situated 60 miles to the west of mainland Scotland and have a joint population of 30,000. The North of Scotland Breast Screening Programme (NSBSP) which is based in Inverness covers the Western Isles.

Seven outreach assessment clinics have taken place so far in Orkney, Shetland and the Western Isles. Table 3 shows the number of women screened and the number of women recalled. It also shows the number of women reviewed in the outreach clinics (and the number of days) and the number of women from Orkney, Shetland and Western Isles reviewed in Aberdeen/Inverness. Finally, the numbers of women who have been reviewed in Orkney, Shetland and Western Isles requiring second assessment (in Aberdeen/Inverness) are reported.

On the islands two view mammography is performed on both prevalent and subsequent rounds. This is done specifically to reduce the rate of recall because of the greater difficulties of assessment of women resident in the islands. The

Table 3. Number of women screened and reviewed.

	1991	Orkney 1994	1997	Shetland 1992	1995	Western Isles 1993	1996
Total screened ( $S$ )	1372	1503	1561	1321	1510	1918	1822
Number of views	2	1	2	2	2	2	2
Total reviewed ( $R$ )	96 (7.0%)	84 (5.6%)	99 (6.3%)	88 (6.7%)	75 (5.0%)	157 (8.2%)	77 (4.2%)
Outreach ( $R_o$ )	96 (100%)	74 (88.1%)	59 (59.6%)	87 (98.9%)	57 (76.0%)	149 (94.9%)	74 (96.1%)
Mainland ( $R_m$ )	0 (0%)	10 (11.9%)	40 (40.4%)	1 (1.1%)	18 (24.0%)	8 (5.1%)	3 (3.9%)
Number of women from outreach clinic requiring second review ( $R_{os}$ )	14	11	0	9	4	13	16

fundamental approach of the outreach clinics is a core team visiting the islands dealing with palpable and ultrasonically visible lesions on site and referring patients who require magnification views. In all of the outreach clinics a local surgeon is available for consultation on palpable lesions.

The model is adjusted in the following way. First, the number of mainland clinics will be the same whether or not there is outreach assessment and only the length of clinics will be affected. This is possible because fewer mainland women will be attending the assessment clinics while the mobile units are screening on the islands. The fixed cost of a main centre clinic ( $F_m$ ) is therefore not relevant and dropped from the model. Second, a maximum of 30 women can be reviewed and assessed at a one-day outreach clinic and  $x$  is based on this figure. Third, all women who require additional views are assessed and reviewed in the main centres. The proportion of women that cannot be assessed at outreach clinics is therefore relatively high in Shetland and Orkney (40 per cent with two view screening and 50 per cent with single view screening).

Data were collected on the cost of undertaking outreach assessment and the proportion of women for whom outreach assessment is feasible at the North East Scotland Breast Screening Centre (Aberdeen) and the North of Scotland Breast Screening Centre (Inverness). Appendix 2 shows the estimates for the various cost components. Data on travel cost for women were collected from the Orkney, Shetland and Western Isles Health Boards. Other data are based on a number of recent UK studies. The additional screening costs are estimated using the average of two studies (Bryan *et al.*, 1995; Wald *et al.*, 1995). The additional recall rate of single view screening compared to two view screening is an average of three UK studies (Moss *et al.*, 1995; Warren *et al.*, 1995). The estimates were all similar and are all within the range of values tested in the sensitivity analysis described below. Appendix 1 shows the assumptions, calculations and base values of all the variables used in the model.

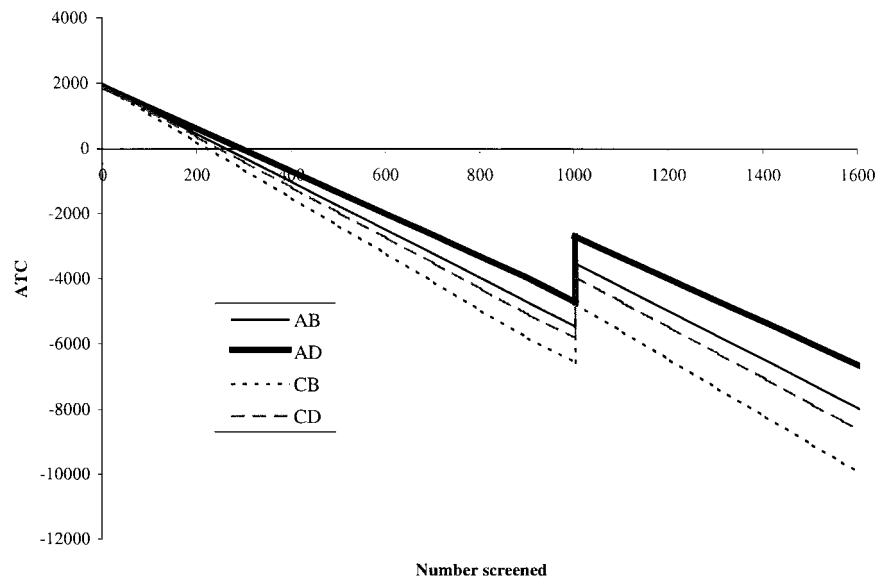


Figure 2. Orkney.

## RESULTS

Figure 2 shows the additional total costs in relation to the number of women screened for Orkney. Outreach assessment on Orkney is cost-minimizing as long as more than about 350 women are screened. The figures for Shetland and the Western Isles are very similar and therefore not shown. Instead, the breakeven points which indicate the number of women screened at which outreach assessment becomes cost-minimizing (ATC equals zero at this point) are shown in Table 4.

The breakeven points vary across the island communities and vary with respect to whether a single or two view policy is adopted. All of the breakeven points involve screening 322 or fewer women while the current number of women screened ranges from 1510 to 1822. Thus, outreach assessment appears to be cost-minimizing.

Table 4. Breakeven points.

	$ATC_{AB} = 0$	$ATC_{AD} = 0$	$ATC_{CB} = 0$	$ATC_{CD} = 0$
Orkney	261	293	223	247
Shetland	286	322	246	271
Western Isles	165	210	104	127

*Sensitivity analysis*

It is important to test the robustness of this finding with respect to the assumptions that have been made. The assumptions that are tested are reported in Appendix 3. For each parameter the impact of a 20 per cent change in the baseline value on the breakeven point is estimated. The results for Orkney and the Western Isles (results for Shetland are very similar to those for Orkney and are therefore not reported) show that changes in the parameters do have an impact on the breakeven points, but in none of the cases do the breakeven points approach the number of women currently screened.

## CONCLUSION

The results of this study show that outreach assessment on island communities is cost-minimizing as long as more than about 350 women are screened. Whether the screening policy is single view or two view mammography has some influence on this number.

The model could readily be applied to mainland communities outwith the main population centres. An example in Scotland would be an area such as Dumfries and Galloway. In the case of Scottish mainland communities the women themselves bear the travel cost to the clinics and so if the same perspective is adopted (SBSP and the rest of the NHS in Scotland) outreach assessment is unlikely to be a cost-minimizing option. If the perspective of the SBSP, the rest of NHS *and* the women recalled is taken (or if women were to have their travelling expenses reimbursed) outreach clinics will become the cost-minimizing option as long as a certain minimum number of women are being screened. The number could be estimated using the model developed in this paper.

The model can also be applied to breast and other screening programmes in other countries, although it may need to be adapted to take into account a different range of options. For example, if double reading of mammograms was not routinely practised it might be relevant to include this as an option for such communities.

## ACKNOWLEDGEMENTS

HERU is funded by the Chief Scientist Office of the Scottish Office Department of Health (SODoH). The views expressed in this paper are those of the authors and not SODoH.

## REFERENCES

- Blanks, R. G., Given-Wilson, R. M., Moss, S. M. (1998). Efficiency of cancer detection during routine repeat (incident) mammographic screening: two view versus one view mammography. *J. Med. Screening* **5**, 141–145.



- Bryan, S., Brown, J., Warren, R. (1995). Mammography screening: an incremental cost effectiveness analysis of two view versus one view procedures in London. *J. Epidemiol. Commun. Health* **49**, 70–78.
- Gillam, S., Ball, M., Parsad, M., Dunne, H., Cohen, S., Vafidis, G. (1995). Investigation of benefits and costs of an ophthalmic outreach clinic in general practice. *Br. J. Gen. Pract.* **45**, 649–652.
- Gosden, T., Black, M., Mead, N., Leese, B. (1997). The efficiency of specialist outreach clinics in general practice: is further evaluation needed? *J. Health Services Res. Policy* **2**, 174–179.
- Helliwell, P. (1996). Comparison of a community clinic with a hospital out-patient clinic in rheumatology. *Br. J. Rheumatol.* **35**, 385–388.
- Moss, S. M., Michel, M., Patnick, J., Johns, L., Blanks, R., Chamberlain, J. (1995). Results from the NHS breast screening programme 1990–1993. *J. Med. Screening* **2**, 186–190.
- Wald, N. J., Murphy, P., Major, P., Parkes, C., Townsend, J., Frost, C. (1995). UKCCCR multicentre randomised controlled trial of one and two view mammography in breast cancer screening. *Br. Med. J.* **311**, 1189–1193.
- Warren, M. L., Duffy, S. W., Bashir, S. (1995). The value of the second view in screening mammography. *Br. J. Radiol.* **69**, 105–108.

## APPENDIX 1: VARIABLES USED IN THE MODEL

Variable	Notation	Calculation/ assumptions/base values
Number of women screened	$S$	
Number of women screened for the first time	$S_F$	$0.25^a \times S$
Number of women previously screened	$S_S$	$0.75^a \times S$
Number of women recalled when using single (two) review screening	$R_s(R_t)$	$0.067^a \times S$ ( $0.052^c \times S$ )
Number of women for whom outreach assessment is feasible when using single (two) view screening	$R_{so}(R_{to})$	$0.50^{a*} \times R_s$ ( $0.60^{a*} \times R_t$ ) $0.95^{a**} \times R_s$ ( $0.95^{a**} \times R_t$ )
Number of women from the outreach clinic who require a second review at the main centre when using single (two) view screening	$R_{sos}(R_{tos})$	$0.22^{a*} \times R_{so}$ ( $0.22^{a*} \times R_{to}$ ) $0.00^{a**} \times R_{so}$ ( $0.00^{a**} \times R_{to}$ )
Number of women for whom outreach assessment is not feasible when using single (two) view screening	$R_{sm}(R_{tm})$	$0.50^{a*} \times R_s$ ( $0.40^{a*} \times R_t$ ) $0.05^{a*} \times R_s$ ( $0.05^{a**} \times R_t$ )
Number of assessment clinics required to assess $R_s(R_t)$	$x_s(x_t)$	$R_s/30^a$ ( $R_t/30^a$ )***
Number of outreach clinics required to assess $R_{so}(R_{to})$	$x_{so}(x_{to})$	$R_{so}/30^a$ ( $R_{to}/30^a$ )***
Number of mainland clinics required to assess $R_{sm}(R_{tm})$	$x_{sm}(x_{tm})$	$R_{sm}/30^a$ ( $R_{tm}/30^a$ )* £972***
Fixed cost per main centre (outreach clinic)	$F_m(F_o)$	(£1,927 <sup>a</sup> – £2,127 <sup>a</sup> )* £972***
Marginal cost of single (two) view screening	$c_s(c_t)$	£4.85 <sup>c</sup>
Marginal cost of main centre assessment	$e$	£30 <sup>a*</sup> – £25 <sup>a**</sup>
Cost of travel of women to main centre	$t$	£220 <sup>b*</sup> – £149 <sup>b**</sup>
Marginal cost of outreach assessment	$b$	(£13 <sup>a</sup> – £12 <sup>a</sup> )* – £8 <sup>a**</sup>

Source: <sup>a</sup>Breast screening centres; <sup>b</sup>Health Boards; <sup>c</sup>Literature. \*Orkney and Shetland; \*\*Western Isles; \*\*\*Rounded up to nearest whole number.

## APPENDIX 2. ESTIMATES OF COST COMPONENTS

	Orkney	Shetland	Western Isles
$F$	Travel cost: £946.80 Staff: £980 $F = £1,927$	Travel cost: £1146.80 Staff: £980 $F = £2,127$	Travel cost: £447 Staff: £525 $F = £972$
$b$	Local staff: £392 $b = £392/30 = £13$	Local staff: £364 $b = £364/30 = £12$	Local staff: £245 $b = £245/30 = £8$
$e$	Staff: £891 $e = £891/30 = £30$	Staff: £891 $e = £891/30 = £30$	Staff: £761 $e = £761/30 = £25$
$t$	£220	£220	£149
$c_t - c_s$	£4.85	£4.85	£4.85

Assumption: marginal cost is equal to average cost.

## APPENDIX 3. SENSITIVITY ANALYSIS

Parameter	Base value	Alternative values (+ and −20%)	ATC <sub>AB</sub> = 0	Break-even points ATC <sub>AD</sub> = 0    ATC <sub>CB</sub> = 0    ATC <sub>CD</sub> = 0		
<b>Orkney</b>						
Baseline			261	293	223	247
Recall rate single (two) view	6.7% (5.2)	5.4% (4.2)	323	420	251	306
		8.0% (6.2)	219	225	201	207
Proportion for whom outreach assessment is feasible with single (two) view	60% (50)	72% (60)	217	239	189	206
		48% (40)	326	379	273	309
$c_t - c_s$	£4.85	£3.9	–	265	242	–
		£5.8	–	329	206	–
$t$	220	176	320	410	251	303
		264	220	228	201	208
$b$	13	10	257	289	221	244
		16	264	298	226	250
$e$	30	24	267	305	227	253
		36	254	282	220	241
$F$	1927	1542	209	235	179	198
		2312	313	352	268	296
<b>Western Isles</b>						
Baseline			165	210	104	127
Recall rate single (two) view	6.7% (5.2)	5.4% (4.2)	204	321	118	157
		8.0% (6.2)	138	156	93	108
Proportion for whom outreach assessment is feasible	95%	76%	206	289	124	158
Percentage of women requiring second review	22%	18%	154	195	99	120
		27%	181	231	110	136
$c_t - c_s$	£4.85	£3.9	–	182	112	–
		£5.8	–	248	97	–
$t$	149	119	202	310	117	155
		179	139	159	93	107
$b$	8	6	162	206	103	125
		10	168	215	105	129
$e$	25	20	170	222	106	131
		30	160	199	102	123
$F$	972	778	132	168	83	101
		1166	198	252	125	152