NHS Breast Screening Programme

NHS
Cancer Screening Programmes

National collation of breast interval cancer data:

Screening years 1st April 2003 - 31st March 2005

NHSBSP Occasional Report 12/03

DECEMBER 2012

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Clinical/healthcare/social questions covered	What was the rate of interval breast cancer during 2003-04 and 2004-05? How does this compare to previous years? What is the geographical variation in incidence? How complete are the data on interval cancer incidence? Are there lessons that can be learned from interval cancer incidence that might benefit the NHSBSP?
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EXECUTIVE SUMMARY

- Data have been collected for interval cancers arising in women screened over two years: 1st April 2003 to 31st March 2004, and 1st April 2004 to 31st March 2005.

- We have data from all English regions, Wales, and Northern Ireland for both years. However, data from Scotland are only available for women screened during 2003-04.

- We have provided collated interval data for women who were aged between 50 and 64 at their most recent* routine screen during the screening year 2003-04. Since most screening units in England and Wales extended the eligible age range for screening to 70 years during 2004-05, the data for this period have been broken down into two groups: women aged 50-64, and women aged 50-70.

- Summary of 2003-04 interval cancer data:
    - A total of 112 cases were excluded.
    - 5,322 cases were analysed.
    - The invasive status was known for 5,282 cases (99.6%).
    - 4,312 invasive cancers occurred in women who were aged 50-64 at their most recent routine screen. 4,161 of these cases were diagnosed within 36 months of the woman's most recent screen.

- Summary of 2004-05 interval cancer data:
    - A total of 206 cases were excluded.
    - 4,585 cases were analysed.
    - The invasive status was known for 4,563 cases (99.5%).
    - 4,192 invasive cancers occurred in women aged 50-70 at their most recent routine screen. 4,045 of these cases were diagnosed within 36 months of the woman's most recent screen.
    - 3,552 invasive cancers occurred in women aged 50-64 at their most recent routine screen, and 3,436 of these cases were diagnosed within 36 months of the woman's most recent screen.

- The interval invasive cancer rates for the screening year 2003-04 for women aged 50-64 at their most recent routine screen were as follows:
    - The overall interval cancer rate was 2.97 per 1,000 women screened (regional range 2.44-3.43 per 1,000 women).
    - The interval cancer rate over the period 0-<12 months after a negative screen was 0.55 per 1,000 women screened.
    - The interval cancer rate for the period 12-<24 months after a negative screen was 1.14 cases per 1,000 women screened. The rate for the period 24-<36 months after a negative screen was similar: 1.29 cases per 1,000 women screened.

- The interval invasive cancer rates for the screening year 2004-05 for women aged 50-70 at their most recent routine screen were as follows:
    - The overall interval cancer rate was 2.67 per 1,000 women screened (regional range 2.10-3.00 per 1,000 women).
    - The interval cancer rate over the period 0-<12 months after a negative screen was 0.46 per 1,000 women screened, lower than the corresponding rate for 2003-04.
    - The interval cancer rate over the period 12-< 24 months after a negative screen was slightly lower than that for 2003-04: 1.01 per 1,000 women screened. The

* For the purpose of this report, a woman's 'most recent' screen is defined as the screen immediately preceding her diagnosis.

rate 24-<36 months after a negative screen was very similar: 1.19 cases per 1,000 women screened.
  - The rates for women aged 50-64 at their most recent routine screen were nearly identical to the rates discussed above for the age group 50-70.

- The overall interval cancer rates for all cancers (invasive, non-invasive, micro-invasive, and unknown invasive status) were 3.14 and 2.82 per 1,000 women screened for 2003-04 and 2004-05 respectively.

- The rate of invasive interval cancers varied considerably by region. In part, this reflects geographic variation in age-standardised incidence of breast cancer within the UK. It is also likely to reflect some variation in completeness of ascertainment, due to population mobility and variation in the data provided by the hospital of diagnosis to both QARCs and cancer registries.

- Another reason for variation in overall rates by region is the difference in achieved interval length, i.e. fluctuations in the length of time elapsing between two consecutive screens. The rate of interval cancers was therefore calculated to 24 months after a negative screen, a cutoff that is applicable to all breast screening units (many have an average interval length of less than 36 months, but none have an interval length of less than 24 months). The variation between regions was 30-50% smaller in its range for overall rates to 24 months than for overall rates to 36 months.

- Interval cancer rates to 24 months were comparable with corresponding rates from the Swedish Two-County Trial, upon which the UK programme was modelled.[1]

- Over time, rates of invasive interval cancers are relatively constant until 2004-05, when they decline substantially. This is likely to reflect the introduction of two-view mammography. If 2004-05 data were available for Scotland, which did not introduce two-view screening at that time, the effect of two-view mammography on rates could be ascertained with more confidence.

- The figures show that interval cancer rates increase more than two-fold during the first and second year after screening. However, the rates increased much more slowly over the third year after screening (i.e. 25-36 months after the screening episode). This plateau in the data would not normally be expected until the interval cancer rates approached the expected rates in the absence of screening (around 2-3 cases per 1,000 women per year). A breakdown of the incidence of interval cancers by individual month during the third year suggests that rates are affected by the fact that many units are keeping the round length some months below 36. Investigation of this is ongoing.

- The pathology data show considerable variation among regions. However, this may be due, in part, to missing data. Node status data, in particular, are sensitive to lack of completeness: higher rates of node-positive disease are strongly associated with higher rates of missing pathology data. Areas where pathology data are known for only a small number of women may therefore have an artificial and unusual pathology profile. Further research on pathology data is planned.

- The Centre for Cancer Prevention (CCP) will request interval cancer data for analysis and publication on an annual basis.

1. INTRODUCTION

1.1 Aim of breast screening and eligible age ranges

The aim of breast screening services is to decrease incidence of, and mortality from, breast cancer. In the UK, the NHS Breast Screening Programme (NHSBSP) has invited women for screening every three years since 1988. Initially, women aged 50-64 were invited, but from 2003 the programme was extended to women aged 50-70 years. In England, rollout of a further age extension means that many women aged 47-73 are now being routinely screened. A randomised trial to evaluate the effects of this policy is underway.[2]

1.2 Definition of interval cancers

A proportion of cancers are diagnosed between scheduled screening episodes. This can be because a cancer was missed at a previous screen, or because it caused symptoms and became mammographically visible only after the screen, or because it was not detectable using mammography.[3] These cancers are called 'interval cancers', and are defined as 'cancers diagnosed following a normal screening result during the interval beginning with the closure of the previous NHS screening episode and ending when the next screening episode is due to commence'.[4]

1.3 Classification of breast cancers

Breast cancers diagnosed in women of screening age are classified into five categories: screen-detected cancers, interval cancers, cancers in non-attenders, cancers in lapsed attenders, and cancers in uninvited women. It is the responsibility of the Regional Breast Screening Quality Assurance Reference Centres (QARCs) to assign all breast cancer cases to one of these categories, following the protocol outlined in NHSBSP publication no 62, *Audit of Breast Cancers in Women Aged 50 to 74.*[4] Close collaboration between QARCs, breast screening services, breast cancer treatment centres, and cancer registries is required to ensure that all requisite information is obtained.

1.4 Rationale for interval cancer audit

Interval cancer data can provide information on the efficiency of the breast cancer screening programme and improve understanding of the natural history and development of breast cancer. For example, interval cancer radiology audits can show why some cancers are not visualised during screening, and can therefore suggest areas for radiographic and radiological improvement.

Interval cancer data are collated and interval cancer rates calculated by year of most recent routine screen. The analysis was first reported for years 1997-2003 by Bennett et al. in 2011.[5] The current document reports interval cancer data and analysis for screening years 2003-04 and 2004-05, and is an outcome of a collaborative project between the CCP, the NHSBSP, the QARCs, and the regional cancer registries.

2. DATA COLLATION AND ANALYSIS

2.1 National collation of individual interval cancer data

Regional interval cancer data are collected by the QARCs from cancer registries, breast screening units, and hospital pathology departments. These datasets are then collated on an annual basis and passed to the CCP for analysis.

The national dataset contains information on screening unit; the age of the woman diagnosed with interval cancer; the date, order, type, and result of her most recent routine screen; and whether she was recalled for assessment. It also includes the date of diagnosis, invasive status, cancer type*, size/number/status of nodes sampled, and grade and stage of the interval cancer. Size, nodal status, grade, and TNM staging information are available for all invasive cancers, though the completeness of the information varies by region.

This report includes all cancers notified to the CCP before 1 September 2012. Occasionally late registrations are notified to the QARCs. Future reports will therefore update current totals in the light of possible late registrations.

2.2 Analysis

The interval data obtained from the QARCs were cleaned (see below), and the total number of women screened was obtained from routinely collected data (KC62 returns). Interval cancer rates were then calculated per 1,000 women screened (including early recalls and self/GP referrals) at both national and regional level for each screening year. Where regional boundaries changed during the period under scrutiny, the configuration of regions and responsibilities for screening units was taken to be that which existed in 2011.

2.3 Identification of core interval cancers

Data were collated from all English regions, Wales, and Northern Ireland for interval cancers arising in women screened over two years: 1st April 2003 to 31st March 2004, and 1st April 2004 to 31st March 2005. Due to data capture problems, Scotland was only able to provide data for the screening year 2003-04.

Figure 1 shows the breakdown of all cancer cases for both screening years by the woman's age at her most recent screen, the cancer's invasive status, and the amount of elapsed time since most recent screen. A number of records were excluded as they were duplicate cases, or were not true interval cancers, or because they did not fall in the requisite screening years (Table 1). Following national guidelines, Paget's disease, second primaries, and recurrences were excluded. In most cases, cancers of unknown type were also excluded, except where more than 10% of interval cancers reported by one QARC were of an unknown type.

For the 2003-04 screening year, a total of 112 cases were excluded (Table 1). 5,302 cases were analysed (Figure 1a). The invasive status was known for 5,282 cases (99.6%). 4,551 invasive cancers were diagnosed in women aged 50-64 at their most recent routine screen, and 4,161 of these cases (79%) were diagnosed within 36 months of the woman's most recent screen. 770 cancers (15%) were diagnosed within the first 12 months, 1,590 (30%) over the second year, and a further 1,801 (34%) cases during the third year after screening.

* In this context, the cancer type is its classification (new first primary tumour, secondary tumour, second primary tumour, or recurrence).

4,791 cases were collected in total for the 2004-05 screening year, of which 206 cases were excluded, so that a total of 4,585 cases were analysed. The invasive status was known for 4,563 cases (99.5%). As most screening units in England and Wales extended the upper age limit for breast screening to 70 years during 2004-05, two sets of core interval data were extracted (see Figure 1b). The first dataset, covering women aged 50-64 at their most recent routine screen (3,725 cases), shows that 3,552 invasive cancers (77.5%) were diagnosed. 3,436 of these cases (74.9%) were diagnosed within 36 months of the woman's most recent screen, 705 fewer than in 2003-04. In this age group, 637 cancers (13.9%) were diagnosed within the first 12 months, 1,384 (30.2%) during the second year, and 1,602 (34.9%) during the third year after screening.

The second dataset, covering women aged 50-70 at their most recent routine screen (4,403 cases), shows that 4,192 invasive cancers (91.4%) occurred in this age group. 4,045 of these cases (88.2%) were diagnosed within 36 months of the woman's most recent screen. 702 cancers (15.3%) were diagnosed within the first 12 months, 1,533 (33.4%) were diagnosed during the second year, and 1,810 (39.5%) during the third year after screening.

a. Screening year 2003-04

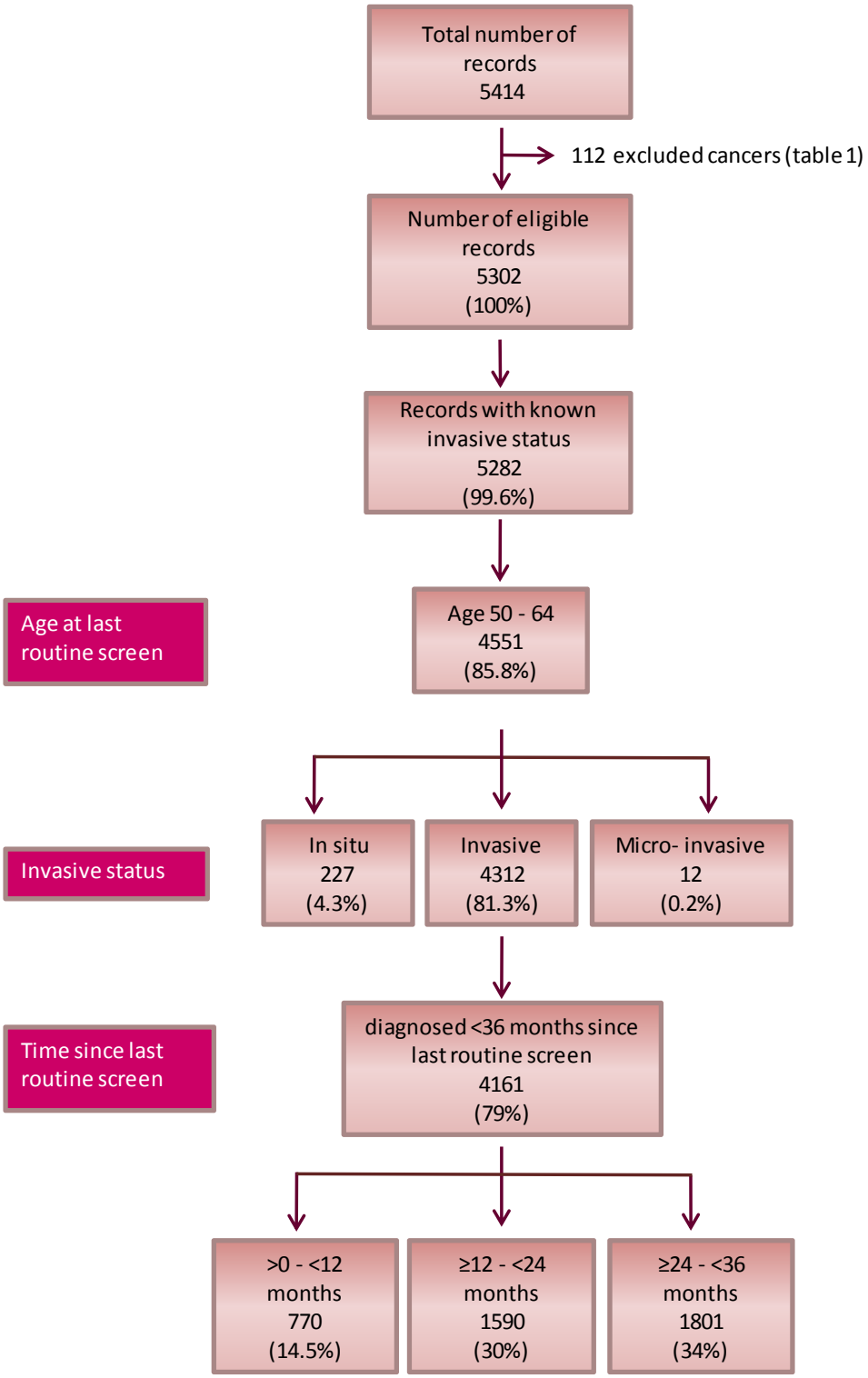


Figure 1 Flowchart showing breakdown of total cases by age at most recent routine screen, invasive status, and time since screen.

b. Screening year 2004-05

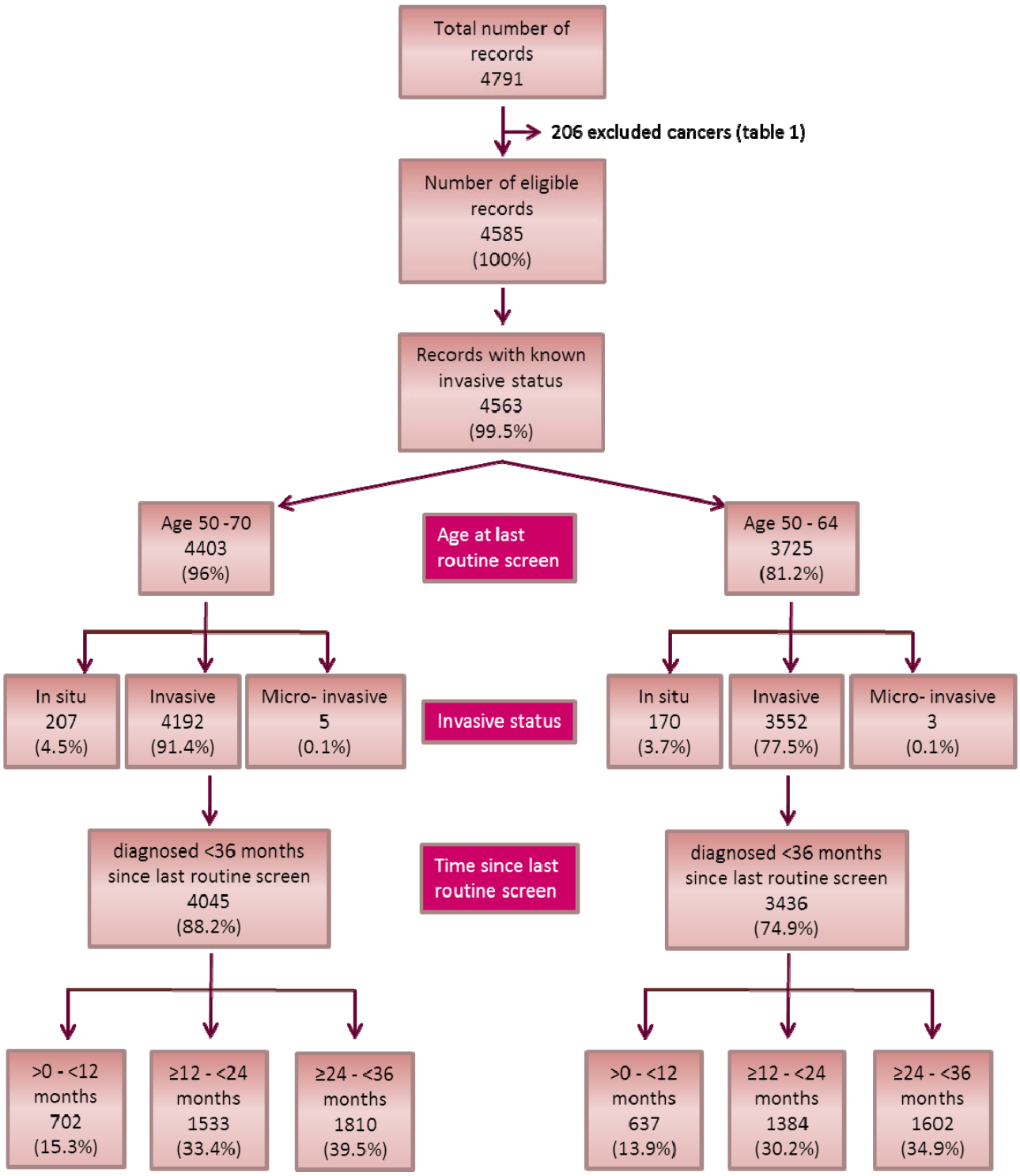


Table 1 Records excluded from the national breast interval cancer data for women whose most recent screen fell between 1st April 2003 and 31st March 2005.

a. by reason for exclusion.

Reason	2003-04*	2004-05+
Paget's disease	5	3
Second primaries	81	109
Unknown cancer type	2	58
Recurrences	11	8
Duplicates	7	11
Not interval cancers	2	9
Not screened in screening round	4	8
Total	**112**	**206**

*A total of 150 'unknown cancer type' cancers from East of England, NEYH, and South Central were included in the analysis as they made up more than 10% of these QARCs' interval cancers.

+77 'unknown cancer type' cancers from NYEH were included as they made up more than 10% of this QARC's interval cancers.

b. by region.

Region	2003-04*	2004-05+
East Midlands	0	1
East of England	4	44
London	10	10
NE, Yorkshire and the Humber (NEYH)	26	27
North West	5	8
South East Coast	6	20
South Central	13	44
South West	10	20
West Midlands	15	24
England	**91**	**198**
Northern Ireland	1	0
Wales	15	8
Scotland	7	n/a
Overall	**114**	**206**

n/a. not available

Table 2 Regional breakdown of the identification of core interval cancers in women aged 50-64 whose most recent screen was between 1st April 2003 and 31st March 2004.

Region	Total number of records (minus exclusions)	Total cancers recorded as invasive, micro-invasive, or non-invasive/in situ; all ages		Cancers (with known invasive status) diagnosed in women aged 50-64 at their most recent routine screen		Invasive cancers diagnosed in women aged 50-64 at their most recent routine screen		Invasive cancers diagnosed <36 months after most recent routine screen, in women aged 50-64 at their most recent routine screen	
	n	n	%	n	%	n	%	n	%
East Midlands	403	403	100.0	326	80.9	300	74.4	289	71.7
East of England	654	652	99.7	526	80.4	493	75.4	470	71.9
London	410	410	100.0	353	86.1	338	82.4	316	77.1
NEYH	625	625	100.0	528	84.5	498	79.7	479	76.6
North West	660	660	100.0	549	83.2	536	82.1	507	76.8
South East Coast	377	359	95.2	298	79.0	283	75.1	272	72.1
South Central	372	372	100.0	333	89.5	319	85.8	312	83.9
South West	436	436	100.0	416	95.4	382	87.6	371	85.1
West Midlands	505	505	100.0	424	84.0	403	79.8	402	79.6
England	**4442**	**4422**	**99.5**	**3753**	**84.5**	**3552**	**80.0**	**3418**	**76.9**
Northern Ireland	126	126	100.0	124	98.4	124	98.4	123	97.6
Wales	275	275	100.0	227	82.5	212	77.1	203	73.8
Scotland	459	459	100.0	447	97.4	424	92.4	417	90.8
Overall	**5302**	**5282**	**99.6**	**4551**	**85.8**	**4312**	**81.3**	**4161**	**78.5**

Table 3 Regional breakdown of the identification of core interval cancers for women whose most recent screen lay between 1st April 2004 and 31st March 2005.

a. In women aged 50-64 at their most recent routine screen.

Region	Total number of records (minus exclusions)	Total cancers recorded as invasive, micro-invasive, or non-invasive/in situ; all ages		Cancers (with known invasive status) diagnosed in women aged 50-64 at their most recent routine screen		Invasive cancers diagnosed in women aged 50-64 at their most recent routine screen		Invasive cancers diagnosed <36 months after most recent routine screen, in women aged 50-64 at their most recent routine screen	
	n	n	%	n	%	n	%	n	%
East Midlands	413	413	100.0	326	78.9	310	75.1	297	71.9
East of England	439	439	100.0	361	82.2	345	78.6	341	77.7
London	434	434	100.0	365	84.1	347	80.0	322	74.2
NEYH	586	585	99.8	465	79.4	442	75.4	425	72.5
North West	616	608	98.7	479	77.8	461	74.8	437	70.9
South East Coast	432	421	97.5	345	79.9	328	75.9	315	72.9
South Central	341	341	100.0	278	81.5	263	77.1	256	75.1
South West	462	461	99.8	387	83.8	362	78.4	361	78.1
West Midlands	508	507	99.8	413	81.3	399	78.5	396	78.0
England	**4231**	**4209**	**99.5**	**3419**	**80.8**	**3257**	**77.0**	**3150**	**74.5**
Northern Ireland	96	96	100.0	91	94.8	91	94.8	90	93.8
Wales	258	258	100.0	215	83.3	204	79.1	196	76.0
Overall	**4585**	**4563**	**99.5**	**3725**	**81.2**	**3552**	**77.5**	**3436**	**74.9**

b. In women aged 50-70 at their most recent routine screen.

Region	Total number of records (minus exclusions)	Total cancers recorded as invasive, micro-invasive, or non-invasive/in situ; all ages		Cancers (with known invasive status) diagnosed in women aged 50-70 at their most recent routine screen		Invasive cancers diagnosed in women aged 50-70 at their most recent routine screen		Invasive cancers diagnosed <36 months after most recent routine screen, in women aged 50-70 at their most recent routine screen	
	n	n	%	n	%	n	%	n	%
East Midlands	413	413	100.0	384	93.0	364	88.1	351	85.0
East of England	439	439	100.0	435	99.1	413	94.1	409	93.2
London	434	434	100.0	422	97.2	401	92.4	369	85.0
NEYH	586	585	99.8	561	95.7	536	91.5	512	87.4
North West	616	608	98.7	580	94.2	557	90.4	525	85.2
South East Coast	432	421	97.5	408	94.4	388	89.8	372	86.1
South Central	341	341	100.0	334	97.9	316	92.7	305	89.4
South West	462	461	99.8	454	98.3	424	91.8	422	91.3
West Midlands	508	507	99.8	486	95.7	466	91.7	462	90.9
England	**4231**	**4209**	**99.5**	**4064**	**96.1**	**3865**	**91.3**	**3727**	**88.1**
Northern Ireland	96	96	100.0	94	97.9	94	97.9	93	96.9
Wales	258	258	100.0	245	95.0	233	90.3	225	87.2
Overall	**4585**	**4563**	**99.5**	**4403**	**96.0**	**4192**	**91.4**	**4045**	**88.2**

3. COMPLETENESS OF DATA AND PATHOLOGY

3.1 Completeness of screening history data

The data obtained from the QARCs can be divided into two categories: data on screening history, and data on pathology. The completeness of the data on screening history is very good for both screening years (Tables 4 and 5).

For 2003-04, completeness for most data items is very good, with information available on 99-100% of all invasive interval cancers. In two categories, a lower percentage of 96% completeness was achieved: for 'number of women recalled' in the South East Coast region, and for 'results of most recent routine screen' in the South West region. The lowest level of completeness is that for the North West on 'order of most recent screen' (89%).

For 2004-05, data completeness is 100% overall, with just a few categories at a slightly lower 99% (these were mainly from South Central). All information on the completeness of 2004-05 data is for women aged 50-64 at their most recent screen, but completeness levels for data collected on women aged 50-70 are very similar.

3.2 Completeness of pathology data

In contrast, there is wide variation in the completeness of pathology data. The completeness of size data ranges from 69% (North West) to 91% (East of England) in data for 2003-04, and from 76% (London and South East Coast) to 96% (Northern Ireland) in data for 2004-05. Information on nodal status ranges in its completeness from 54% (London) to 92% (NEYH) in data for 2003-04, and 51% (London) to 96% (Northern Ireland) in data for 2004-05. The completeness of grade data ranges from 56% (North West) to 97% (NEYH) in data for 2003-04, and 77% (London) and 98% (South West) in data for 2004-05.

The overall completeness of staging data remains low, at only 32% (2003-04) and 36% (2004-05). For both screening years investigated by this study, only 6 QARCs provided a staging dataset that was more than 40% complete. However, the completeness of staging data increases dramatically between both screening years for those QARCs that did provide this information. This is in line with data from the National Cancer Intelligence Network (NCIN), which shows that for all cancers diagnosed in 2007, the completeness of staging data varies between registries, from 15% (North West Cancer Intelligence Service) to 70% (Eastern Cancer Registration and Information Centre), with the average completeness being around 30%.[6]

3.3 Variations in pathology data

The invasive interval cancer pathology data indicates that the percentage of large, high-grade and node-positive cancers varies considerably between regions but remains constant between the two screening years (Tables 6 and 7). To some degree, this variation between regions can be attributed to missing data, which causes those areas where only a small number of cases have known pathology to appear unusual in their pathology profile. Node status, in particular, is sensitive to missing data. Node status is more likely to be reported in the case of node-positive disease, which suggests that a large proportion of those cases where the node status is missing are node-negative. This results in a strong correlation between the proportion of cases with missing node status and the percentage of women with known node status who have node-positive disease (in other words, the higher the proportion of cases with unknown node status, the higher the percentage of node-positive

disease amongst the women with known nodal status). In 2003-04, the percentage of node-positive cancers ranged from 36% in North West to 66% in London and 89% in Scotland. For 2004-05, in the absence of data from Scotland, the percentage of node-positive cancers ranged from 37% in Northern Ireland to 57% in London. The proportion of large tumours ranged from 38% in Wales to 59% in Northern Ireland in 2003-04, and from 46% in London to 56% in Northern Ireland and the South East Coast during 2004-05.

Table 4 Completeness (in percentages) of screening history data items for records identified as core interval cancers (year of most recent routine screen 2003-04).

	Screening History				Pathology			
	Order of most recent routine screen	Type of most recent routine screen	Recalled for assessment at most recent routine screen	Result of most recent routine screen	Size	Nodal status	Grade	Stage
East Midlands	100	100	100	100	89	89	89	0
East of England	100	100	100	100	91	80	93	46
London	100	100	100	100	71	54	72	0
NEYH	100	100	100	100	96	92	97	4
North West	89	100	100	100	69	62	56	26
South East Coast	100	100	96	100	82	84	92	0
South Central	100	100	100	100	76	59	94	69
South West	99	100	100	96	90	89	92	1
West Midlands	100	100	100	100	82	91	93	78
England	**98**	**100**	**100**	**100**	**83**	**79**	**92**	**27**
N Ireland	100	100	100	100	82	85	81	0
Wales	100	100	100	100	84	87	93	90
Scotland	100	100	100	99	82	49	89	56
Overall	**99**	**100**	**100**	**99**	**83**	**78**	**94**	**32**

Table 5 Completeness (in percentages) of screening history data items for records identified as core interval cancers (year of most recent routine screen 2004-05).

a. in women aged 50-64 at their most recent routine screen.

	Screening History				Pathology			
	Order of most recent routine screen	Type of most recent routine screen	Recalled for assessment at most recent routine screen	Result of most recent routine screen	Size	Nodal status	Grade	Stage
East Midlands	100	100	100	100	86	86	86	0
East of England	100	100	100	100	94	70	95	70
London	100	100	100	100	76	51	77	0
NEYH	100	100	100	100	88	74	94	7
North West	100	100	100	100	81	78	90	49
South East Coast	100	100	100	100	76	72	90	0
South Central	100	99	99	99	86	81	94	60
South West	100	100	100	99	92	93	98	3
West Midlands	100	100	100	100	83	94	96	85
England	**100**	**100**	**100**	**100**	**85**	**78**	**91**	**31**
N Ireland	100	100	100	100	96	96	96	89
Wales	100	100	100	100	88	91	94	93
Overall	**100**	**100**	**100**	**100**	**84**	**79**	**91**	**36**

b. in women aged 50-70 at their most recent routine screen.

	Screening History				Pathology			
	Order of most recent routine screen	Type of most recent routine screen	Recalled for assessment at most recent routine screen	Result of most recent routine screen	Size	Nodal status	Grade	Stage
East Midlands	100	100	100	100	86	86	86	0
East of England	100	100	100	100	93	67	95	67
London	100	100	100	100	76	51	77	0
NEYH	100	100	100	99	88	74	94	7
North West	100	100	100	100	80	77	89	49
South East Coast	100	100	100	100	75	71	88	0
South Central	100	99	99	99	86	81	94	60
South West	100	100	100	100	92	91	96	3
West Midlands	100	100	100	100	84	94	97	86
England	**100**	**100**	**100**	**100**	**85**	**77**	**91**	**31**
N Ireland	100	100	100	100	95	92	95	88
Wales	100	100	100	100	89	92	95	93
Overall	**100**	**100**	**100**	**100**	**85**	**79**	**91**	**36**

Table 6 Percentage of large (>20 mm), high-grade, and node-positive invasive cancers for cancers with available pathology data (year of most recent routine screen: 2003-04).

Region	Size >20 mm	Node Positive	Grade 3
East Midlands	41.4	44.1	49.6
East of England	38.6	54.9	43.9
London	40.2	65.7	44.1
NEYH	41.4	54.0	45.0
North West	45.2	36.4	45.0
South East Coast	54.9	40.8	51.6
South Central	40.7	44.0	36.2
South West	41.2	47.1	46.3
West Midlands	52.7	46.6	45.5
England	**47.5**	**44.0**	**45.4**
Northern Ireland	59.4	52.9	53.0
Scotland	46.8	88.7	51.6
Wales	37.6	44.6	34.9
Overall	**48.1**	**46.2**	**45.4**

Table 7 Percentage of large (>20 mm), high-grade, and node-positive invasive cancers for cancers with available pathology data (year of most recent routine screen 2004-05).

a. in women aged 50-64 at their most recent routine screen.

Region	Size >20 mm	Node Positive	Grade 3
East Midlands	47.1	38.4	51.0
East of England	46.7	41.8	50.5
London	46.3	57.0	47.2
NE, Yorkshire & Humber	48.9	45.5	48.3
North West	49.2	45.3	52.2
South East Coast	55.5	46.5	44.3
South Central	54.1	50.2	53.5
South West	49.7	38.5	44.5
West Midlands	47.9	43.3	45.0
England	**49.2**	**44.4**	**48.4**
Northern Ireland	55.8	36.5	45.3
Wales	49.7	41.9	40.0
Overall	**50.0**	**44.0**	**47.8**

b. in women aged 50-70 at their most recent routine screen.

Region	Size >20 mm	Node Positive	Grade 3
East Midlands	48.3	38.9	51.3
East of England	48.2	42.8	49.6
London	46.6	58.2	46.7
NEYH	50.2	43.4	46.4
North West	50.5	45.3	51.1
South East Coast	55.0	46.6	43.5
South Central	52.3	48.4	53.7
South West	49.0	39.7	45.2
West Midlands	47.5	42.4	46.0
England	**49.6**	**44.2**	**48.0**
Northern Ireland	55.7	36.0	45.5
Wales	50.5	40.6	41.8
Overall	**49.8**	**43.7**	**47.6**

4. INTERVAL CANCER RATES

4.1 Invasive interval cancer rates for the screening year 2003-04

The overall rate of invasive interval cancers in women aged 50-64 whose most recent screen fell during the screening year 2003-04 was 2.97 cases per 1,000 women screened (Tables 8 and 9).

- Regional rates ranged from 2.44 per 1,000 women in London to 3.43 per 1,000 women in Scotland.
- The interval rate in the period 0-<12 months after a negative screen was 0.55 per 1,000 women screened (Figure 2a). The rate ranged from 0.49 for Northern Ireland to 0.64 in South Central (Figure 3).
- The rate of invasive interval cancers in the second year (12-<24 months) after a negative screen was 1.14 (0.88 in NEYH to 1.36 in Scotland) per 1,000 women screened.
- In the third year, the interval rate was 1.29 (0.92 in South East Coast and 1.52 in Scotland) per 1,000 women screened.
- The overall rate over the first two years following a negative screen was 1.68 (1.40 in NEYH to 1.91 in Scotland) per 1,000 women screened.

The variation in the range of interval cancer rates between regions during the first 0-24 months after screening was half that observed over the full 0-36 months. This suggests that the variation in overall interval cancer rates is at least as attributable to variation in average interval length as it is to regional variation in underlying breast cancer incidence or in propensity to detect cancer. Therefore, for a region aiming to reduce overall interval cancer rates, controlling the length of the interval between screens must be a priority.

4.2 Invasive interval cancer rates for the screening year 2004-05

The overall rate of invasive interval cancers for the screening year 2004-05 was 2.67 per 1,000 women screened for both women aged 50-64 and women aged 50-70 at their most recent routine screen. The overall rates of interval cancers, as well as the rates over each year following a negative screen, were therefore lower in 2004-5 than in 2003-04. Where two rates are stated below, the first rate is for women aged 50-64, the second for women aged 50-70.

- The regional range over the three years (0-<36 months) following a negative screen varied from 2.09 / 2.10 for NEYH to 2.99 / 3.00 per 1,000 women for Northern Ireland (Table 9).
- The overall interval cancer rate during the first year (0-<12 months after a negative screen) was 0.46 cases per 1,000 women screened for both 50-64 and 50-70 year olds. Regional data ranged from 0.34 cases per 1,000 women screened in both age groups for NEYH, to 0.57 / 0.60 cases per 1,000 women screened for West Midlands.
- The interval cancer rate during the second year (12-<24 months after a negative screen in 2004-05) was also slightly lower than that for women last screened during 2003-04: 1.02 / 1.01 per 1,000 women screened. The rates were lowest for NEYH (0.84 / 0.82) and highest for West Midlands (1.14 / 1.13 per 1,000 women).
- In the third year (24-<36 months after a negative screen), the interval rate was 1.19 per 1,000 women screened over both age groups (0.91 / 0.93 for NEYH, 1.63 / 1.61 for Northern Ireland).

- During 2004-05, NEYH had the lowest rates for all three years. Again, the variation in rate between regions was considerably greater for the full 0-<36 month period following a negative screen than for the 0-<24 month period.

4.3 Interval cancer rates for all cancer types

The overall rate of interval breast cancers for all cancer types (including non-invasive and micro-invasive cases) over the full three years (0-<36 months) after a negative screen was 3.14 per 1,000 screened women for women whose most recent screen fell in 2003-04, and 2.82 per 1,000 screened women for women whose most recent screen fell in 2004-05 (Tables 10 and 11 and Figures 2b and 4b).

All QARCs provided data on non-invasive cancers, apart from Northern Ireland. Including non-invasive cancers in the interval cancer rate increased the yearly regional rates by up to 0.1, and the total regional rates by between 0.1 and 0.3 per 1,000 women screened. As with invasive cancer cases, the overall rates of all cancers after a negative screen showed considerably less regional variation over the first 0-24 months after a negative screen that over the full 0-36 months. Again, this indicates that a promising approach to controlling the overall incidence of interval cancers would be to regulate interval length.

4.4 Discussion

Rates for both invasive cancers and all cancer types vary considerably by region. To some extent, this reflects geographic variation in the age-standardised incidence of breast cancer within the UK, although London has lower interval cancer rates than some might expect, given its age-standardised incidence.

The figures show that rates increase sharply with time over the first and second years after screening (0-<24 months), but considerably less steeply during the third year (24-<36 months) after a negative screen. One would not normally expect to see such a plateau in the data until the interval cancer rates approached the expected incidence rate in the absence of screening (around 2-3 cases per 1,000 women per year). When the data for women whose most recent screen fell in 2003-04 are broken down into individual months, a steep increase in the incidence of interval cancers can be seen in data from the first year, with a slight levelling off during the second year (Figure 8a). In the third year, however, interval cancer incidence reaches its highest point for the whole three years at month 26, but then drops rapidly to levels as low as those seen during the first year after screening. For the screening year 2004-05 (Figure 8b) a more steady increase in interval cancer incidence can be observed until 32 months after screening, when incidence starts to fall. These results suggest that many units are running round lengths that are below 36 months.

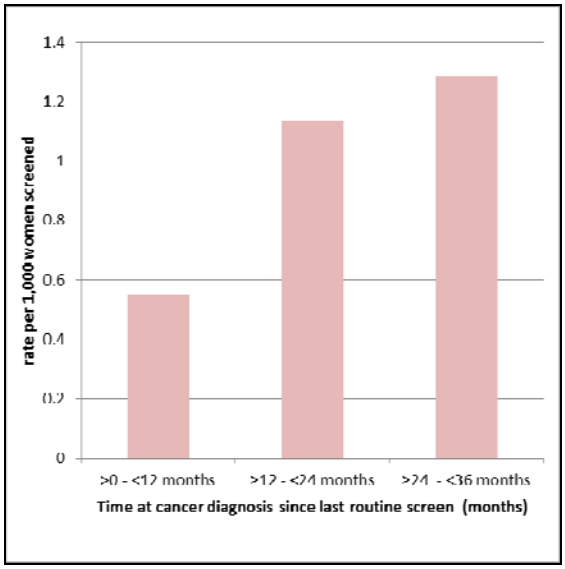
It is also worth noting that the proportional rates of interval cancers 0-12 months and 12-24 months after screening are comparable to those seen in the Swedish Two-County Trial, the study that provided the model for the UK Programme.[7] In the Swedish trial, average interval cancer incidence rates over the first and second years after a negative screen for women aged 50-69 were respectively 17% and 31% of the incidence observed in the absence of screening (estimated from the trial's control group). In Table 11b here, the interval cancer rates (all cancer types) for women aged 50-70 whose most recent screen fell in 2004-05 were 0.49 and 1.08 per 1,000 women. The expected incidence in this age group in the early 2000s, calculated from pre-screening trends, is around 3.4 cases per 1000 women per year.[8] Thus, the proportional incidence of interval cancers is 14% and 32% of the rate that would exist in the absence of screening for years 1 and 2 following a negative screen respectively. In the early years of the UK screening programme, the high interval cancer incidence in comparison with the Two-County Trial was a cause for concern.[8] These rates indicate that this situation has been rectified.

Table 8 Interval cancer rates for all invasive cancers by time since most recent screen in women aged 50-64 whose most recent routine screen fell in 2003-04.

Region	Women screened	>0 -<12 months		≥12 -<24 months		≥24 -<36 months		>0 -<24 months		>0 -<36 months	
	n	n	rate*	n	rate*	n	rate*	n	rate*	n	rate*
East Midlands	106072	55	0.52	100	0.94	134	1.26	155	1.46	289	2.72
East of England	139629	84	0.60	178	1.27	208	1.49	262	1.88	470	3.37
London	129280	77	0.60	118	0.91	121	0.94	195	1.51	316	2.44
NEYH	187411	98	0.52	164	0.88	217	1.16	262	1.40	479	2.56
North West	153221	82	0.54	192	1.25	233	1.52	274	1.79	507	3.31
South East Coast	104498	61	0.58	115	1.10	96	0.92	176	1.68	272	2.60
South Central	102511	66	0.64	122	1.19	124	1.21	188	1.83	312	3.04
South West	124219	67	0.54	136	1.09	168	1.35	203	1.63	371	2.99
West Midlands	125776	66	0.52	160	1.27	176	1.40	226	1.80	402	3.20
England	**1172617**	**656**	**0.56**	**1285**	**1.10**	**1477**	**1.26**	**1941**	**1.66**	**3418**	**2.91**
Northern Ireland	38936	19	0.49	51	1.31	53	1.36	70	1.80	123	3.16
Scotland	121606	67	0.55	165	1.36	185	1.52	232	1.91	417	3.43
Wales	67464	28	0.42	89	1.32	86	1.27	117	1.73	203	3.01
Overall	**1400623**	**770**	**0.55**	**1590**	**1.14**	**1801**	**1.29**	**2360**	**1.68**	**4161**	**2.97**

* per 1,000 women screened

a Invasive cancers only.



b All cancers (including unknown, non-invasive and micro-invasive).

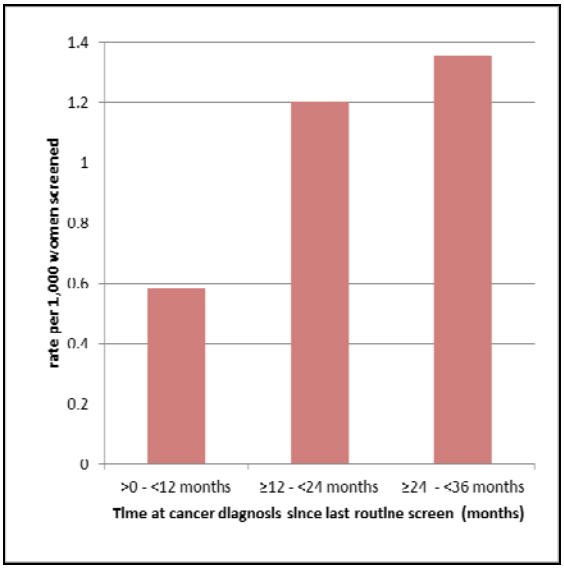


Figure 2 Interval cancer rates over the 0-<36 month period after a negative screen by time after screen in women aged 50-64 at their most recent routine screen in 2003-04.

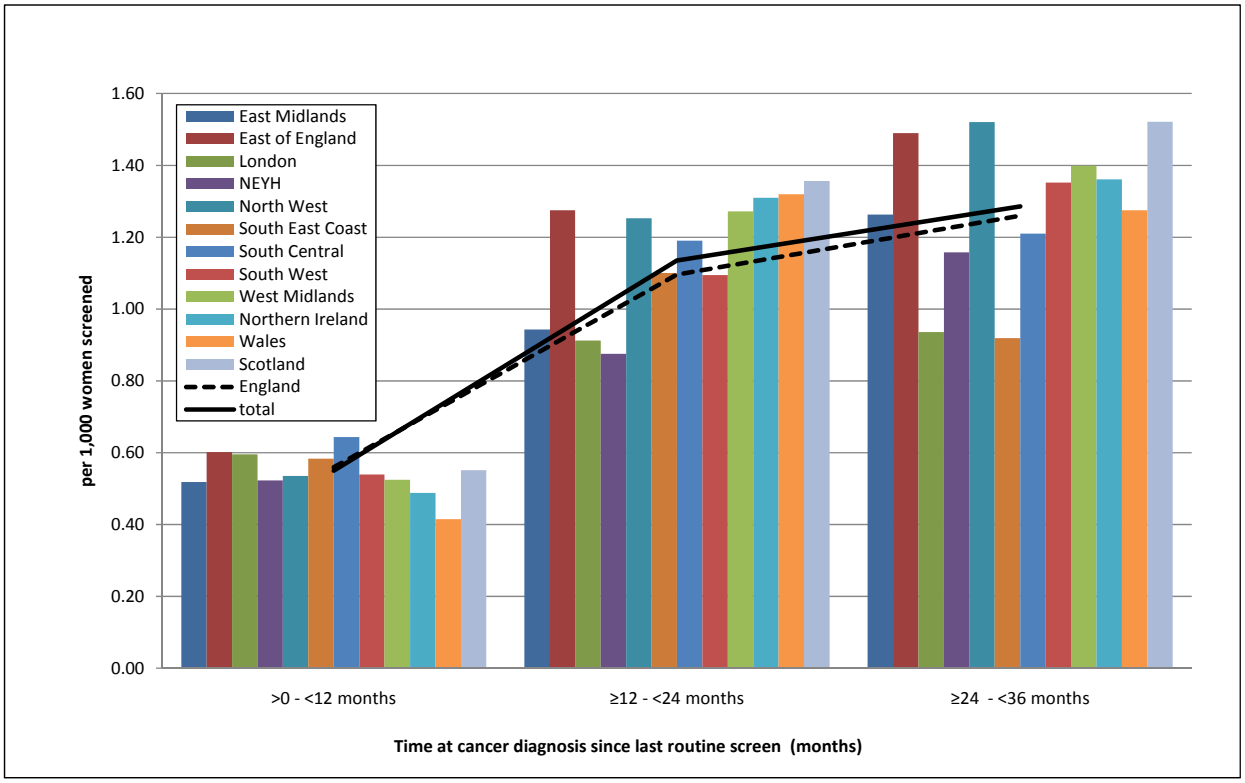


Figure 3 Invasive interval cancer rates in the 0-<36 month period after a negative screen, by time after screen and by region in women aged 50-64 at their most recent routine screen during 2003-04.

Table 9 Interval cancer rates for all invasive cancers by time since most recent screen for the screening year 2004-05.

a. in women aged 50-64 at their most recent routine screen.

Region	Women screened	>0 - <12 months		≥12 - <24 months		≥24 - <36 months		>0 - <24 months		>0 - <36 months	
	n	n	rate*	n	rate*	n	rate*	n	rate*	n	rate*
East Midlands	105020	43	0.41	119	1.13	135	1.29	162	1.54	297	2.83
East of England	128211	51	0.40	143	1.12	147	1.15	194	1.51	341	2.66
London	127855	56	0.44	112	0.88	154	1.20	168	1.31	322	2.52
NEYH	202973	70	0.34	170	0.84	185	0.91	240	1.18	425	2.09
North West	151940	69	0.45	143	0.94	225	1.48	212	1.40	437	2.88
South East Coast	109754	61	0.56	115	1.05	139	1.27	176	1.60	315	2.87
South Central	98956	55	0.56	108	1.09	93	0.94	163	1.65	256	2.59
South West	126242	67	0.53	148	1.17	146	1.16	215	1.70	361	2.86
West Midlands	134215	77	0.57	153	1.14	166	1.24	230	1.71	396	2.95
England	**1185166**	**549**	**0.46**	**1211**	**1.02**	**1390**	**1.17**	**1760**	**1.49**	**3150**	**2.66**
Northern Ireland	30146	15	0.50	26	0.86	49	1.63	41	1.36	90	2.99
Wales	70932	33	0.47	71	1.00	92	1.30	104	1.47	196	2.76
Overall	**1286244**	**597**	**0.46**	**1308**	**1.02**	**1531**	**1.19**	**1905**	**1.48**	**3436**	**2.67**

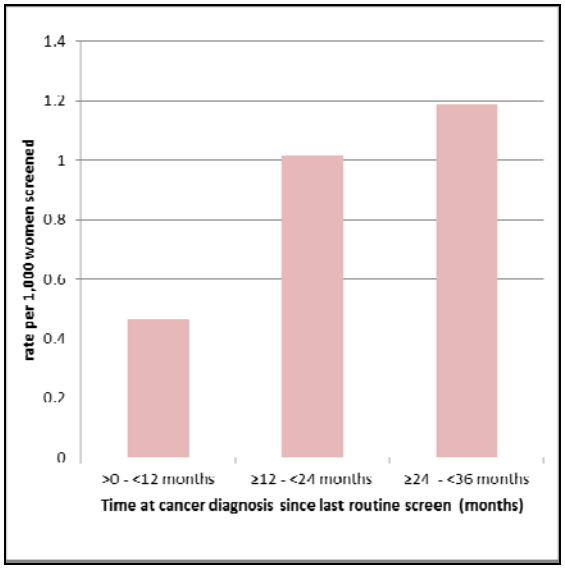
* per 1,000 women screened

b. in women aged 50 - 70 at their most recent routine screen.

Region	Women screened	>0 - <12 months		≥12 - <24 months		≥24 - <36 months		>0 - <24 months		>0 - <36 months	
	n	n	rate*	n	rate*	n	rate*	n	rate*	n	rate*
East Midlands	125219	51	0.41	141	1.13	159	1.27	192	1.53	351	2.80
East of England	160994	62	0.39	176	1.09	171	1.06	238	1.48	409	2.54
London	145460	66	0.45	127	0.87	176	1.21	193	1.33	369	2.54
NEYH	244099	83	0.34	201	0.82	228	0.93	284	1.16	512	2.10
North West	183190	81	0.44	171	0.93	273	1.49	252	1.38	525	2.87
South East Coast	127920	73	0.57	133	1.04	166	1.30	206	1.61	372	2.91
South Central	113091	60	0.53	129	1.14	116	1.03	189	1.67	305	2.70
South West	146907	78	0.53	163	1.11	181	1.23	241	1.64	422	2.87
West Midlands	157810	95	0.60	178	1.13	189	1.20	273	1.73	462	2.93
England	**1404690**	**649**	**0.46**	**1419**	**1.01**	**1659**	**1.18**	**2068**	**1.47**	**3727**	**2.65**
Northern Ireland	30963	15	0.48	28	0.90	50	1.61	43	1.39	93	3.00
Wales	79237	38	0.48	86	1.09	101	1.27	124	1.56	225	2.84
Overall	**1514890**	**702**	**0.46**	**1533**	**1.01**	**1810**	**1.19**	**2235**	**1.48**	**4045**	**2.67**

* per 1,000 women screened

a. Invasive cancers only.



b. All cancers (including unknown, non-invasive, and micro-invasive).

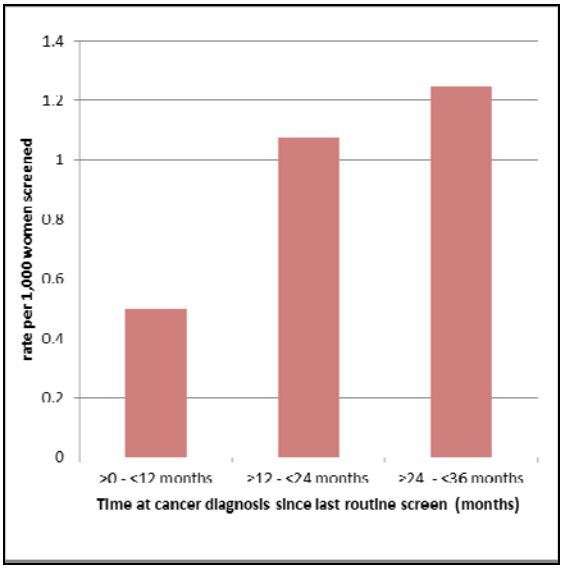


Figure 4 Interval cancer rates in the 0-<36 month period after a negative screen, by time after screen in women aged 50-64 at their most recent routine screen in 2004-05.

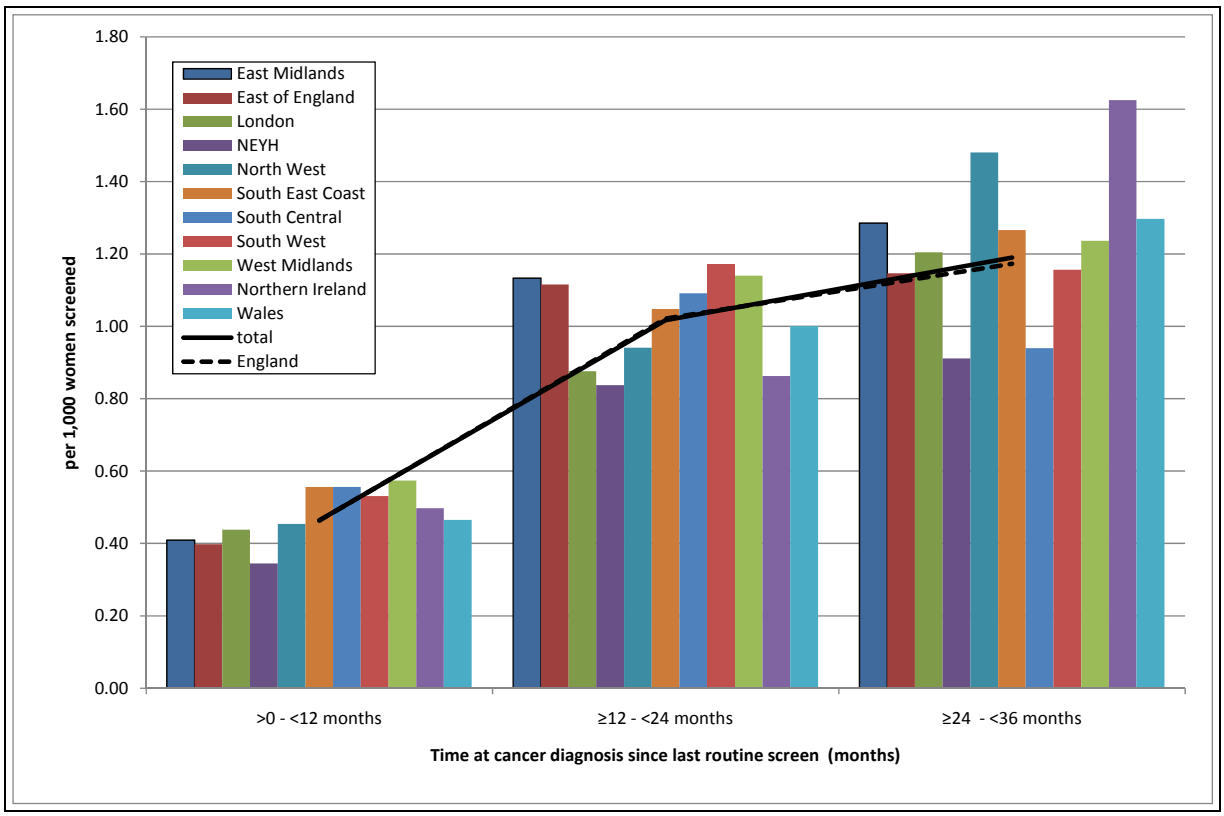
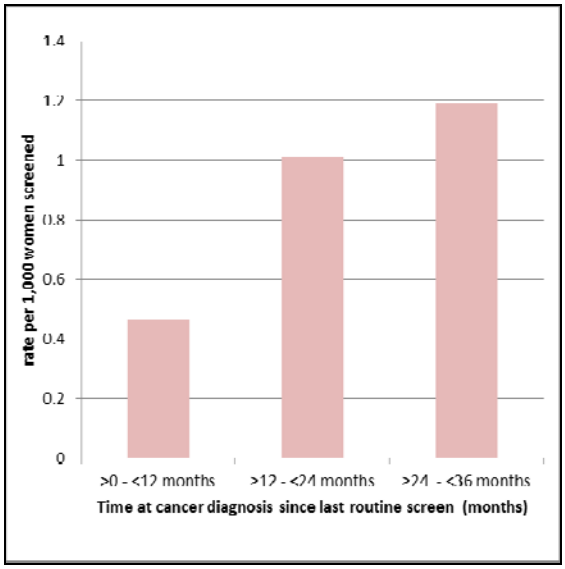


Figure 5 Invasive interval cancer rates over the 0-<36 month period after a negative screen, by time after screen and by region in women aged 50-64 at their most recent routine screen during 2004-05.

a. Invasive cancers only.



b. All cancers (including unknown, non-invasive, and micro-invasive).

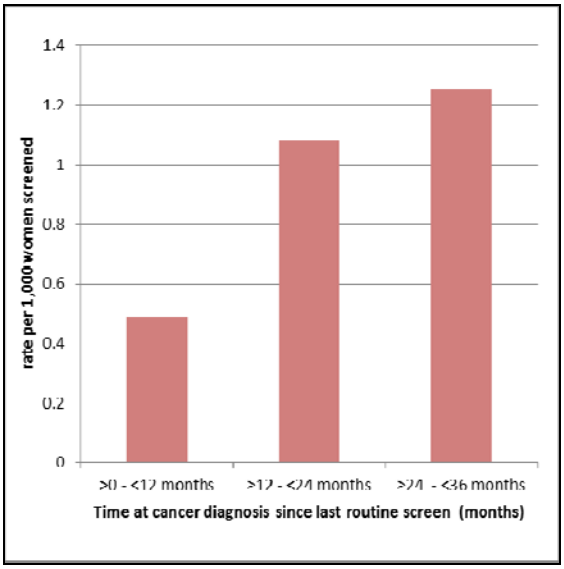


Figure 6 Interval cancer rates in the 0-<36 month period after a negative screen by time after screen in women aged 50-70 at their most recent routine screen during 2004-05.

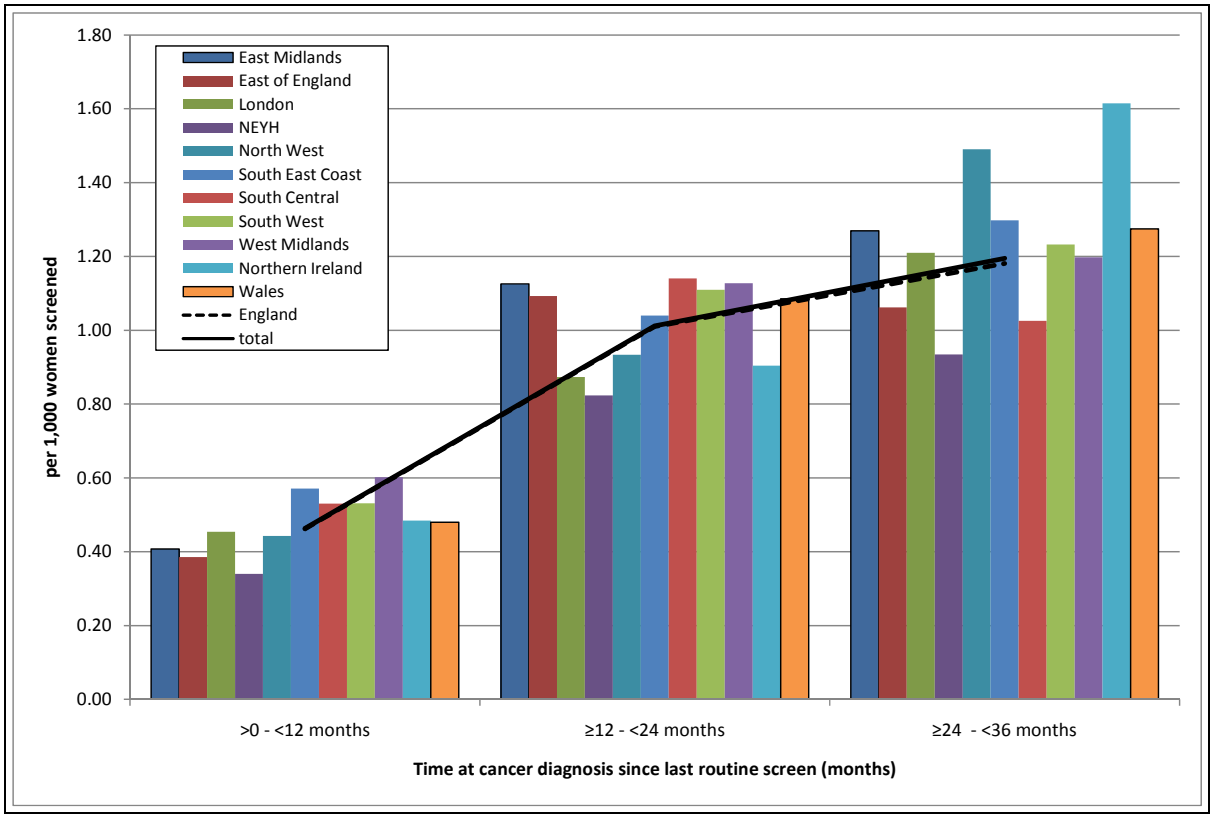


Figure 7 Invasive interval cancer rates in the 0-<36 month period after a negative screen, by time after screen and by region in women aged 50-70 at their most recent routine screen during 2004-05.

Table 10 Interval cancer rates for all cancers (invasive, non-invasive, micro-invasive, and unknown invasive status) by time since most recent screen, in women aged 50-64 at their most recent routine screen during 2003-04.

Region	Women screened	>0 - <12 months		≥12 - <24 months		≥24 - <36 months		>0 - <24 months		>0 - <36 months	
	n	n	rate*	n	rate*	n	rate*	n	rate*	n	rate*
East Midlands	106072	58	0.55	111	1.05	145	1.37	169	1.59	314	2.96
East of England	139629	92	0.66	188	1.35	220	1.58	280	2.01	500	3.58
London	129280	78	0.60	126	0.97	126	0.97	204	1.58	330	2.55
NEYH	187411	106	0.57	174	0.93	228	1.22	280	1.49	508	2.71
North West	153221	83	0.54	196	1.28	239	1.56	279	1.82	518	3.38
South East Coast	104498	69	0.66	128	1.22	104	1.00	197	1.89	301	2.88
South Central	102511	70	0.68	127	1.24	129	1.26	197	1.92	326	3.18
South West	124219	70	0.56	152	1.22	181	1.46	222	1.79	403	3.24
West Midlands	125776	74	0.59	166	1.32	183	1.45	240	1.91	423	3.36
England	**1172617**	**700**	**0.60**	**1368**	**1.17**	**1555**	**1.33**	**2068**	**1.76**	**3623**	**3.09**
Northern Ireland	38936	19	0.49	51	1.31	53	1.36	70	1.80	123	3.16
Scotland	121606	69	0.57	171	1.41	199	1.63	240	1.97	439	3.60
Wales	67464	30	0.44	95	1.41	91	1.35	125	1.85	216	3.20
Overall	**1400623**	**818**	**0.58**	**1685**	**1.20**	**1897**	**1.35**	**2503**	**1.79**	**4400**	**3.14**

* per 1,000 women screened

Table 11 Interval cancer rates for all cancers (invasive, non-invasive, micro-invasive, and unknown invasive status) by time since most recent screen for the screening year 2004-05.

a. in women aged 50-64 at their most recent routine screen.

Region	Women screened	>0 - <12 months		≥12 - <24 months		≥24 - <36 months		>0 - <24 months		>0 - <36 months	
	n	n	rate*	n	rate*	n	rate*	n	rate*	n	rate*
East Midlands	105020	45	0.43	126	1.20	142	1.35	171	1.63	313	2.98
East of England	128211	55	0.43	149	1.16	152	1.19	204	1.59	356	2.78
London	127855	59	0.46	116	0.91	165	1.29	175	1.37	340	2.66
NEYH	202973	74	0.36	180	0.89	195	0.96	254	1.25	449	2.21
North West	151940	74	0.49	157	1.03	231	1.52	231	1.52	462	3.04
South East Coast	109754	65	0.59	124	1.13	150	1.37	189	1.72	339	3.09
South Central	98956	60	0.61	112	1.13	98	0.99	172	1.74	270	2.73
South West	126242	74	0.59	158	1.25	155	1.23	232	1.84	387	3.07
West Midlands	134215	82	0.61	159	1.18	169	1.26	241	1.80	410	3.05
England	**1185166**	**588**	**0.50**	**1281**	**1.08**	**1457**	**1.23**	**1869**	**1.58**	**3326**	**2.81**
Northern Ireland	30146	15	0.50	26	0.86	49	1.63	41	1.36	90	2.99
Wales	70932	34	0.48	77	1.09	96	1.35	111	1.56	207	2.92
Overall	**1286244**	**637**	**0.50**	**1384**	**1.08**	**1602**	**1.25**	**2021**	**1.57**	**3623**	**2.82**

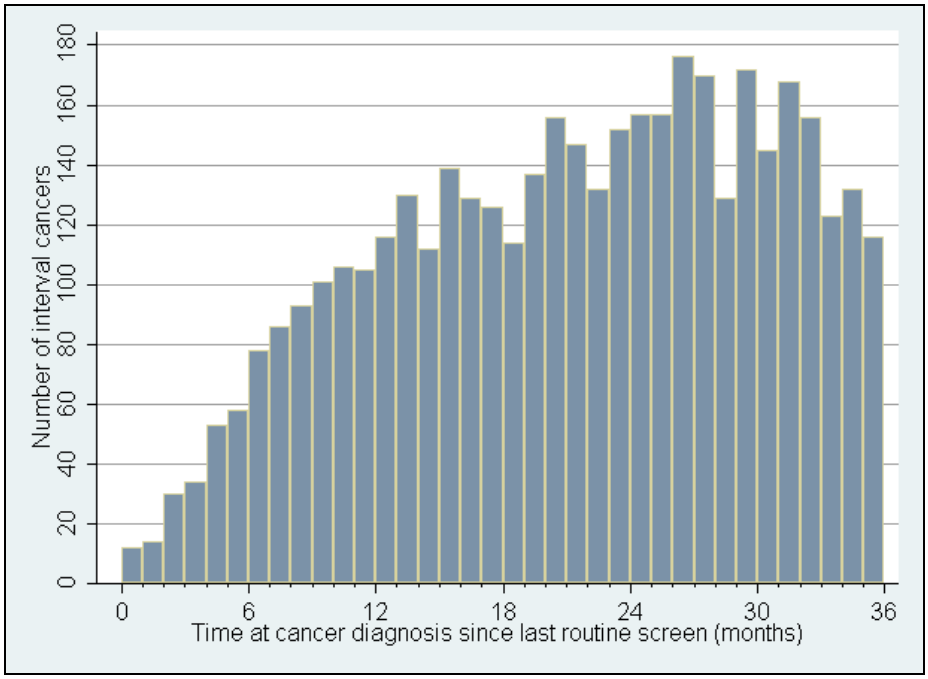
* per 1,000 women screened

b. in women aged 50-70 at their most recent routine screen.

Region	Women screened	>0 - <12 months		≥12 - <24 months		≥24 - <36 months		>0 - <24 months		>0 - <36 months	
	n	n	rate*	n	rate*	n	rate*	n	rate*	n	rate*
East Midlands	125219	54	0.43	150	1.20	167	1.33	204	1.63	371	2.96
East of England	160994	66	0.41	187	1.16	177	1.10	253	1.57	430	2.67
London	145460	69	0.47	132	0.91	189	1.30	201	1.38	390	2.68
NEYH	244099	87	0.36	213	0.87	239	0.98	300	1.23	539	2.21
North West	183190	86	0.47	188	1.03	282	1.54	274	1.50	556	3.04
South East Coast	127920	77	0.60	146	1.14	179	1.40	223	1.74	402	3.14
South Central	113091	66	0.58	135	1.19	121	1.07	201	1.78	322	2.85
South West	146907	86	0.59	176	1.20	191	1.30	262	1.78	453	3.08
West Midlands	157810	100	0.63	187	1.18	196	1.24	287	1.82	483	3.06
England	**1404690**	**691**	**0.49**	**1514**	**1.08**	**1741**	**1.24**	**2205**	**1.57**	**3946**	**2.81**
Northern Ireland	30963	15	0.48	28	0.90	50	1.61	43	1.39	93	3.00
Wales	79237	39	0.49	92	1.16	106	1.34	131	1.65	237	2.99
Overall	**1514890**	**745**	**0.49**	**1634**	**1.08**	**1897**	**1.25**	**2379**	**1.57**	**4276**	**2.82**

* per 1,000 women screened

a. for the screening year 2003-04



b. for the screening year 2004-05

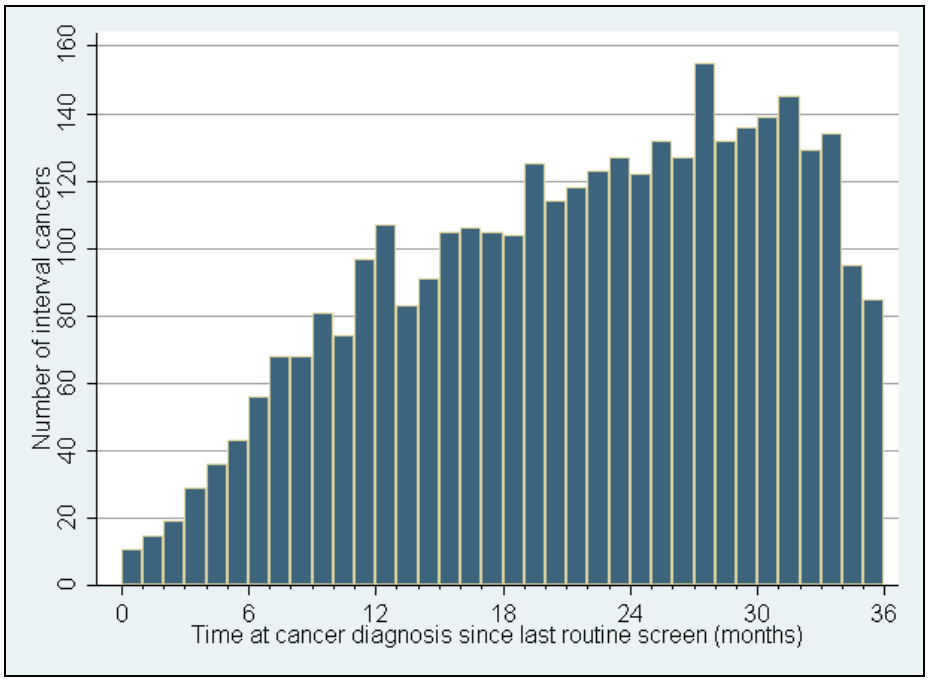


Figure 8 Number of interval cancers diagnosed by month since most recent screen

5. INTERVAL CANCER RATES OVER TIME

Table 12 and Figure 9 show interval cancer rates over time. This figure combines the interval cancer rates published by Bennett et al. for the time period 1 April 1997-31 March 2003 with the rates analysed in this report.[5]

The rates are relatively constant until 2004-05, when they decline substantially. This is likely to reflect the introduction of two-view mammography. If data for Scotland from 2004-05 were available, this could be concluded with more certainty, since Scotland had not introduced two-view screening at that time.

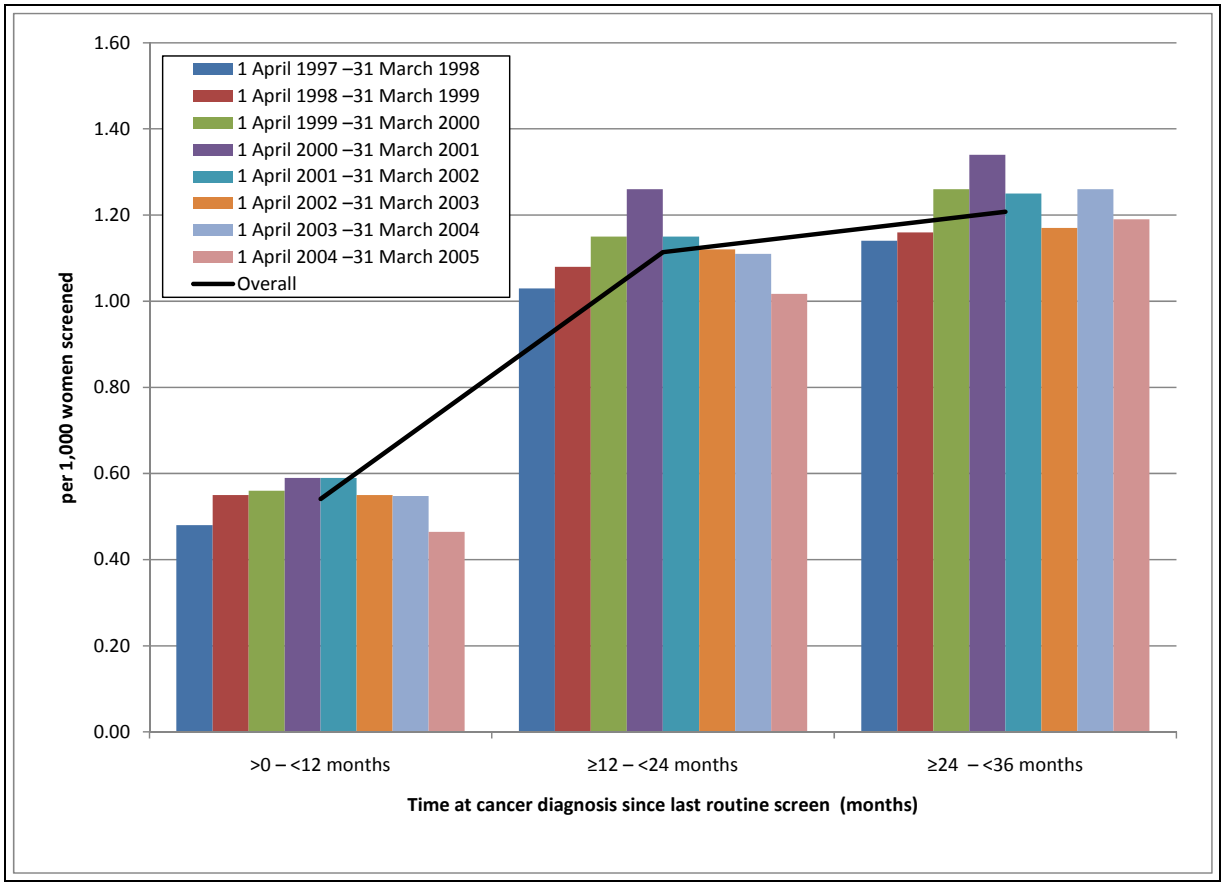


Figure 9 Interval cancer rates for all invasive cancers in women aged 50-64 at their most recent routine screen, by time since most recent screen and screening year.

Table 12 Interval cancer rates for all invasive cancers in women aged 50-64 at their most recent routine screen, by time since most recent screen and screening year.

		>0 – <12 months			≥12 – <24 months			≥24 – <36 months			>0 – <36 months		
Year of most recent routine screen	Women screened	n	/1000	Regional range	n	/1000	Regional range	n	/1000	Regional range	n	/1000	Regional range
1 April 1997-31 March 1998*	1,148,986	555	0.48	0.17 – 0.71	1180	1.03	0.56 –1.56	1311	1.14	0.75 – 1.71	3046	2.65	1.62 – 3.78
1 April 1998-31 March 1999*	1,192,474	651	0.55	0.24 – 0.84	1284	1.08	0.71 – 1.42	1379	1.16	0.76 – 1.62	3314	2.78	1.81 – 3.84
1 April 1999-31 March 2000*	1,262,681	707	0.56	0.38 – 0.77	1450	1.15	0.81 – 1.47	1597	1.26	0.69 – 1.74	3754	2.97	1.94 – 3.81
1 April 2000-31 March 2001*	1,247,661	733	0.59	0.38 – 0.84	1568	1.26	0.85 – 1.80	1670	1.34	0.88 – 1.69	3971	3.18	2.34 – 4.29
1 April 2001-31 March 2002*	1,211,972	711	0.59	0.35 – 0.84	1398	1.15	0.88 – 1.45	1516	1.25	0.93 – 1.63	3625	2.99	2.33 – 3.81
1 April 2002-31 March 2003*	1,256,874	691	0.55	0.37 – 0.69	1409	1.12	0.78 – 1.45	1471	1.17	0.85 – 1.54	3571	2.84	2.03 – 3.56
Overall (1 April 1997-31 March 2003)*	**7,320,648**	**4840**	**0.55**	**0.43 – 0.76**	**8289**	**1.13**	**0.92 – 1.47**	**8944**	**1.22**	**0.93 – 1.57**	**21281**	**2.91**	**2.28 – 3.79**
1 April 2003-31 March 2004	1,279,017	703	0.55	0.42 – 0.64	1425	1.11	0.88 – 1.32	1616	1.26	0.92 – 1.52	3744	2.93	2.04 – 3.37
1 April 2003-31 March 2004 incl. Scotland	1,400,623	770	0.55	0.42 – 0.64	1590	1.14	0.88 – 1.36	1801	1.29	0.92 – 1.52	4161	2.97	2.44 – 3.43
1 April 2004-31 March 2005	1,286,244	597	0.46	0.34 – 0.57	1308	1.02	0.84 – 1.17	1531	1.19	0.91 – 1.63	3436	2.67	2.09 – 2.99
Overall (without Scotland) 1 April 1997 - 31 March 2005	**9,885,909**	**5348**	**0.54**		**11022**	**1.11**		**12091**	**1.22**		**28461**	**2.88**	

* BJC data does not include Scotland. n/a, not available.

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