

Chapter 4. COLORECTAL CANCER

Summary

Trends in incidence, mortality and patient/tumour characteristics

Numbers of cases, but not deaths, showed a significant upward trend between 1994 and 2001. Age-standardized incidence rates appeared to be stable; increases in case-numbers largely reflected population increases and ageing. Age-standardized mortality rates declined significantly for females but not for males.

Overall, there was little evidence of any move towards earlier detection of colorectal cancers or improvements in the completeness or specificity of diagnostic and prognostic investigations.

Survival

1994-2001 average

Relative survival to five years after diagnosis was estimated as 49.2% (95% CI 48.1-50.3%) for 1994-2001 as a whole; 48.1% (46.6-49.5%) for males, 50.7% (49.1-52.2%) for females.

Survival trends

Five-year survival showed a clear improvement from 47.7% (95% CI 46.1-49.1%) for cases diagnosed during 1994-97 to 51.0% (49.3-52.6%) for 1998-2001. This improvement was also evident (and statistically significant) after adjustment for age, stage and other variables. It involved a 10% reduction in age-adjusted excess risk of death (i.e. the risk having allowed for expected background mortality), or a 22% reduction in excess risk after adjustment for other tumour or patient variables. Only the Western region showed a significant increase in relative survival between diagnosis-periods 1994-97 and 1998-2001, but the trends in most regions were consistent with the national improvement in survival.

Much of the improvement in survival seems likely to reflect improvements in the quality of treatment and in proportions of patients receiving appropriate treatment. Data indicating increased chemotherapy and radiotherapy use, in particular, may support this. Further improvements in survival can be expected once screening becomes more widespread.

Regional variation in survival

Taking account of a wide range of patient and tumour characteristics, three regions had a

significantly high excess risk of death during 1994-2001: Mid-Western (15% higher than Eastern), Southern (24% higher) and South-Eastern (10% higher). Only the Southern region had significantly low survival (high excess risk) for 1994-97 cases, and the Southern and Mid-Western regions for 1998-2001 cases. Adjustment for patient and tumour characteristics appeared to moderate the extent and magnitude of regional variation in survival to some extent. The remaining variation may be accounted for by unmeasured variables, or regional variation in treatment, or both. Patients from the two regions with the highest excess mortality risk (Mid-Western and Southern) were the least likely to receive chemotherapy and radiotherapy.

International comparison of survival

Five-year relative survival estimates for Irish men and women diagnosed with colorectal cancer during 1994-97 were similar to or slightly lower than European averages based on cases diagnosed during 1990-94.

Treatment

Proportions of patients treated: main modalities and combinations

83% of cases diagnosed during 1994-2001 had some form of definitive or tumour-directed treatment within six months of diagnosis, 77% had surgical treatment, 28% had chemotherapy and 12% had radiotherapy. Equivalent figures for 1998-2001 were 84% treated, 77% surgery, 33% chemotherapy and 14% radiotherapy. The most frequent treatments or combinations were surgery only (51% of cases 1994-2001), surgery plus chemotherapy (18%), and surgery plus chemotherapy plus radiotherapy (6.1%).

Region of treatment versus region of residence

The majority of patients resident in each region had their main surgical treatment in the same region, ranging from 75% of surgical patients from the North-Eastern region to 99% of those from the Southern region.

Hospital caseloads

59 hospitals treated colorectal cancers surgically during 1994-2001. There was no strong evidence of any trend in numbers of hospitals providing surgical treatment. About one-fifth of hospitals in any given year treated fewer than 10 surgical cases

each; two-fifths treated fewer than 20, and over three-quarters treated fewer than 50 cases. There was a modest tendency for average hospital caseload to increase during the period 1994-2001. Significant declines were seen in the proportions of surgical cases treated in 'low volume' hospitals (if defined using thresholds of <10 and <50 cases annually, but not using <20 cases).

Surgical consultant caseloads

At least 293 individual consultants were responsible for surgical management of colorectal cancers during 1994-2001, 197 in 1994-97 and 241 during 1998-2001. About one-quarter of surgical consultants in any given year treated fewer than 10 surgical cases each, and over half treated fewer than 20 surgical cases. There was some evidence of a decline in the proportion of patients treated by consultants with low average caseloads.

Treatment trends

Use of surgery, nationally, fell significantly between 1996 and 2001, by about 1.5% annually after adjustment for age and stage. Significant age-adjusted declines were seen for the Midland (3.8% per year) and North-Eastern regions (2.4%).

Radiotherapy use increased between 1996 and 2001, by 11% annually overall and 16-43% annually in four of the eight regions (Midland, North-Eastern, Southern and South-Eastern) (adjusted for age and sex).

The proportion of patients having chemotherapy also increased (by 13% annually between 1996 and 2001) after adjustment for age, sex, and stage. Similar or more marked (age- and sex-adjusted) increases were seen for five regions (Eastern, North-Eastern, Southern, South-Eastern and Western), by 10-31% annually.

Regional variation in treatment

For 1994-2001, there was significantly low use of surgery in patients from the Midland and South-Eastern regions and significantly high use in those from the Mid-Western and Western regions, compared with the Eastern region, adjusted for age, stage and other variables. Regional variation was less marked for cases diagnosed during 1998-2001 than for 1994-97.

Patients from the Mid-Western, North-Eastern, Southern and Western regions were significantly (and substantially) less likely to have radiotherapy than those from the Eastern region during 1994-2001. Variation appeared to be more marked in the 1994-97 diagnosis period. During 1998-2001, patients from the Midland region were more likely

to have radiotherapy than those from the Eastern region, a reversal of the pattern seen in the earlier period.

There was significantly low use of chemotherapy among patients from the Mid-Western and Southern regions (24-29% lower than patients from the Eastern region), and significantly high use among those from the North-Western and South-Eastern regions (26-31% higher)

Interpreting the variations seen in treatment, and the extent to which they can be accounted for by patient or tumour characteristics, is difficult. Some relevant variables may not have been measured or included. However, it seems likely that a substantial proportion of the variation in radiotherapy and chemotherapy use for colorectal cancer reflects regional or institutional differences in the extent to which given treatments were offered or provided.

International comparison of treatment

For both colon and rectal cancer, Irish patients were significantly less likely to receive overall treatment or surgical treatment than in the USA during 1998-2001. For rectal cancer, significantly smaller proportions of Irish patients had radiotherapy and chemotherapy but more had surgery. Surgery was significantly less frequent for Irish colon cancer cases. Use of the main multimodal therapy for colon cancer (surgery plus adjuvant chemotherapy) was similar in Ireland and the US, but that for rectal cancer (surgery plus radiotherapy and chemotherapy) was less frequent in Ireland.

4.1 Incidence and mortality statistics

On average, there were 1821 cases of and 930 deaths from invasive colorectal cancer annually in Ireland during 1994-2001 (*Table 4.1.1*). Over this period, numbers of cases showed a significant upward trend, but numbers of deaths showed no significant trend. Age-standardized incidence rates

appeared to be stable, thus increases in case-numbers largely reflected population increases and ageing. Age-standardized mortality rates declined significantly for females but showed no trend for males.

Table 4.1.1 Incidence of and mortality from invasive colorectal cancer, Republic of Ireland, 1994-2001.

1994-2001	annual average numbers						age-standardized rate ^a			
	total		male		female		male		female	
Incidence (cases)	1821		1029		792		65.0		40.3	
Incidence trend (per year) ^b	+1.5%	***	+1.8%	***	+1.1%	*	+0.1%	ns	-0.3%	ns
Mortality (deaths)	930		526		404		33.2		19.1	
Mortality trend (per year)	-0.3%	ns	+0.7%	ns	-1.5%	ns	-0.8%	ns	-2.8%	*

^aEuropean age-standardized rate per 100,000 persons per year.

^bEstimated annual percentage change (ns not significant, * P<0.05, **P<0.01, ***P<0.001).

4.2 Cases included for treatment and survival analyses; patient and tumour characteristics

Analyses cover invasive cancers of the colon (ICD-10 code C18), rectosigmoid junction (C19), rectum (C20) and anus (C21), diagnosed in 13,702 persons aged 15-99 years during 1994-2001. Full details of exclusion/inclusion criteria are shown in *Table 4.2.1*.

Table 4.2.1 Summary of inclusions and exclusions for colorectal cancer analyses.

Case definition	total
all registered tumours ^a	15 685
ages 15-99 only	15 656
excluding death-certificate-only & autopsy-only cases	15 206
invasive tumours only	14 318
first tumours only ^b	13 702

^aIncluding in situ carcinomas, and tumours of unspecified behaviour, but excluding lymphomas (classified separately within ICD-10) ^bOr most serious tumour diagnosed same date.

A breakdown of basic patient and tumour characteristics is given in *Table 4.2.2*, including comparisons between diagnosis periods 1994-97 and 1998-2001. The variables and category-values shown are those considered, later in this chapter, for inclusion in statistical models aimed at describing and if possible explaining regional variation and time-trends in survival and treatment.

Statistically significant changes between 1994-97 and 1998-2001 in proportions of patients or tumours with particular characteristics were:

- Decrease in stage I cancers, increase in stage III.
- Decrease in tumours in T2 and T3 categories, increase in T4.
- Increase in node-positive cancers.
- Decrease in cases with unknown metastatic status.
- Decrease in tumours sited in colon, increase in rectum/anus.
- Decrease in grade 1 tumours, increase in grade 2 and grade unknown.
- Increase in microscopically verified (MV) cases, decrease in non-MV cases.
- Decrease in symptomatic cases, increase in screen-detected cases and unknown method of presentation.
- Decrease in patients with marital status unknown.
- Decrease in smokers, increase in patients with unknown smoking status.

Overall, these changes provide little evidence of any move towards earlier detection of colorectal cancers or improvements in the completeness or specificity of diagnostic and prognostic investigations.

Variation in patient and tumour characteristics by region of residence is summarized in *Table 4.2.3*.

Table 4.2.2 Summary of patient and tumour characteristics for colorectal cancer patients included in survival and treatment analyses, 1994-2001.

	diagnosed 1994-2001		diagnosed 1994-1997		diagnosed 1998-2001	
	number	% of cases	number	% of cases	number	% of cases
total	13702		6708		6994	
age 15-44	486	3.5%	233	3.5%	253	3.6%
age 45-54	1297	9.5%	615	9.2%	682	9.8%
age 55-64	2734	20.0%	1351	20.1%	1383	19.8%
age 65-74	4491	32.8%	2234	33.3%	2257	32.3%
age 75+	4694	34.3%	2275	33.9%	2419	34.6%
male	7768	56.7%	3786	56.4%	3982	56.9%
female	5934	43.3%	2922	43.6%	3012	43.1%
stage I	1118	8.2%	605	9.0%	513	*7.3%
stage II	2205	16.1%	1107	16.5%	1098	15.7%
stage III	1826	13.3%	829	12.4%	997	*14.3%
stage IV	2908	21.2%	1397	20.8%	1511	21.6%
stage X ^a	5645	41.2%	2770	41.3%	2875	41.1%
T1	702	5.1%	356	5.3%	346	4.9%
T2	2043	14.9%	1056	15.7%	987	*14.1%
T3	6728	49.1%	3371	50.3%	3357	*48.0%
T4	1984	14.5%	858	12.8%	1126	*16.1%
T X	2245	16.4%	1067	15.9%	1178	16.8%
N negative	5751	42.0%	2861	42.7%	2890	41.3%
N positive	4316	31.5%	2038	30.4%	2278	*32.6%
N X	3635	26.5%	1809	27.0%	1826	26.1%
M negative	5827	42.5%	2817	42.0%	3010	43.0%
M positive ^b	2924	21.3%	1404	20.9%	1520	21.7%
M X	4951	36.1%	2487	37.1%	2464	*35.2%
grade 1	1396	10.2%	805	12.0%	591	*8.5%
grade 2	7340	53.6%	3503	52.2%	3837	*54.9%
grade 3+	1794	13.1%	906	13.5%	888	12.7%
grade X	3172	23.1%	1494	22.3%	1678	*24.0%
colon	8518	62.2%	4250	63.4%	4268	*61.0%
rectosigmoid	1072	7.8%	538	8.0%	534	7.6%
rectum/anus	4112	30.0%	1920	28.6%	2192	*31.3%
MV ^c yes	12558	91.7%	6138	91.5%	6420	91.8%
MV no	1045	7.6%	515	7.7%	530	7.6%
MV X	99	0.7%	55	0.8%	44	0.6%
symptomatic	13037	95.1%	6453	96.2%	6584	*94.1%
incidental	160	1.2%	80	1.2%	80	1.1%
screen detected	44	0.3%	14	0.2%	30	*0.4%
presentation X	461	3.4%	161	2.4%	300	*4.3%
non-smoker	5995	43.8%	2985	44.5%	3010	43.0%
ex-smoker	2217	16.2%	1057	15.8%	1160	16.6%
smoker	2740	20.0%	1404	20.9%	1336	*19.1%
smoking X	2750	20.1%	1262	18.8%	1488	*21.3%
ever married	10740	78.4%	5237	78.1%	5503	78.7%
never married	2503	18.3%	1234	18.4%	1269	18.1%
marital status X	459	3.3%	237	3.5%	222	3.2%

^aUnknown values shown as "X" for stage and other variables. ^bMinor discrepancies between stage IV and M positive cases reflect morphologies for which TNM staging is not strictly applicable. ^cMV = microscopic verification (histology or cytology).

*Significant change in the proportion of cases in this category (χ^2 test, 1 df, $P < 0.05$); but note that some further changes may be significant if cases in "unknown" categories are excluded.

Table 4.2.3 Summary of patient and tumour characteristics, by region of residence, for colorectal cancer patients included in survival and treatment analyses, 1994-2001. Account is taken of the potential confounding affect of these variables in statistical models of regional variation in survival (*section 4.4.4*) and treatment (*section 4.6.3*).

	Eastern	Mid-Western	Midland	North-Eastern	North-Western	Southern	South-Eastern	Western
total cases	4461	783	1057	1180	951	2315	1479	1476
age 15-44	3.5%	3.4%	3.9%	3.2%	2.5%	3.4%	4.6%	3.7%
age 45-54	9.7%	7.7%	10.8%	9.7%	10.0%	9.1%	8.8%	9.5%
age 55-64	21.3%	20.2%	21.2%	20.8%	*16.0%	19.5%	20.8%	*16.7%
age 65-74	33.1%	33.8%	33.0%	33.3%	30.4%	32.4%	32.4%	33.1%
age 75+	32.4%	34.9%	31.1%	33.0%	*41.1%	*35.6%	33.5%	*37.1%
male	54.3%	55.4%	*62.6%	*57.9%	54.4%	55.7%	*57.8%	*61.3%
female	45.7%	44.6%	*37.4%	*42.1%	45.6%	44.3%	*42.2%	*38.7%
stage I	8.1%	*12.9%	*10.8%	*4.4%	*10.7%	8.3%	9.4%	*3.9%
stage II	17.2%	20.2%	18.8%	*10.4%	16.7%	*13.5%	*20.1%	*12.7%
stage III	14.2%	13.5%	14.4%	*8.1%	13.7%	*10.5%	*17.3%	14.2%
stage IV	21.5%	*17.1%	20.2%	23.7%	20.1%	20.3%	*24.3%	20.3%
stage X	39.0%	36.3%	35.8%	*53.3%	38.8%	*47.4%	*28.8%	*49.0%
T1	4.5%	4.3%	4.4%	*7.3%	*6.2%	*7.3%	3.4%	3.9%
T2	14.5%	*19.5%	*18.4%	13.9%	14.5%	16.0%	13.9%	*11.7%
T3	51.3%	50.1%	48.3%	52.9%	49.0%	*42.3%	*46.7%	52.6%
T4	13.6%	*8.6%	13.0%	13.6%	16.0%	*17.4%	*18.3%	12.7%
T X	16.1%	17.5%	16.0%	*12.3%	14.3%	17.0%	17.8%	*19.0%
N negative	43.0%	43.0%	42.7%	42.8%	39.9%	43.5%	44.2%	*33.8%
N positive	31.8%	30.9%	*25.4%	32.6%	34.9%	*28.7%	33.9%	34.0%
N X	25.1%	26.1%	*31.9%	24.6%	25.2%	*27.9%	*21.8%	*32.2%
M negative	45.7%	*52.6%	*53.5%	*25.1%	45.2%	*35.1%	*52.1%	*34.1%
M positive	21.6%	*17.4%	20.5%	23.9%	20.2%	20.3%	*24.3%	20.5%
M X	32.7%	30.0%	*26.0%	*51.0%	34.6%	*44.5%	*23.6%	*45.5%
grade 1	3.5%	*39.8%	*35.4%	*10.8%	*5.3%	*5.4%	*6.9%	*10.2%
grade 2	66.4%	*24.3%	*29.3%	*50.5%	*54.0%	*58.1%	*56.7%	*39.6%
grade 3+	12.5%	11.9%	*9.7%	12.5%	*20.5%	13.2%	*9.0%	*17.6%
grade X	17.6%	*24.0%	*25.5%	*26.2%	20.2%	*23.3%	*27.5%	*32.5%
colon	61.3%	64.9%	60.5%	64.5%	*67.2%	63.2%	61.3%	58.6%
rectosigmoid	8.2%	6.6%	9.7%	7.3%	9.8%	*5.0%	7.8%	9.7%
rectum/anus	30.5%	28.5%	29.7%	28.2%	*23.0%	31.8%	31.0%	31.7%
MV yes	94.9%	*91.2%	*93.0%	*92.1%	*91.0%	*87.0%	*89.2%	*91.1%
MV no	4.3%	*8.0%	*6.1%	*7.4%	*8.6%	*12.8%	*9.3%	*8.1%
MV X	0.8%	0.8%	0.9%	0.5%	0.4%	*0.2%	*1.5%	0.8%
symptomatic	92.3%	*96.3%	93.8%	*96.9%	*98.3%	*97.7%	*95.5%	*96.2%
incidental	1.4%	0.9%	*0.5%	1.1%	*0.2%	1.8%	0.9%	0.9%
screen detected	0.6%	0.0%	0.3%	0.1%	0.4%	*0.1%	0.3%	0.2%
presentation X	5.7%	*2.8%	5.5%	*1.9%	*1.1%	*0.3%	*3.3%	*2.6%
non-smoker	35.7%	*45.8%	*43.6%	*39.9%	*44.4%	*54.9%	*48.0%	*48.1%
ex-smoker	18.4%	*13.7%	16.4%	18.8%	18.7%	*10.7%	*14.0%	17.9%
smoker	19.4%	19.8%	20.5%	19.5%	20.9%	20.1%	19.3%	*21.8%
smoking status X	26.6%	*20.7%	*19.5%	*21.8%	*16.0%	*14.3%	*18.7%	*12.2%
ever married	79.3%	77.0%	76.5%	79.7%	76.4%	78.3%	79.2%	77.2%
never married	16.4%	18.9%	18.4%	16.9%	*22.6%	*19.3%	17.8%	*20.6%
marital status X	4.3%	4.1%	5.1%	3.3%	*0.9%	*2.5%	*3.0%	*2.2%

*Significant difference in proportion of cases, compared with Eastern region (χ^2 test, 1 df, $P < 0.05$)

4.3 Relative survival: descriptive analysis

Five-year relative survival estimates for national population, by period of diagnosis, age, sex and other patient or tumour characteristics, are shown in *Table 4.3.1*. Survival curves, to five years after diagnosis, are plotted for the same variables in *Figure 4.3.1*. Five-year survival estimates by treatment status are shown in *Table 4.3.2*; by sex and region in *Table 4.3.3*; and one-year, three-year and five-year estimates, nationally and regionally by diagnosis period, in *Table 4.3.4*.

Results and comparisons presented in this section are not adjusted for potential confounding variables, thus are potentially open to misinterpretation if taken at face value. More formal (multivariate) comparisons are made in *section 4.4*.

4.3.1 General summary

For colorectal cancer cases diagnosed in Ireland during 1994-2001 as a whole, relative survival to five years after diagnosis was estimated as 49.2% (95% CI 48.1-50.3%) (*Table 4.3.1*). Equivalent figures for males were 48.1% (46.6-49.5%), for females 50.7% (49.1-52.2%). Relative survival to one year averaged 70.2% (69.3-71.0%), and to three years 54.7% (53.7-55.6%) (*Table 4.3.4*).

4.3.2 Variation by patient and tumour characteristics

In general, relative survival (to five years) was highest for age-groups under 65 or 75 years or, for other specific variables, cases that were early stage; T category 1 or 2; node-negative; non-metastatic; grade 1 or 2; microscopically verified; screen-detected; or in non-smokers, ex-smokers or patients who were ever married (*Table 4.3.1 & Figure 4.3.1*). Survival was lowest in the oldest age-group (75+), and, for other variables, cases that were stage IV; T category 4 or unknown; node-positive or nodal status unknown; metastatic; grade 3+ or unknown; lacking microscopic verification (or with MV status unknown); or in smokers, or patients with unknown smoking or marital status. Note however that patients in a given univariate category may differ with respect to other characteristics - see *section 4.4.1* for multivariate comparisons.

4.3.3 Variation by treatment status

Patients who received any tumour-directed treatment, or surgery, within six months of diagnosis had substantially higher five-year survival than patients who did not receive these

treatments: averaging 57% v 12% for treatment v no treatment, and 60% v 12% for surgery v no surgery for 1994-2001 as a whole (*Table 4.3.2*). In contrast, survival was slightly lower overall in patients who had radiotherapy compared with those who did not, though this was mainly apparent for earlier diagnosis years (1994-97). No differences were apparent between patients who did and did not have chemotherapy. However, since patients given or not given particular treatments may have differed greatly in disease stage or other characteristics, these figures do not provide any measure of treatment effectiveness.

4.3.4 National and regional trends

National estimates of five-year survival showed a clear improvement from 47.7% (95% CI 46.1-49.1%) for cases diagnosed during 1994-97 to 51.0% (49.3-52.6%) for 1998-2001 (*Table 4.3.1, Figure 4.3.1*). Patients from most regions also showed evidence of improvements, but less clear-cut in terms of statistical significance (*Table 4.3.4*). See *sections 4.4.2-3* for more formal comparisons, adjusted for age or other factors.

4.3.5 Regional variation

Five-year relative survival estimates during 1994-2001 ranged from 46.3% (95% CI 43.0-49.6%) for patients from the Western region to 52.4% (48.6-56.0%) for the North-Eastern region (*Table 4.3.4*). However, precise rankings varied between diagnosis periods, and these comparisons may be influenced by age or other factors (cf. *section 4.4.4*).

Table 4.3.1 National five-year relative survival for colorectal cancer patients, by patient and tumour characteristics, 1994-2001. Relative survival is the survival of cancer patients as a percentage of the expected survival of persons of the same age and sex in the general population.

	1994-2001		1994-1997		1998-2001	
	5-yr survival	(95% CI)	survival	(95% CI)	survival	(95% CI)
total	49.2%	(48.1%-50.3%)	47.7%	(46.1%-49.1%)	*51.0%	(49.3%-52.6%)
age 15-44	53.2%	(48.4%-57.8%)	50.2%	(43.5%-56.4%)	58.1%	(51.1%-64.4%)
age 45-54	54.0%	(51.0%-56.9%)	49.9%	(45.8%-53.9%)	*59.6%	(55.3%-63.6%)
age 55-64	54.0%	(51.8%-56.0%)	50.6%	(47.6%-53.3%)	*57.8%	(54.4%-61.0%)
age 65-74	50.1%	(48.3%-51.9%)	48.4%	(45.9%-50.8%)	52.0%	(49.2%-54.7%)
age 75+	44.8%	(42.5%-47.1%)	45.9%	(42.7%-49.0%)	43.1%	(39.7%-46.5%)
male	48.1%	(46.6%-49.5%)	46.4%	(44.4%-48.4%)	50.1%	(47.9%-52.3%)
female	50.7%	(49.1%-52.2%)	49.1%	(46.9%-51.2%)	52.1%	(49.6%-54.5%)
stage I	88.1%	(84.4%-91.4%)	87.9%	(83.1%-92.2%)	87.7%	(81.5%-93.0%)
stage II	74.1%	(71.3%-76.8%)	72.7%	(68.9%-76.2%)	75.4%	(70.9%-79.5%)
stage III	51.6%	(48.5%-54.6%)	46.2%	(42.2%-50.2%)	*56.8%	(52.0%-61.4%)
stage IV	7.9%	(6.7%-9.1%)	7.5%	(6.1%-9.1%)	8.1%	(6.3%-10.0%)
stage X ^a	52.3%	(50.6%-54.0%)	49.8%	(47.4%-52.0%)	*55.5%	(52.9%-58.0%)
T1	80.7%	(76.0%-85.0%)	79.3%	(72.8%-85.1%)	80.5%	(72.6%-87.3%)
T2	77.0%	(74.1%-79.6%)	74.7%	(70.8%-78.2%)	80.3%	(75.9%-84.3%)
T3	55.4%	(53.7%-56.9%)	51.4%	(49.2%-53.4%)	*59.8%	(57.3%-62.2%)
T4	18.5%	(16.4%-20.6%)	16.9%	(14.2%-19.8%)	19.6%	(16.5%-22.8%)
T X	22.5%	(20.4%-24.6%)	23.2%	(20.2%-26.3%)	22.2%	(19.3%-25.2%)
N negative	72.8%	(71.0%-74.4%)	71.2%	(68.8%-73.4%)	74.7%	(72.0%-77.2%)
N positive	37.2%	(35.4%-39.0%)	33.6%	(31.2%-35.9%)	*40.8%	(37.9%-43.6%)
N X	26.0%	(24.3%-27.8%)	26.5%	(24.1%-29.0%)	25.7%	(23.2%-28.2%)
M negative	67.0%	(65.2%-68.6%)	65.9%	(63.5%-68.1%)	67.8%	(65.1%-70.3%)
M positive ^b	8.1%	(6.9%-9.2%)	7.8%	(6.3%-9.4%)	8.2%	(6.5%-10.1%)
M X	52.9%	(51.0%-54.6%)	49.7%	(47.2%-52.1%)	*56.9%	(54.1%-59.6%)
grade 1	59.2%	(55.7%-62.6%)	59.0%	(54.5%-63.2%)	59.4%	(53.1%-65.3%)
grade 2	56.4%	(54.9%-57.9%)	53.7%	(51.6%-55.7%)	*59.2%	(56.9%-61.4%)
grade 3+	40.0%	(37.2%-42.8%)	38.6%	(34.8%-42.3%)	41.5%	(37.1%-45.8%)
grade X	33.4%	(31.3%-35.4%)	32.7%	(29.8%-35.5%)	34.2%	(31.2%-37.1%)
colon	50.1%	(48.6%-51.4%)	49.1%	(47.2%-50.9%)	51.4%	(49.3%-53.4%)
rectosigmoid	47.8%	(43.9%-51.5%)	44.9%	(39.8%-49.9%)	50.1%	(43.9%-56.1%)
rectum/anus	47.9%	(45.9%-49.8%)	45.3%	(42.6%-47.8%)	50.4%	(47.4%-53.3%)
MV yes	52.9%	(51.7%-53.9%)	51.1%	(49.6%-52.6%)	*54.7%	(52.9%-56.4%)
MV no	7.7%	(5.7%-10.0%)	7.5%	(4.9%-10.8%)	8.2%	(5.4%-11.7%)
MV X	19.5%	(11.1%-30.0%)	24.9%	(12.8%-40.1%)	13.3%	(4.2%-28.7%)
symptomatic	48.9%	(47.8%-50.0%)	47.4%	(45.9%-48.9%)	*50.6%	(48.9%-52.2%)
incidental	49.5%	(39.5%-59.2%)	51.5%	(37.7%-65.0%)	45.6%	(30.6%-60.4%)
screen detected	86.0%	(64.9%-99.0%)	101.4%	(63.7%-113%)	80.9%	(55.7%-95.8%)
presentation X	54.7%	(48.4%-60.8%)	50.2%	(40.7%-59.4%)	59.4%	(51.1%-67.2%)
non-smoker	53.0%	(51.3%-54.6%)	51.7%	(49.4%-53.8%)	54.5%	(51.9%-56.9%)
ex-smoker	50.6%	(47.8%-53.3%)	48.2%	(44.3%-51.9%)	53.5%	(49.2%-57.7%)
smoker	44.3%	(42.0%-46.6%)	42.1%	(39.0%-45.1%)	47.2%	(43.5%-50.7%)
smoking X	45.0%	(42.6%-47.3%)	43.9%	(40.6%-47.2%)	45.6%	(42.1%-49.0%)
ever married	51.0%	(49.7%-52.2%)	49.7%	(47.9%-51.3%)	52.5%	(50.6%-54.3%)
never married	43.9%	(41.4%-46.4%)	40.9%	(37.6%-44.2%)	46.8%	(42.9%-50.5%)
marital status X	37.2%	(31.8%-42.6%)	38.2%	(31.0%-45.5%)	36.7%	(28.3%-45.4%)

^aUnknown values shown as "X" for stage, T category, N category, M category, grade, microscopic verification (MV), method of presentation, marital status and smoking status. ^bMinor discrepancies between Stage IV and M+ cases are because some M+ cases were of morphologies (e.g. carcinoid tumours) for which TNM staging is not strictly applicable for this site. *Significant changes (improvements) in survival between diagnosis periods, unadjusted for age, based on non-overlap of 95% CIs; some other changes may also be significant.

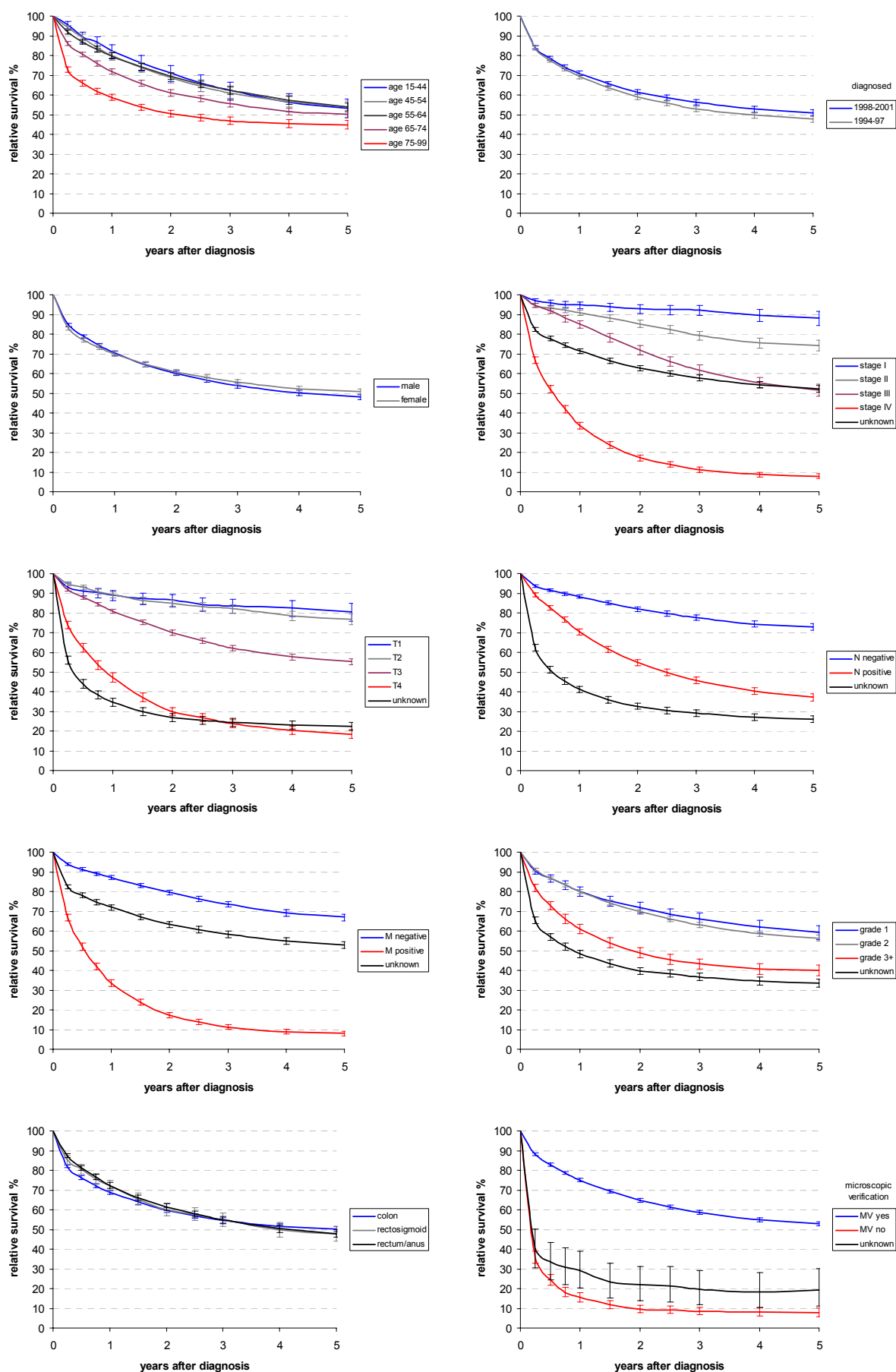


Figure 4.3.1 Relative survival up to five years after diagnosis for colorectal cancer patients diagnosed during 1994-2001: variation by patient and tumour characteristics. 95% confidence intervals are shown.

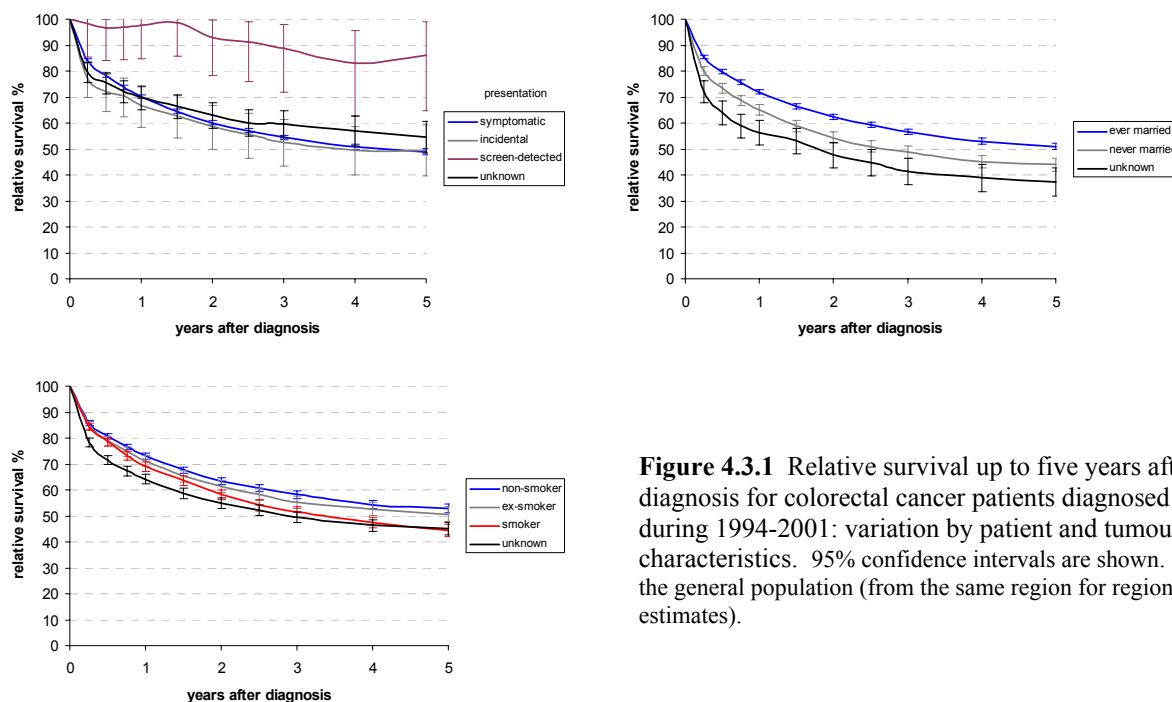


Figure 4.3.1 Relative survival up to five years after diagnosis for colorectal cancer patients diagnosed during 1994-2001: variation by patient and tumour characteristics. 95% confidence intervals are shown. the general population (from the same region for regional estimates).

Figure 4.3.1 (continued)

Table 4.3.2 National five-year relative survival for colorectal cancer patients, by treatment status (within six months of diagnosis) and period of diagnosis, 1994-2001. Patients treated and not treated are likely to differ markedly in disease stage, age or other characteristics, thus *differences in survival between treated and untreated patients below should not be interpreted as reflecting the effect of treatment.*

	1994-2001		1994-1997		1998-2001	
	survival	(95% CI)	survival	(95% CI)	survival	(95% CI)
total	49.2%	(48.1%-50.3%)	47.7%	(46.1%-49.1%)	*51.0%	(49.3%-52.6%)
treatment	56.8%	(55.5%-57.9%)	55.4%	(53.7%-56.9%)	58.3%	(56.5%-60.1%)
no treatment	12.4%	(10.7%-14.1%)	12.4%	(10.2%-14.7%)	12.7%	(10.2%-15.3%)
surgery	59.8%	(58.5%-61.0%)	57.8%	(56.0%-59.4%)	*62.1%	(60.1%-63.9%)
no surgery	12.7%	(11.3%-14.1%)	11.7%	(9.8%-13.6%)	13.9%	(11.8%-16.1%)
radiotherapy	45.5%	(42.4%-48.5%)	39.8%	(35.4%-44.2%)	*49.1%	(44.8%-53.3%)
no radiotherapy	49.7%	(48.5%-50.8%)	48.5%	(46.9%-50.0%)	51.3%	(49.5%-53.0%)
chemotherapy	49.1%	(47.1%-50.9%)	45.2%	(42.4%-47.9%)	*52.4%	(49.6%-55.1%)
no chemotherapy	49.4%	(48.1%-50.7%)	48.7%	(46.9%-50.3%)	50.5%	(48.3%-52.5%)

*Significant changes (improvements) in survival between diagnosis periods, unadjusted for age, based on non-overlap of 95% CIs; some other changes may also be significant.

Table 4.3.3 Five-year relative survival for colorectal cancer patients, unadjusted for age, by region of residence and sex, 1994-2001. Relative survival is the survival of cancer patients as a percentage of the expected survival of persons of the same age and sex in the general population (from the same region for regional estimates).

Region	Total		Males		Females	
	5-yr survival	(95% CI)	survival	(95% CI)	survival	(95% CI)
total	49.2%	(48.1%-50.3%)	48.1%	(46.6%-49.5%)	50.7%	(49.1%-52.2%)
E	51.9%	(50.0%-53.8%)	50.8%	(48.1%-53.3%)	53.3%	(50.5%-55.9%)
M	48.8%	(44.2%-53.3%)	40.9%	(34.7%-47.1%)	57.6%	(50.8%-64.1%)
MW	49.7%	(45.7%-53.6%)	51.0%	(45.8%-56.0%)	47.7%	(41.5%-53.8%)
NE	52.4%	(48.6%-56.0%)	52.3%	(47.2%-57.3%)	52.4%	(46.8%-57.8%)
NW	49.3%	(45.1%-53.4%)	49.6%	(43.7%-55.3%)	49.0%	(43.1%-54.9%)
S	47.1%	(44.4%-49.7%)	45.8%	(42.2%-49.4%)	48.5%	(44.6%-52.3%)
SE	46.4%	(43.2%-49.6%)	46.4%	(42.1%-50.7%)	46.6%	(41.7%-51.3%)
W	46.3%	(43.0%-49.6%)	44.0%	(39.8%-48.2%)	49.9%	(44.5%-55.2%)

Table 4.3.4 One-year, three-year and five-year relative survival for colorectal cancer patients, unadjusted for age, by region of residence and period of diagnosis, 1994-2001.

Region	1994-2001		1994-1997		1998-2001	
	1-yr survival	(95% CI)	survival	(95% CI)	survival	(95% CI)
total	70.2%	(69.3%-71.0%)	69.4%	(68.2%-70.5%)	71.0%	(69.8%-72.0%)
E	73.2%	(71.7%-74.5%)	73.4%	(71.3%-75.2%)	73.0%	(70.9%-74.8%)
M	70.7%	(67.1%-73.9%)	72.3%	(67.3%-76.8%)	69.0%	(63.7%-73.6%)
MW	71.5%	(68.4%-74.2%)	71.7%	(67.1%-75.8%)	71.2%	(67.1%-75.0%)
NE	72.4%	(69.5%-75.0%)	73.6%	(69.3%-77.4%)	71.3%	(67.4%-74.8%)
NW	66.9%	(63.5%-69.9%)	64.3%	(59.6%-68.7%)	69.6%	(64.9%-73.9%)
S	66.5%	(64.4%-68.5%)	65.3%	(62.2%-68.1%)	67.7%	(64.7%-70.4%)
SE	68.0%	(65.4%-70.4%)	65.8%	(62.0%-69.3%)	70.2%	(66.5%-73.5%)
W	69.0%	(66.3%-71.4%)	65.0%	(61.2%-68.6%)	*72.7%	(69.1%-75.9%)

Region	1994-2001		1994-1997		1998-2001	
	3-yr survival	(95% CI)	survival	(95% CI)	survival	(95% CI)
total	54.7%	(53.7%-55.6%)	53.0%	(51.5%-54.3%)	*56.4%	(55.0%-57.7%)
E	57.5%	(55.7%-59.1%)	56.2%	(53.8%-58.5%)	58.8%	(56.3%-61.0%)
M	55.5%	(51.3%-59.4%)	53.5%	(47.8%-59.0%)	57.6%	(51.6%-63.3%)
MW	55.0%	(51.4%-58.3%)	55.9%	(50.7%-60.8%)	54.2%	(49.4%-58.7%)
NE	58.0%	(54.7%-61.2%)	58.5%	(53.5%-63.1%)	57.7%	(53.1%-62.0%)
NW	53.2%	(49.4%-56.8%)	49.5%	(44.4%-54.5%)	57.3%	(51.9%-62.4%)
S	51.6%	(49.2%-53.9%)	50.0%	(46.6%-53.2%)	53.3%	(49.9%-56.4%)
SE	52.2%	(49.2%-55.0%)	50.4%	(46.3%-54.4%)	53.9%	(49.7%-57.9%)
W	52.1%	(49.1%-55.0%)	46.4%	(42.2%-50.5%)	57.6%	(53.4%-61.6%)

Region	1994-2001		1994-1997		1998-2001	
	5-yr survival	(95% CI)	survival	(95% CI)	survival	(95% CI)
total	49.2%	(48.1%-50.3%)	47.7%	(46.1%-49.1%)	*51.0%	(49.3%-52.6%)
E	51.9%	(50.0%-53.8%)	50.3%	(47.7%-52.8%)	54.3%	(51.4%-57.1%)
M	48.8%	(44.2%-53.3%)	47.8%	(41.8%-53.7%)	50.2%	(42.9%-57.2%)
MW	49.7%	(45.7%-53.6%)	51.0%	(45.4%-56.5%)	48.2%	(42.2%-54.0%)
NE	52.4%	(48.6%-56.0%)	53.1%	(47.8%-58.3%)	51.5%	(45.9%-56.9%)
NW	49.3%	(45.1%-53.4%)	45.7%	(40.2%-51.1%)	53.5%	(47.0%-59.9%)
S	47.1%	(44.4%-49.7%)	46.0%	(42.3%-49.5%)	47.9%	(43.9%-51.8%)
SE	46.4%	(43.2%-49.6%)	44.6%	(40.2%-48.8%)	48.4%	(43.3%-53.3%)
W	46.3%	(43.0%-49.6%)	41.0%	(36.7%-45.4%)	51.8%	(46.7%-56.8%)

*Significant changes (improvements) in survival between diagnosis periods, unadjusted for age, based on non-overlap of 95% CIs; some other changes may also be significant.

4.4 Relative survival: modelling

4.4.1 Variation by patient and tumour characteristics

For assessment of regional variation in relative survival during 1994-2001, a full relative survival model was run, potentially incorporating and adjusting for available patient and tumour characteristics. These included year of follow-up (years 1 to 5 after diagnosis), age-group, stage-related variables (T, N and M categories), grade, interaction between those variables and year of follow-up, and additional patient and tumour variables without interaction terms (sex, tumour site, microscopic verification status, method of presentation, marital status, smoking status, year of diagnosis). Excluding region and year (covered later), and variables that did not contribute significantly to model-fit, statistically significant excess hazard ratios (EHRs) were recorded as follows:

- During year 1 of follow-up (for variables assessed using an interaction term for follow-up year):
 - Higher EHR (lower relative survival) for age-groups 55-64 years (1.348 [95% CI 1.073-1.694]), 65-74 (1.940 [1.557-2.417]) and 75+ (3.022 [2.427-3.763]), compared with age-group 15-44 years.
 - Higher EHR for T categories 3 (1.848 [1.409-2.422]), 4 (3.586 [2.739-4.696]), and unknown or non-applicable (3.456 [2.645-4.517]), compared with T category 1.
 - Higher EHR for N positive (1.823 [1.638-2.030]) and N unknown cases (2.632 [2.332-2.971]), compared with N negative cases.
 - Higher EHR for M positive (4.133 [3.742-4.565]) and M unknown cases (1.487 [1.340-1.650]), compared with M negative cases.
 - Higher EHR for grade 3+ (1.750 [1.500-2.042]) and grade unknown cases (1.220 [1.047-1.422]), compared with grade 1.
- For age, stage-related and grade variables, EHRs varied significantly during subsequent follow-up and cannot readily be summarized beyond year 1.
- Overall (for variables assessed without an interaction term for follow-up year):
 - Lower EHR (higher relative survival) for female patients (0.936 [0.886-0.988]), compared with males.
 - Higher EHR (lower relative survival) for cases lacking microscopic verification (1.991 [1.797-2.206]) or with unknown MV status (1.921 [1.487-2.480]).
 - Lower EHR for cases that were screen detected (0.382 [0.152-0.954]) or whose method of presentation was unknown (0.759 [0.643-0.897]), compared with cases presenting symptomatically.
- Higher EHR for ex-smokers (1.121 [1.034-1.215]), current smokers (1.187 [1.105-1.274]) and patients of unknown smoking status (1.238 [1.150-1.332]), compared with non-smokers (never-smokers).
- Higher EHR for patients who were never married (1.122 [1.050-1.199]), compared with those who were ever married.
- Tumour site did not significantly improve model fit, after adjustment for other variables, and was excluded from the full model.

These findings broadly confirmed the variations already noted for unadjusted relative survival (*Table 4.4.2*), for the overall period 1994-2001.

4.4.2 National and age-specific trends

Relative survival improved significantly (i.e. excess hazard ratios fell significantly) for Ireland as a whole between diagnosis periods 1994-97 and 1998-2001 (*Table 4.4.1*). The improvement represented a 10% reduction in age-adjusted excess risk of death, or a 22% reduction in excess risk after adjustment for other patient and tumour variables, including stage. Improvements in survival were also significant in age-groups 45-54, 55-64 and 65-74 years, equivalent to 10-20% reductions in excess risk of death, but not in younger or older patients (unadjusted models, *Table 4.4.1*).

4.4.3 Regional trends

Relative survival improved significantly for the Western region, between diagnosis periods 1994-97 and 1998-2001 (*Table 4.4.1*), equivalent to a 29% reduction in excess risk of death. Other regions showed no significant changes in relative survival, although the trends in most regions (sometimes approaching statistical significance) appeared to be consistent with the national improvement in survival.

4.4.4 Regional variation

This was moderately high over the period 1994-2001 as a whole. There was a significantly higher (by 12-24%) excess risk of death (lower relative survival) among patients from the North-Western, Southern, South-Eastern and Western regions, compared with the Eastern region, having adjusted for age and sex (*Figure 4.4.1, Table 4.4.2*). The pattern was similar for cases diagnosed during 1994-97, but excess risks were no longer significantly high for the North-Western and Western regions based on 1998-2001 cases. However, the Mid-Western region also showed significantly high excess risks among recent cases.

Adjustment for stage-related variables modified or reduced these differences somewhat. In the fully adjusted model, taking account of a wider range of patient and tumour characteristics, three regions had a significantly high excess risk of death during 1994-2001: Mid-Western (15% higher than Eastern), Southern (24% higher) and South-Eastern (10% higher). Only the Southern region had significantly low survival (high excess risk) for 1994-97 cases, and the Southern and Mid-Western regions for 1998-2001 cases.

While variations in patient and tumour characteristics appear to account for some of the regional variation in survival, cautious interpretation is needed. For example, patients from a region with a below-average proportion of cases microscopically verified – a factor associated with poor survival (*section 4.4.1*) - will tend to have below-average survival, other factors being equal. While this could reflect a higher proportion of patients from a given region being considered too unwell for full diagnostic investigation, it could also reflect poorer-quality investigation and care of patients from that region.

Table 4.4.1 Changes in relative survival between diagnosis-years 1994-97 and 1998-2001, stratified by age and region of residence, for patients diagnosed with colorectal cancer during 1994-2001. Excess hazard ratios in bold = significant difference from baseline (1994-1997). (EHR <1 = reduction in excess hazard thus improvement in relative survival, EHR >1 = increase in excess hazard thus reduction in relative survival). Only the basic model is shown for individual regions as regional sample sizes are generally too small to allow complex modelling.

	1998-2001 v 1994-97	
	^aEHR (95% CI)	P
basic model: age-specific, sex-adjusted		
age 15-44	0.858 (0.654-1.126)	0.272
age 45-54	0.795 (0.671-0.942)	0.008
age 55-64	0.803 (0.712-0.907)	0.000
age 65-74	0.905 (0.824-0.994)	0.038
age 75+	1.003 (0.916-1.099)	0.934
basic model: sex-, age-adjusted ^b		
total	0.903 (0.856-0.952)	0.000
E	0.923 (0.838-1.017)	0.109
M	0.892 (0.711-1.119)	0.325
MW	1.080 (0.891-1.309)	0.431
NE	1.063 (0.878-1.285)	0.529
NW	0.827 (0.675-1.012)	0.066
S	0.903 (0.797-1.023)	0.112
SE	0.854 (0.730-1.000)	0.050
W	0.710 (0.605-0.832)	0.000
fuller model: sex-, age-, stage-adjusted ^b		
total	0.856 (0.812-0.902)	0.000
final multivariate model ^b		
total	0.781 (0.703-0.867)	0.000

^aEHR = excess hazard ratio (or “relative excess risk”) estimated by a generalized linear model (GLM) with a Poisson error structure, fitted to exact survival times and collapsed observations.

^bSee *Table 4.4.2* but region and diagnosis year excluded here.

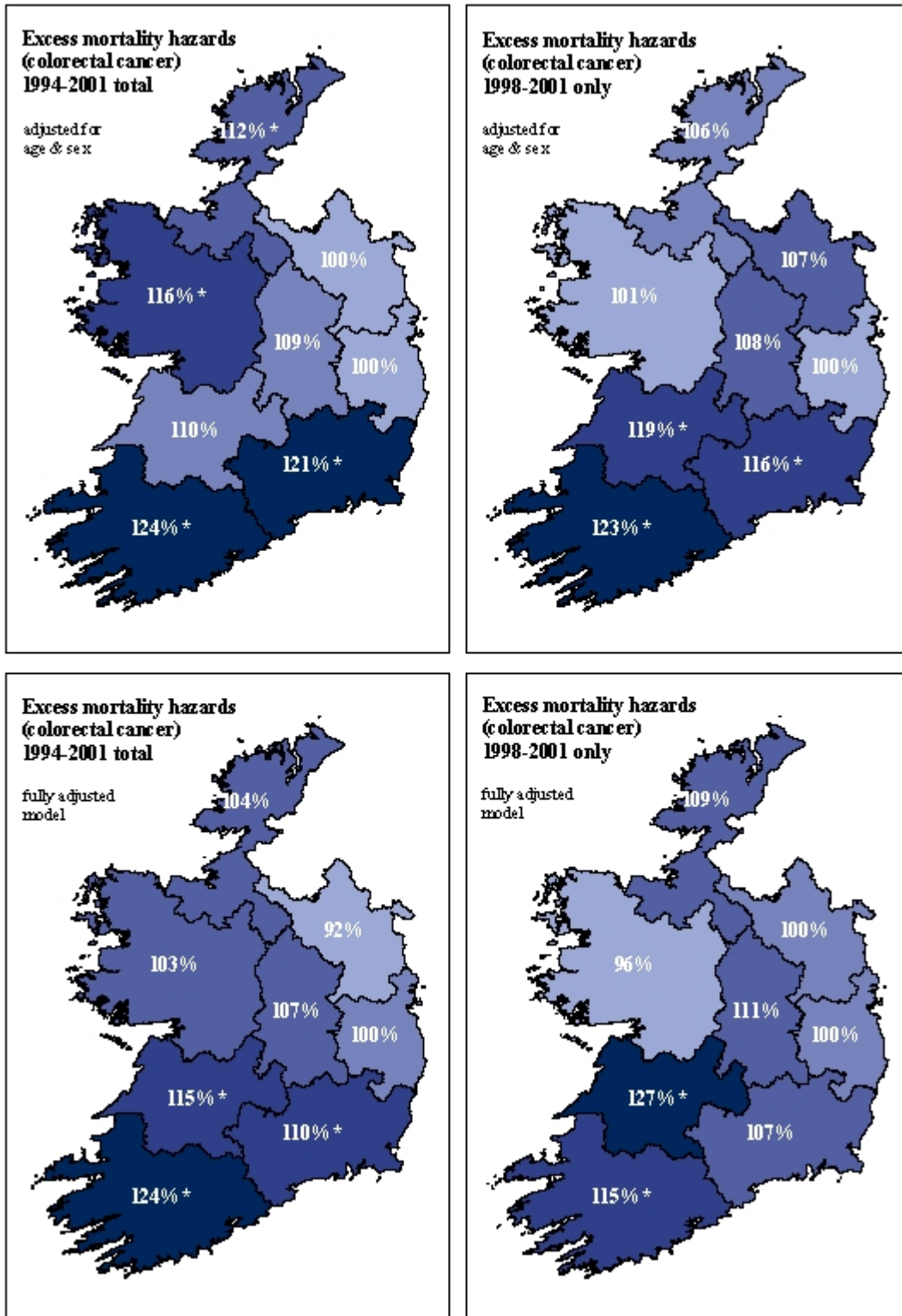


Figure 4.4.1 Regional variation in excess mortality hazards (based on relative survival) for colorectal cancer, expressed in comparison with patients from the Eastern region (100%): 1994-2001 total (left), 1998-2001 (right); basic age- & sex-adjusted model (top), fully-adjusted model (bottom). See Table 4.4.2 for further details. * = significantly high or low excess risk (P<0.05).

Table 4.4.2 Variation in relative survival, by region of residence, for patients diagnosed with colorectal cancer during 1994-2001. Analysis is based on survival up to five years from diagnosis. Excess hazard ratios in bold = significant difference from Eastern region (EHR <1 = lower excess hazard thus higher relative survival than in Eastern region, EHR >1 = higher excess hazard thus lower relative survival).

	1994-2001 ^a EHR (95% CI)	P	1994-1997 EHR (95% CI)	P	1998-2001 EHR (95% CI)	P
basic model: sex-, age-adjusted ^{b,c}						
E	1.000		1.000		1.000	
M	1.087 (0.963-1.227)	0.176	1.090 (0.924-1.286)	0.304	1.079 (0.903-1.289)	0.401
MW	1.102 (0.990-1.227)	0.073	1.022 (0.873-1.195)	0.786	1.194 (1.030-1.383)	0.018
NE	0.995 (0.895-1.106)	0.929	0.930 (0.796-1.086)	0.360	1.065 (0.921-1.231)	0.391
NW	1.124 (1.006-1.256)	0.039	1.188 (1.023-1.380)	0.023	1.058 (0.896-1.249)	0.504
S	1.236 (1.143-1.337)	0.000	1.248 (1.119-1.393)	0.000	1.228 (1.097-1.375)	0.000
SE	1.205 (1.100-1.321)	0.000	1.249 (1.102-1.416)	0.000	1.159 (1.015-1.324)	0.029
W	1.158 (1.055-1.271)	0.002	1.326 (1.170-1.503)	0.000	1.012 (0.882-1.163)	0.855
fuller model: sex-, age-, stage-adjusted ^{b,c,d}						
E	1.000		1.000		1.000	
M	1.119 (0.991-1.264)	0.068	0.987 (0.835-1.166)	0.880	1.311 (1.098-1.567)	0.003
MW	1.133 (1.018-1.260)	0.021	0.996 (0.852-1.165)	0.968	1.311 (1.133-1.518)	0.000
NE	0.958 (0.863-1.064)	0.430	0.875 (0.751-1.021)	0.091	1.073 (0.929-1.240)	0.332
NW	1.088 (0.975-1.215)	0.129	1.071 (0.923-1.243)	0.362	1.109 (0.939-1.308)	0.220
S	1.320 (1.221-1.426)	0.000	1.386 (1.245-1.544)	0.000	1.265 (1.132-1.414)	0.000
SE	1.159 (1.058-1.269)	0.001	1.162 (1.026-1.317)	0.018	1.159 (1.015-1.324)	0.029
W	1.081 (0.986-1.185)	0.095	1.169 (1.031-1.325)	0.015	1.014 (0.885-1.161)	0.837
final multivariate model ^{b,e}						
E	1.000		1.000		1.000	
M	1.066 (0.939-1.210)	0.317	1.036 (0.870-1.233)	0.690	1.111 (0.922-1.338)	0.267
MW	1.152 (1.032-1.286)	0.012	1.069 (0.906-1.261)	0.426	1.269 (1.092-1.474)	0.002
NE	0.917 (0.825-1.020)	0.112	0.873 (0.747-1.020)	0.088	0.995 (0.860-1.151)	0.949
NW	1.038 (0.929-1.160)	0.501	1.015 (0.873-1.179)	0.844	1.093 (0.926-1.291)	0.289
S	1.240 (1.145-1.343)	0.000	1.327 (1.188-1.483)	0.000	1.145 (1.019-1.286)	0.023
SE	1.100 (1.003-1.206)	0.042	1.125 (0.991-1.276)	0.068	1.071 (0.935-1.227)	0.319
W	1.027 (0.935-1.129)	0.565	1.114 (0.978-1.269)	0.103	0.955 (0.832-1.096)	0.517

^aEHR = excess hazard ratio (or “relative excess risk”) estimated by a generalized linear model (GLM) with a Poisson error structure, fitted to exact survival times and collapsed observations.

^bModels included interaction terms between follow-up interval (years 1-5) and age (plus stage-related variables and grade), equivalent to stratification by these variables, to allow for non-proportional hazards across follow-up time.

^cAge-categories: EUROCARE age-groups 15-44, 45-54, 55-64, 65-74, 75+.

^dStage-related variables: T categories 1-4 & unknown; N category negative, positive, unknown; M category negative, positive, unknown.

^eFinal (full) multivariate model, also including: grade 1, 2, 3+ or unknown; microscopic verification (yes, no, or unknown); method of presentation (symptomatic, incidental, screen-detected, unknown); smoking status (non, ex, smoker, unknown); marital status (ever married, never married, unknown); individual year of diagnosis. [Tumour site – colon, rectosigmoid junction or rectum/anus – did not significantly improve model-fit and was excluded.]

4.5 Treatment: descriptive analysis

4.5.1 General comment

Analyses here are restricted to *treatments administered within six months after diagnosis*. Variations noted in treatment between patient groups may thus, to some extent, reflect variations in timing of treatment. However, the majority of first-line treatments for this cancer should be included.

4.5.2 General summary of treatment

Of the total 13,702 colorectal cancer cases included in analyses for the period 1994-2001, 83% had some form of definitive or tumour-directed treatment within six months of diagnosis, 77% had

surgical treatment, 28% had chemotherapy and 12% had radiotherapy (*Table 4.5.1*). Equivalent figures for the most recent period, 1998-2001, were 6994 cases, of which 84% were treated, 77% had surgery, 33% had chemotherapy and 14% had radiotherapy (*Table 4.5.1, Figure 4.5.2*). A further breakdown by age is shown in *Table 4.5.1* and *Figure 4.5.1*.

The most frequent treatments or combinations were surgery only (51% of cases 1994-2001), surgery plus chemotherapy (18%), and surgery plus chemotherapy plus radiotherapy (6.1%). For the most recent period (1998-2001), equivalent figures were 46%, 20% and 8.0% (*Table 4.5.1*).

Table 4.5.1 Summary of main treatment modalities and combinations (within six months of diagnosis) for colorectal cancer patients, by age and diagnosis period, 1994-2001. Only treatments or combinations making up at least 1% of cases in any period are listed.

	1994-2001					total	1994-97	1998-2001	
	age 15-44	44-54	55-64	65-74	75+		subtotal	subtotal	
total cases	486	1297	2734	4491	4694	13 702	6708	6994	
any treatment	94.4%	92.8%	90.6%	85.8%	71.4%	82.8%	81.8%	83.7%	*
no treatment	5.6%	7.2%	9.4%	14.2%	28.6%	17.2%	18.2%	16.3%	*
any surgery ^a	86.6%	82.7%	84.3%	79.7%	68.5%	77.3%	77.8%	76.8%	
any chemotherapy ^b	61.7%	54.2%	44.4%	28.7%	7.1%	28.0%	22.3%	33.5%	*
any radiotherapy	19.5%	20.7%	16.3%	12.7%	4.5%	11.6%	8.8%	14.3%	*
surgery only	28.0%	33.9%	42.2%	52.2%	60.9%	50.6%	55.6%	45.8%	*
surge + chemo	42.2%	32.9%	28.3%	18.3%	4.9%	17.9%	15.4%	20.4%	*
surge + chemo + radio	12.6%	12.3%	10.8%	6.2%	0.9%	6.1%	4.1%	8.0%	*
surge + radio	3.9%	3.4%	2.8%	3.0%	1.7%	2.6%	2.6%	2.6%	
chemotherapy only	4.7%	5.1%	3.7%	2.5%	1.0%	2.5%	1.9%	3.1%	*
radiotherapy only	0.8%	1.2%	1.0%	1.8%	1.6%	1.5%	1.2%	1.8%	*
chemo + radio	2.3%	3.9%	1.6%	1.7%	0.3%	1.4%	1.0%	1.9%	*
others	0.0%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	0.2%	

^aSurgery and related treatments. ^bChemotherapy and related treatments (excluding hormonal therapy).

*Significant difference between diagnosis periods in percentage having this treatment (χ^2 tests), unadjusted for age or other variables.

4.5.3 Region of surgical treatment v. region of residence

Based on surgical treatment within six months of diagnosis, the majority of colorectal cancer patients during 1994-2001 had their main surgical treatment within their region of residence (*Table 4.5.2*). The proportion was highest for the Eastern and

Southern regions (98-99%), lowest for the North-Eastern, Midland and South-Eastern regions (75-79%). Patterns based on the most recent four years (1998-2001) were broadly similar to the longer-term average, with the proportion again highest for the Eastern and Southern regions (98-99%), lowest for the North-Eastern, Midland and Mid-Western regions (77-79%) (*Table 4.5.2*).

Table 4.5.2 Breakdown of colorectal cancer surgery, 1994-2001, by region of residence and region where main surgery was performed, expressed as percentages of surgically-treated cases. Only surgical procedures within 6 months of diagnosis are included.

Region where treated	Region of residence																	
	1994-2001 total									1998-2001 subtotal								
	E	M	MW	NE	NW	S	SE	W	Total	E	M	MW	NE	NW	S	SE	W	Total
Eastern	% 98.5	13.8	4.9	24.6	10.8	0.9	10.0	3.8	38.4	98.4	13.0	5.7	21.7	10.7	0.8	8.2	3.7	37.5
Midland	% 0.5	76.0	0.7	0.2	0.7	0.0	0.5	0.1	4.5	0.4	78.5	0.9	0.4	0.8	0.0	0.7	0.2	4.3
Mid-Western	% 0.0	0.3	82.7	0.0	0.0	0.2	1.0	0.1	6.9	0.0	0.4	79.3	0.0	0.0	0.2	0.7	0.0	6.9
North-Eastern	% 0.5	1.0	0.0	74.6	3.3	0.0	0.0	0.0	7.1	0.6	1.1	0.0	77.0	4.0	0.0	0.0	0.0	7.6
North-Western	% 0.0	0.0	0.0	0.3	84.2	0.0	0.1	1.3	6.0	0.1	0.0	0.0	0.4	83.5	0.0	0.2	2.1	6.1
Southern	% 0.1	0.0	5.1	0.0	0.0	98.8	9.5	0.0	17.5	0.2	0.0	5.5	0.0	0.0	98.7	4.1	0.0	17.1
South-Eastern	% 0.2	0.3	3.3	0.1	0.0	0.1	79.0	0.0	8.6	0.3	0.4	4.6	0.2	0.0	0.2	86.0	0.0	9.5
Western	% 0.1	8.4	3.4	0.1	0.6	0.0	0.0	94.7	11.0	0.2	6.7	4.1	0.2	0.5	0.0	0.0	94.1	10.9
Northern Ireland	% 0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0

4.5.4 Hospital caseloads (surgical cases)

Colorectal cancer cases were surgically treated (within six months of diagnosis) in a total of 59 hospitals in the Republic of Ireland during 1994-2001 (*Table 4.5.3*). There was no strong evidence of any trend in numbers of hospitals providing surgical treatment, although slightly fewer hospitals were involved for cases diagnosed during 1998-2001 (54) than during 1994-97 (57).

About one-fifth (8-11 annually) of the hospitals involved in surgery in any given year treated fewer than 10 surgical cases each, accounting for between 2.5% and 6.3% of annual totals. About two-fifths (19-25) of the hospitals treated fewer than 20 surgical cases each in a given year (12% to 18% of annual totals), and over three-quarters (38-45) treated fewer than 50 cases (53% to 72% of annual totals).

There was a modest tendency for average hospital caseload to increase during the period 1994-2001. Significant declines were seen in the proportions of surgical cases treated in 'low volume' hospitals (using thresholds of <10 and <50 cases annually). However, no trend was apparent based on a threshold of <20 cases annually. Based on surgical caseloads averaged over four-year periods, there was an increase from 23 annual cases per hospital during 1994-97 to 26 cases per hospital during 1998-2001. The proportion of surgical cases treated in hospitals treating 50 or more cases per

year increased significantly from 30% during 1994-97 to 36% during 1998-2001.

4.5.5 Consultant caseloads (surgical cases)

At least 293 individual consultants were coded as responsible for surgical managements of colorectal cancers during 1994-2001. Of these, there were more during 1998-2001 (241) than 1994-97 (197) (*Table 4.5.4*).

About one-quarter of surgical consultants in any given year treated fewer than 10 surgical cases each, accounting for 19%-27% of annual totals. More than half of the consultants treated fewer than 20 surgical cases each in a given year (54%-67% of annual totals), and almost all treated fewer than 50 cases (99-100% of annual totals).

There was limited (and somewhat conflicting) evidence that average annual caseloads increased over time. Significant declines during 1994-2001 were seen in the proportions of surgical patients treated by 'low volume' consultants if defined using caseloads of less than 20 (or less than 50) cases annually, but a significant increase if defined using caseloads of less than 10 cases annually (*Table 4.5.4*). These trends and their interpretation could be further complicated, however, if recording of multiple surgical treatments has been more complete in recent years. This might increase recorded caseloads, and the apparent proportion of patients treated by higher-volume surgeons.

Table 4.5.3 Summary of surgical caseloads by year of diagnosis and hospital, based on colorectal cancer patients having surgical treatment within six months of diagnosis (invasive cancers only). For this table, but not main treatment analyses, patients are counted once (for a given diagnosis year or diagnosis period) for *each* hospital where surgical treatment received, excluding unidentified hospitals and those outside the Republic of Ireland.

	1994	1995	1996	1997	1998	1999	2000	2001		94-97	98-01	
hospitals (1+ case)	48	52	50	51	50	49	50	49		57	54	
case average	28	24	26	28	28	28	28	29		23	26	
<10 cases/year ^a	13	11	9	10	8	9	8	9		17	13	
% of cases	6.3	3.6	2.7	2.7	2.5	3.0	2.6	2.8	***	3.8	3.1	*
<20 cases/year	19	25	23	20	19	21	22	20		30	26	
% of cases	13.2	17.9	16.6	11.6	13.4	14.9	17.3	12.1		17.7	16.1	*
<50 cases/year	40	45	43	44	44	41	44	38		51	46	
% of cases	60.6	66.1	65.2	65.7	70.6	60.0	71.8	52.8	*	69.9	63.7	***
50+ cases/year	8	7	7	7	6	8	6	11		6	8	
% of cases	39.4	33.9	34.8	34.3	29.4	40.0	28.2	47.2	*	30.1	36.3	***

^aSurgical caseloads per year (individual years or averaged across four years – latter not equivalent to average of annual caseloads).

* P<0.05, ** P<0.01, *** P<0.001: significant trend (1994 to 2001, Mantel's trend test, 1 d.f.) or difference (1994-97 v. 1998-01, χ^2 test, 1 d.f.) in proportion of patients treated in hospitals of a given caseload

Table 4.5.4 Summary of surgical caseloads by year of diagnosis and surgical consultant, based on colorectal cancer patients having surgical treatment within six months of diagnosis (invasive cancers only). For this table, but not main treatment analyses, patients are counted once (for a given diagnosis year or diagnosis period) for *each* surgical consultant involved, excluding unknown consultants and those based outside the Republic of Ireland

caseload category	1994	1995	1996	1997	1998	1999	2000	2001		94-97	98-01	
consultants (1+ case)	133	129	136	132	150	138	157	171		197	241	
case average	10	10	10	11	9	10	9	8		7	6	
<10 cases/year ^a	81	76	80	73	98	87	102	119		148	195	
% of cases	23.0	22.6	21.8	18.6	25.2	23.6	25.1	27.2	***	28.6	33.1	***
<20 cases/year	118	110	122	114	130	118	140	149		181	224	
% of cases	64.9	57.5	66.7	59.7	56.2	54.0	63.0	53.5	***	64.4	62.2	*
<50 cases/year	133	129	135	131	148	136	155	170		196	239	
% of cases	100	100	99.3	99.2	98.7	98.6	98.7	99.4	***	99.5	99.2	***
50+ cases/year	0	0	1	1	2	2	2	1		1	2	
% of cases	0.0	0.0	4.4	4.7	8.4	9.2	7.9	3.7	***	3.8	7.9	***

^aSurgical caseloads per year (individual years or averaged across four years – latter not equivalent to average of annual caseloads).

* P<0.05, ** P<0.01, *** P<0.001: significant trend (1994 to 2001, Mantel's trend test, 1 d.f.) or difference (1994-97 v. 1998-01, χ^2 test, 1 d.f.) in proportion of patients treated by surgical consultants of a given caseload.

4.5.6 Variation by patient and tumour characteristics

More detailed comparisons are made under the section covering logistic regression analysis (*section 4.6.1*). Basic tabulations of treatment for each category of patient or tumour are shown in *Table 4.5.5*. Note that cases lacking information on a given characteristic tend to be less likely to receive a given treatment. It should also be noted that these tabulations are based on unadjusted data

– thus patients or tumours compared under a given variable may also differ in other characteristics, some of which may be more important determinants of treatment.

See also *Table 4.5.1* and *Figure 4.5.1* for further summaries of treatments in relation to age.

Table 4.5.5 Summary of treatment of colorectal cancer cases, 1998-2001, by patient and tumour characteristics: unadjusted percentages receiving treatment within six months of diagnosis. See *Table 4.2.2* for sample sizes.

	Overall treatment	Surgery	Radiotherapy	Chemotherapy
total cases	83.7%	76.8%	14.3%	33.5%
age 15-44 ^a	92.9%	83.0%	21.3%	64.4%
age 45-54	93.3%	81.5%	24.3%	59.7%
age 55-64	91.6%	84.0%	19.6%	52.0%
age 65-74	87.4%	79.5%	16.3%	36.6%
age 75+	72.1%	68.2%	5.9%	9.4%
male	85.1%	77.6%	17.0%	36.4%
female	81.9%	75.8%	10.8%	29.6%
stage I	98.1%	96.9%	7.6%	10.5%
stage II	97.7%	95.1%	14.2%	34.3%
stage III	98.1%	94.2%	22.2%	60.8%
stage IV	66.8%	50.4%	9.7%	39.0%
stage X	79.7%	74.2%	15.3%	24.8%
T1	93.1%	90.8%	4.9%	8.4%
T2	96.9%	93.9%	12.7%	22.2%
T3	96.8%	94.1%	14.9%	42.5%
T4	79.7%	66.7%	18.4%	40.1%
T X	36.7%	18.9%	13.1%	18.1%
N negative	96.2%	93.7%	11.7%	25.5%
N positive	95.7%	90.2%	18.3%	55.4%
N X	49.0%	33.5%	13.6%	18.8%
M negative	94.4%	90.4%	17.2%	37.4%
M positive	66.8%	50.4%	9.7%	38.8%
M X	81.1%	76.6%	13.7%	25.4%
grade 1	92.2%	85.6%	12.9%	28.8%
grade 2	93.4%	88.7%	14.8%	37.3%
grade 3+	90.0%	81.5%	18.4%	41.0%
grade X	55.3%	44.0%	11.7%	22.5%
colon	82.8%	78.4%	3.8%	31.5%
rectosigmoid	85.4%	79.8%	16.1%	36.1%
rectum/anus	85.1%	73.1%	34.4%	36.7%
MV yes	90.1%	83.3%	15.2%	36.0%
MV no	11.7%	3.8%	4.3%	4.9%
MV X	13.6%	6.8%	4.5%	6.8%
symptomatic	84.1%	77.1%	14.4%	33.8%
incidental	80.0%	76.3%	6.3%	21.3%
screen detected	90.0%	90.0%	10.0%	26.7%
presentation X	76.0%	69.3%	15.0%	30.3%
non-smoker	85.2%	79.0%	13.1%	35.7%
ex-smoker	86.0%	79.6%	14.0%	32.6%
smoker	85.5%	77.9%	19.1%	35.8%
smoking status X	77.4%	69.4%	12.8%	27.5%
ever married	85.3%	78.4%	14.4%	35.3%
never married	80.9%	73.4%	15.3%	28.4%
marital status X	60.4%	57.2%	5.9%	18.5%

^aSee *Table 4.5.1* for a further breakdown by age, for the overall period 1994-2001.

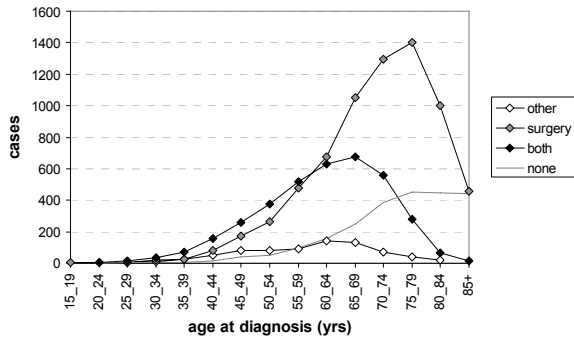


Figure 4.5.1 Age-profiles for tumour-directed treatments within six months of diagnosis for colorectal cancer cases diagnosed 1994-2001: numbers of cases having surgery (only), other treatments (radiotherapy, chemotherapy or hormone therapy but not surgery), both surgery and other treatments, or no treatment.

4.5.7 National trends

See *section 4.5.2*.

4.5.8 Regional variation

Regional variations in treatment, unadjusted for patients or tumour characteristics, are summarized for the period 1998-2001 in *Figure 4.5.2*. Overall treatment varied little between regions (range 80-86% of regional cases), use of surgery to a slightly greater extent (70-82%). More substantial variation was apparent for chemotherapy (ranging from 26% of cases in the Mid-Western to 46% in the South-Eastern region) and radiotherapy (from 9% in the Mid-Western to 20% in the Midland region). The degree of variation was broadly similar during earlier years (not presented) although precise patterns differed somewhat. More rigorous comparisons of treatments between regions, taking account of age and where possible other patient and tumour characteristics, are presented in *section 4.6.3*.

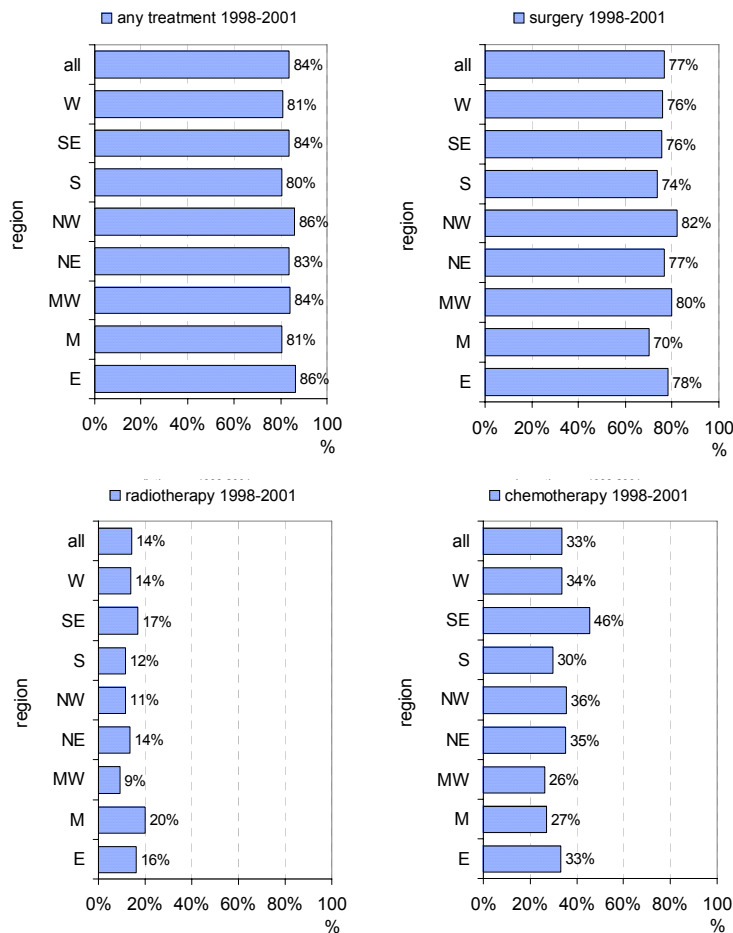


Figure 4.5.2 Percentage of colorectal cancer cases having tumour-directed treatment within six months of diagnosis, by region of residence, 1998-2001.

4.6 Treatment: logistic regression analysis

4.6.1 Variation by patient and tumour characteristics

Preliminary multivariate logistic regression models were used to assess variation in treatments in relation to patient and tumour characteristics other than region of residence and year of diagnosis (before examining those). Comparisons here are with baseline groups for relevant variables – diagnosis age 15-44, male, T category 1 (smallest size/local extension), N negative (no nodal involvement), M negative (no distant metastasis), colon (colorectal site), tumour grade 1, microscopically verified (MV), symptomatic method of presentation, non-smoker and ever married – having adjusted for all variables shown in the relevant table (*Tables 4.6.1-4*). The main comparisons are based on data for 1994-2001 as a whole. However, attention is drawn to any significant differences in patterns between the diagnosis periods 1994-97 and 1998-2001 (details also tabulated).

Overall treatment

For 1994-2001 as a whole, treatment was significantly less likely, compared with baseline groups, for patients aged 55 or above; T category 4 or unknown; N category unknown; M category positive or unknown; grade unknown; cases lacking microscopic verification (MV) or with MV status unknown; and for patients who were never married (*Table 4.6.1*). Cases in T category 2 or 3 were significantly more likely to be treated. Patterns in general were similar for the diagnosis periods 1994-97 and 1998-2001, although the magnitude or significance of relative risk values (RRs) showed some changes. The only significant differences between these periods were for cases in the T 3, M positive or M unknown categories, incidentally detected cases and patients of unknown marital status.

Surgical treatment

Surgical treatment was significantly less likely for age-groups 45 or over and cases that were T category 4 or unknown; N category unknown; metastatic; grade 3+ or unknown; sited in the rectum or anus; lacking MV or with MV status unknown; and for patients who were never married or whose smoking status was unknown (*Table 4.6.2*). Patterns varied between diagnosis periods to a greater extent than for overall treatment, with significant differences in RRs for T categories 2, 3, and unknown; M category unknown; grade 2 and 3+; rectal/anal site; incidentally detected cases; smokers; and marital status unknown.

Radiotherapy

Variation was greater than for surgical treatment. Radiotherapy use was significantly lower for patients aged 55 or over, and for women; metastatic cases or M category unknown; cases lacking MV; and marital status unknown (*Table 4.6.3*). Its use was significantly higher, relative to baseline groups, for cases that were T category 2-4 or unknown; N positive or N unknown; grade 3+; and sited in the rectosigmoid junction or, especially, the rectum or anus. These patterns were broadly similar for 1994-97 and 1998-2001, and RRs differed significantly only for rectal/anal cancers (higher RR latterly) and metastatic cases.

Chemotherapy

Chemotherapy use was significantly less likely among patients aged 45 or over (*Table 4.6.4*), and age-related variation was greater than for other treatment modalities. Its use was also less for female patients, and cases that with M category unknown, lacking MV or with MV status unknown, and for patients who were smokers, never married or of unknown smoking or marital status. Chemotherapy use was significantly more likely for cases coded as T 2-4 or unknown; N positive or unknown; grade 2 or 3+; or rectal/anal. RR estimates differed significantly between diagnosis periods for age-group 65-74, cases of unknown nodal status and rectal/anal tumours, otherwise patterns were broadly similar.

Table 4.6.1 Risk ratios for overall treatment of colorectal cancer patients (within six months of diagnosis), by patient and tumour variables other than year of diagnosis and region of residence, for cases diagnosed 1994-2001: multivariate model.

Variable value ^b	1994-2001		1994-1997		1998-2001	
	^a RR (95% CI)	P	RR (95% CI)	P	RR (95% CI)	P
age 15-44	1.000		1.000		1.000	
age 45-54	0.979 (0.932-1.009)	0.208	0.962 (0.875-1.005)	0.108	0.992 (0.926-1.030)	0.755
age 55-64	0.939 (0.880-0.981)	0.001	0.903 (0.779-0.973)	0.001	0.971 (0.899-1.016)	0.262
age 65-74	0.887 (0.811-0.943)	0.000	0.841 (0.687-0.938)	0.000	0.926 (0.835-0.986)	0.010
age 75+	0.771 (0.668-0.856)	0.000	0.743 (0.556-0.878)	0.000	0.787 (0.652-0.891)	0.000
male	1.000		1.000		1.000	
female	0.991 (0.967-1.012)	0.434	0.992 (0.957-1.024)	0.674	0.994 (0.962-1.022)	0.730
T1	1.000		1.000		1.000	
T2	1.036 (1.009-1.055)	0.012	1.060 (1.021-1.085)	0.006	1.015 (0.972-1.040)	0.412
T3	1.035 (1.012-1.052)	0.004	1.062 (1.030-1.084)	0.001 *	1.013 (0.976-1.036)	0.420
T4	0.909 (0.853-0.954)	0.000	0.928 (0.850-0.989)	0.017	0.883 (0.794-0.948)	0.000
T X	0.779 (0.706-0.843)	0.000	0.796 (0.695-0.883)	0.000	0.746 (0.630-0.843)	0.000
N negative	1.000		1.000		1.000	
N positive	0.999 (0.990-1.007)	0.955	0.992 (0.976-1.005)	0.297	1.006 (0.994-1.014)	0.269
N X	0.887 (0.860-0.911)	0.000	0.898 (0.860-0.929)	0.000	0.876 (0.835-0.911)	0.000
M negative	1.000		1.000		1.000	
M positive	0.882 (0.854-0.907)	0.000	0.843 (0.795-0.883)	0.000 *	0.920 (0.885-0.948)	0.000
M X	0.980 (0.967-0.992)	0.000	0.967 (0.946-0.985)	0.000 *	0.994 (0.977-1.008)	0.479
grade 1	1.000		1.000		1.000	
grade 2	0.992 (0.969-1.010)	0.443	0.971 (0.934-1.000)	0.057	1.009 (0.977-1.031)	0.518
grade 3+	0.979 (0.949-1.003)	0.105	0.953 (0.903-0.991)	0.012	1.001 (0.961-1.029)	0.915
grade X	0.964 (0.934-0.989)	0.004	0.957 (0.912-0.992)	0.013	0.967 (0.919-1.002)	0.077
colon	1.000		1.000		1.000	
rectosigmoid	0.998 (0.951-1.039)	0.960	0.999 (0.932-1.053)	0.978	0.995 (0.923-1.052)	0.901
rectum/anus	1.003 (0.976-1.027)	0.810	1.002 (0.963-1.037)	0.874	1.002 (0.964-1.036)	0.883
MV yes	1.000		1.000		1.000	
MV no	0.541 (0.472-0.611)	0.000	0.498 (0.400-0.600)	0.000	0.584 (0.486-0.679)	0.000
MV X	0.718 (0.548-0.862)	0.000	0.719 (0.491-0.903)	0.000	0.761 (0.499-0.947)	0.004
symptomatic	1.000		1.000		1.000	
incidental	0.942 (0.809-1.039)	0.284	0.786 (0.573-0.960)	0.011 *	1.059 (0.919-1.131)	0.329
screen detected	0.995 (0.702-1.132)	0.964	1.099 (0.638-1.197)	0.511	0.831 (0.388-1.090)	0.303
presentation X	0.943 (0.869-1.005)	0.075	0.847 (0.700-0.966)	0.009	0.977 (0.886-1.045)	0.556
non-smoker	1.000		1.000		1.000	
ex-smoker	1.012 (0.982-1.039)	0.386	1.021 (0.977-1.057)	0.318	1.010 (0.965-1.046)	0.631
smoker	0.985 (0.955-1.013)	0.326	0.976 (0.931-1.015)	0.256	0.999 (0.955-1.035)	0.968
smoking status X	0.980 (0.949-1.007)	0.160	0.961 (0.913-1.003)	0.076	0.993 (0.951-1.028)	0.743
ever married	1.000		1.000		1.000	
never married	0.965 (0.935-0.992)	0.011	0.954 (0.909-0.994)	0.024	0.980 (0.939-1.015)	0.283
marital status X	0.982 (0.920-1.032)	0.522	1.071 (1.008-1.115)	0.029 *	0.839 (0.711-0.943)	0.001

^aRisk ratios derived from adjusted odds ratios using the method of Zhang & Yu (1998).^bUnknown values shown as "X" for T category, N category, M category, grade, microscopic verification (MV), method of presentation, marital status and smoking status.

*Significant difference in RR between diagnosis periods.

Table 4.6.2 Risk ratios for surgical treatment of colorectal cancer patients (within six months of diagnosis), by patient and tumour variables other than year of diagnosis and region of residence, for cases diagnosed 1994-2001: multivariate model.

Variable value ^b	1994-2001		1994-97		1998-2001	
	^a RR (95% CI)	P	RR (95% CI)	P	RR (95% CI)	P
age 15-44	1.000		1.000		1.000	
age 45-54	0.910 (0.826-0.977)	0.006	0.909 (0.788-0.991)	0.026	0.903 (0.773-1.005)	0.066
age 55-64	0.926 (0.850-0.986)	0.014	0.899 (0.782-0.981)	0.010	0.946 (0.832-1.032)	0.251
age 65-74	0.869 (0.785-0.938)	0.000	0.846 (0.716-0.943)	0.000	0.883 (0.760-0.981)	0.017
age 75+	0.823 (0.732-0.900)	0.000	0.800 (0.659-0.910)	0.000	0.840 (0.710-0.947)	0.002
male	1.000		1.000		1.000	
female	1.003 (0.974-1.030)	0.788	1.018 (0.978-1.055)	0.343	0.991 (0.948-1.030)	0.692
T1	1.000		1.000		1.000	
T2	1.013 (0.975-1.042)	0.458	1.049 (1.003-1.081)	0.039 *	0.971 (0.902-1.019)	0.285
T3	1.004 (0.969-1.032)	0.761	1.040 (0.996-1.071)	0.067 *	0.967 (0.904-1.012)	0.177
T4	0.775 (0.699-0.842)	0.000	0.829 (0.728-0.912)	0.000	0.707 (0.589-0.812)	0.000
T X	0.555 (0.474-0.636)	0.000	0.647 (0.533-0.754)	0.000 *	0.454 (0.342-0.573)	0.000
N negative	1.000		1.000		1.000	
N positive	0.990 (0.984-1.006)	0.522	0.994 (0.977-1.008)	0.496	0.998 (0.981-1.012)	0.874
N X	0.809 (0.775-0.841)	0.000	0.827 (0.778-0.870)	0.000	0.785 (0.733-0.832)	0.000
M negative	1.000		1.000		1.000	
M positive	0.770 (0.733-0.805)	0.000	0.752 (0.695-0.803)	0.000	0.787 (0.734-0.835)	0.000
M X	1.001 (0.987-1.013)	0.865	0.983 (0.962-1.001)	0.069 *	1.016 (0.995-1.033)	0.114
grade 1	1.000		1.000		1.000	
grade 2	0.994 (0.964-1.019)	0.662	0.947 (0.899-0.986)	0.006 *	1.048 (1.009-1.079)	0.018
grade 3+	0.955 (0.913-0.990)	0.010	0.904 (0.838-0.958)	0.000 *	1.013 (0.956-1.057)	0.599
grade X	0.929 (0.886-0.967)	0.000	0.922 (0.863-0.969)	0.000	0.950 (0.882-1.004)	0.078
colon	1.000		1.000		1.000	
rectosigmoid	0.977 (0.921-1.027)	0.394	0.981 (0.904-1.046)	0.600	0.963 (0.875-1.037)	0.356
rectum/anus	0.847 (0.809-0.884)	0.000	0.903 (0.852-0.951)	0.000 *	0.788 (0.730-0.844)	0.000
MV yes	1.000		1.000		1.000	
MV no	0.294 (0.224-0.377)	0.000	0.309 (0.215-0.427)	0.000	0.270 (0.177-0.394)	0.000
MV X	0.646 (0.439-0.841)	0.000	0.711 (0.459-0.924)	0.004	0.543 (0.225-0.897)	0.006
symptomatic	1.000		1.000		1.000	
incidental	0.990 (0.837-1.102)	0.887	0.824 (0.592-1.013)	0.072 *	1.138 (0.962-1.228)	0.104
screen detected	1.152 (0.899-1.246)	0.176	1.209 (0.860-1.267)	0.145	1.014 (0.533-1.230)	0.940
presentation X	0.946 (0.858-1.022)	0.183	0.847 (0.684-0.984)	0.026	1.005 (0.895-1.091)	0.919
non-smoker	1.000		1.000		1.000	
ex-smoker	1.001 (0.962-1.036)	0.932	1.007 (0.953-1.053)	0.760	1.007 (0.949-1.056)	0.794
smoker	0.972 (0.935-1.006)	0.113	0.938 (0.883-0.986)	0.011 *	1.013 (0.961-1.058)	0.590
smoking status X	0.949 (0.910-0.986)	0.006	0.937 (0.879-0.988)	0.014	0.963 (0.905-1.013)	0.162
ever married	1.000		1.000		1.000	
never married	0.957 (0.920-0.991)	0.013	0.934 (0.880-0.982)	0.007	0.978 (0.925-1.025)	0.395
marital status X	1.053 (0.985-1.106)	0.114	1.113 (1.042-1.162)	0.004 *	0.931 (0.792-1.041)	0.248

^aRisk ratios derived from adjusted odds ratios using the method of Zhang & Yu (1998).^bUnknown values shown as "X" for T category, N category, M category, grade, microscopic verification (MV), method of presentation, marital status and smoking status.

*Significant difference in RR between diagnosis periods.

Table 4.6.3 Risk ratios for radiotherapy of colorectal cancer patients (within six months of diagnosis), by patient and tumour variables other than year of diagnosis and region of residence, for cases diagnosed 1994-2001: multivariate model.

Variable value ^b	1994-2001		1994-97		1998-2001	
	^a RR (95% CI)	P	RR (95% CI)	P	RR (95% CI)	P
age 15-44	1.000		1.000		1.000	
age 45-54	0.989 (0.772-1.251)	0.935	0.889 (0.606-1.273)	0.535	1.081 (0.775-1.464)	0.633
age 55-64	0.772 (0.604-0.976)	0.031	0.660 (0.454-0.942)	0.022	0.890 (0.640-1.208)	0.468
age 65-74	0.591 (0.461-0.752)	0.000	0.452 (0.309-0.653)	0.000	0.736 (0.528-1.005)	0.055
age 75+	0.204 (0.153-0.271)	0.000	0.157 (0.100-0.243)	0.000	0.238 (0.161-0.348)	0.000
male	1.000		1.000		1.000	
female	0.844 (0.754-0.943)	0.003	0.885 (0.738-1.059)	0.185	0.819 (0.707-0.945)	0.006
T1	1.000		1.000		1.000	
T2	2.945 (2.008-4.239)	0.000	2.733 (1.456-4.950)	0.002	3.081 (1.894-4.819)	0.000
T3	5.213 (3.730-7.089)	0.000	4.821 (2.731-8.075)	0.000	5.577 (3.697-7.956)	0.000
T4	8.103 (5.982-10.55)	0.000	7.985 (4.662-12.59)	0.000	7.921 (5.473-10.67)	0.000
T X	5.055 (3.537-7.012)	0.000	3.944 (2.114-6.994)	0.000	5.704 (3.711-8.238)	0.000
N negative	1.000		1.000		1.000	
N positive	1.630 (1.441-1.839)	0.000	1.608 (1.309-1.966)	0.000	1.640 (1.404-1.905)	0.000
N X	1.430 (1.204-1.691)	0.000	1.607 (1.216-2.104)	0.001	1.358 (1.089-1.679)	0.007
M negative	1.000		1.000		1.000	
M positive	0.465 (0.393-0.548)	0.000	0.591 (0.456-0.764)	0.000	0.401 (0.321-0.499)	0.000
M X	0.879 (0.779-0.991)	0.036	1.009 (0.826-1.227)	0.926	0.842 (0.721-0.980)	0.026
grade 1	1.000		1.000		1.000	
grade 2	1.115 (0.919-1.346)	0.265	1.203 (0.897-1.601)	0.214	0.965 (0.740-1.246)	0.790
grade 3+	1.381 (1.108-1.710)	0.004	1.390 (0.992-1.926)	0.056	1.326 (0.985-1.753)	0.062
grade X	1.190 (0.949-1.482)	0.129	1.233 (0.864-1.740)	0.245	1.050 (0.775-1.402)	0.748
colon	1.000		1.000		1.000	
rectosigmoid	4.063 (3.370-4.871)	0.000	3.762 (2.819-4.964)	0.000	4.397 (3.431-5.568)	0.000
rectum/anus	8.708 (7.870-9.595)	0.000	6.831 (5.751-8.048)	0.000	10.20 (9.023-11.44)	0.000
MV yes	1.000		1.000		1.000	
MV no	0.526 (0.366-0.749)	0.000	0.508 (0.285-0.892)	0.018	0.568 (0.355-0.892)	0.013
MV X	0.852 (0.334-1.967)	0.725	1.177 (0.349-3.334)	0.783	0.659 (0.141-2.374)	0.566
symptomatic	1.000		1.000		1.000	
incidental	0.461 (0.201-1.015)	0.055	0.216 (0.029-1.415)	0.115	0.593 (0.228-1.417)	0.254
screen detected	0.603 (0.169-1.903)	0.412	-	-	0.898 (0.237-2.667)	0.865
presentation X	1.292 (0.976-1.689)	0.073	1.402 (0.811-2.329)	0.221	1.122 (0.801-1.539)	0.492
non-smoker	1.000		1.000		1.000	
ex-smoker	1.090 (0.932-1.271)	0.278	1.120 (0.871-1.432)	0.372	1.045 (0.851-1.274)	0.669
smoker	1.066 (0.930-1.219)	0.353	0.967 (0.776-1.200)	0.767	1.168 (0.979-1.386)	0.083
smoking status X	1.019 (0.873-1.186)	0.807	0.868 (0.667-1.123)	0.285	1.099 (0.905-1.326)	0.333
ever married	1.000		1.000		1.000	
never married	0.929 (0.809-1.065)	0.295	0.813 (0.644-1.020)	0.075	1.025 (0.860-1.215)	0.776
marital status X	0.539 (0.358-0.801)	0.002	0.706 (0.400-1.216)	0.215	0.472 (0.258-0.842)	0.010

^aRisk ratios derived from adjusted odds ratios using the method of Zhang & Yu (1998).

^bUnknown values shown as "X" for T category, N category, M category, grade, microscopic verification (MV), method of presentation, marital status and smoking status.

*Significant difference in RR between diagnosis periods.

Table 4.6.4 Risk ratios for chemotherapy of colorectal cancer patients (within six months of diagnosis), by patient and tumour variables other than year of diagnosis and region of residence, for cases diagnosed 1994-2001: multivariate model.

Variable value ^b	1994-2001		1994-97		1998-2001	
	^a RR (95% CI)	P	RR (95% CI)	P	RR (95% CI)	P
age 15-44	1.000		1.000		1.000	
age 45-54	0.864 (0.769-0.958)	0.004	0.823 (0.683-0.963)	0.013	0.900 (0.771-1.023)	0.115
age 55-64	0.704 (0.618-0.792)	0.000	0.618 (0.502-0.744)	0.000	0.785 (0.664-0.905)	0.000
age 65-74	0.431 (0.367-0.502)	0.000	0.346 (0.269-0.438)	0.000	0.504 (0.406-0.613)	0.000
age 75+	0.109 (0.087-0.135)	0.000	0.083 (0.060-0.116)	0.000	0.121 (0.089-0.163)	0.000
male	1.000		1.000		1.000	
female	0.896 (0.838-0.957)	0.001	0.945 (0.847-1.051)	0.304	0.880 (0.807-0.957)	0.003
T1	1.000		1.000		1.000	
T2	2.625 (1.994-3.402)	0.000	2.696 (1.729-4.068)	0.000	2.528 (1.770-3.498)	0.000
T3	5.040 (4.071-6.101)	0.000	4.852 (3.340-6.730)	0.000	5.203 (4.039-6.430)	0.000
T4	5.109 (4.095-6.222)	0.000	4.826 (3.258-6.795)	0.000	4.967 (3.783-6.237)	0.000
T X	3.734 (2.869-4.751)	0.000	2.858 (1.785-4.400)	0.000	4.084 (2.980-5.353)	0.000
N negative	1.000		1.000		1.000	
N positive	2.184 (2.063-2.306)	0.000	2.185 (1.972-2.408)	0.000	2.169 (2.032-2.304)	0.000
N X	1.149 (1.020-1.289)	0.023	1.367 (1.134-1.632)	0.001	* 1.049 (0.896-1.216)	0.541
M negative	1.000		1.000		1.000	
M positive	0.987 (0.905-1.072)	0.764	1.056 (0.918-1.207)	0.434	0.975 (0.873-1.082)	0.654
M X	0.776 (0.716-0.839)	0.000	0.791 (0.693-0.899)	0.000	0.789 (0.713-0.869)	0.000
grade 1	1.000		1.000		1.000	
grade 2	1.162 (1.042-1.289)	0.007	1.046 (0.889-1.222)	0.575	1.164 (0.999-1.343)	0.051
grade 3+	1.219 (1.073-1.377)	0.003	1.171 (0.967-1.400)	0.102	1.219 (1.018-1.436)	0.031
grade X	1.116 (0.974-1.269)	0.110	0.952 (0.765-1.170)	0.649	1.135 (0.944-1.343)	0.171
colon	1.000		1.000		1.000	
rectosigmoid	1.063 (0.944-1.190)	0.307	1.062 (0.880-1.268)	0.520	1.071 (0.916-1.238)	0.376
rectum/anus	1.157 (1.080-1.238)	0.000	0.975 (0.864-1.097)	0.689	* 1.263 (1.162-1.367)	0.000
MV yes	1.000		1.000		1.000	
MV no	0.355 (0.259-0.479)	0.000	0.388 (0.236-0.624)	0.000	0.361 (0.240-0.528)	0.000
MV X	0.371 (0.138-0.885)	0.023	0.248 (0.033-1.376)	0.125	0.593 (0.196-1.367)	0.262
symptomatic	1.000		1.000		1.000	
incidental	0.742 (0.509-1.044)	0.090	0.769 (0.424-1.303)	0.349	0.729 (0.444-1.117)	0.159
screen detected	1.014 (0.566-1.623)	0.958	1.447 (0.525-2.816)	0.436	0.803 (0.379-1.437)	0.507
presentation X	1.080 (0.892-1.289)	0.416	0.820 (0.512-1.254)	0.378	1.029 (0.829-1.248)	0.785
non-smoker	1.000		1.000		1.000	
ex-smoker	0.989 (0.901-1.081)	0.818	0.971 (0.832-1.127)	0.712	0.986 (0.877-1.100)	0.809
smoker	0.886 (0.812-0.964)	0.005	0.903 (0.787-1.032)	0.137	0.892 (0.796-0.993)	0.038
smoking status X	0.835 (0.758-0.918)	0.000	0.806 (0.684-0.945)	0.008	0.832 (0.737-0.934)	0.002
ever married	1.000		1.000		1.000	
never married	0.746 (0.679-0.817)	0.000	0.702 (0.601-0.816)	0.000	0.779 (0.692-0.874)	0.000
marital status X	0.799 (0.634-0.992)	0.042	0.971 (0.688-1.325)	0.862	0.723 (0.522-0.968)	0.029

^aRisk ratios derived from adjusted odds ratios using the method of Zhang & Yu (1998).^bUnknown values shown as "X" for T category, N category, M category, grade, microscopic verification (MV), method of presentation, marital status and smoking status.

*Significant difference in RR between diagnosis periods.

4.6.2 National and regional trends

Overall treatment

Over the period 1996-2001, nationally there was a small but significant average annual increase in overall treatment within six months of diagnosis, by *c.*0.6% per year in relative terms, having adjusted for age and sex, or *c.*0.9% per year after further adjustment for stage-related variables (Table 4.6.5). At regional scales, significant increases were also seen for patients resident in the Eastern and South-Eastern regions (+1.0% and +3.4% per year, respectively). Other regions showed no significant trends.

Table 4.6.5 Average annual changes in the proportion of colorectal cancer patients having any tumour-directed treatment (within six months of diagnosis), overall and by region of residence, 1996-2001.

	1996-2001 annual ^a RR (95% CI)	P
age- & sex-adjusted		
total	1.006 (1.000-1.012)	0.021
E	1.010 (1.001-1.018)	0.023
M	0.985 (0.962-1.006)	0.172
MW	0.994 (0.977-1.009)	0.478
NE	0.992 (0.973-1.009)	0.413
NW	1.022 (0.998-1.044)	0.067
S	1.008 (0.994-1.022)	0.224
SE	1.034 (1.008-1.058)	0.010
W	1.002 (0.984-1.019)	0.791
age-, sex-, stage-adjusted ^b		
total	1.009 (1.002-1.017)	0.012

^aRisk ratios derived from adjusted odds ratios using the method of Zhang & Yu (1998).

^bT categories 1-4 & unknown; N category negative, positive, unknown; M category negative, positive, unknown.

Surgical treatment

Nationally, the use of surgery fell slightly but significantly between 1996 and 2001, by *c.*0.7% per year in relative terms, adjusted for age and sex, or *c.*1.5% after further adjustment for stage (Table 4.6.6). Most regions showed no trends, but significant age-adjusted declines were seen for the Midland and North-Eastern regions (by about 3.8% and 2.4% per year, respectively).

Table 4.6.6 Average annual changes in the proportion of colorectal cancer patients having surgical treatment (within six months of diagnosis), overall and by region of residence, 1996-2001.

	1996-2001 annual RR (95% CI)	P
age- & sex-adjusted		
total	0.993 (0.986-0.999)	0.027
E	0.998 (0.988-1.008)	0.789
M	0.962 (0.938-0.984)	0.001
MW	0.985 (0.967-1.002)	0.090
NE	0.976 (0.958-0.993)	0.008
NW	1.012 (0.986-1.037)	0.332
S	0.999 (0.983-1.014)	0.954
SE	0.997 (0.972-1.021)	0.847
W	0.998 (0.977-1.017)	0.849
age-, sex-, stage-adjusted		
total	0.985 (0.976-0.994)	0.002

Radiotherapy

Radiotherapy use increased significantly, at national scale, by *c.*11% annually in relative terms between 1996 and 2001 (Table 4.6.7). Patients from four of the eight regions (Midland, North-Eastern, Southern and South-Eastern) also showed significant increases, by 16-43% annually (adjusted for age and sex), but no clear trends for evident for other regions.

Table 4.6.7 Average annual changes in the proportion of colorectal cancer patients having radiotherapy (within six months of diagnosis), overall and by region of residence, 1996-2001.

	1996-2001 annual RR (95% CI)	P
age- & sex-adjusted		
total	1.108 (1.074-1.142)	0.000
E	1.041 (0.993-1.092)	0.092
M	1.427 (1.243-1.637)	0.000
MW	1.076 (0.943-1.227)	0.273
NE	1.156 (1.028-1.299)	0.015
NW	0.945 (0.837-1.064)	0.355
S	1.213 (1.107-1.327)	0.000
SE	1.273 (1.157-1.399)	0.000
W	1.068 (0.966-1.179)	0.195
age-, sex-, stage-adjusted		
total	1.106 (1.071-1.141)	0.000

Chemotherapy

As for radiotherapy, a marked increase was seen the proportion of patients nationally having chemotherapy within six months of diagnosis: by *c.*12% annually in relative terms between 1996 and 2001 after adjustment for age and sex, or *c.*13% annually after further adjustment for stage (*Table 4.6.8*). Similar or more marked increases were seen for five regions (Eastern, North-Eastern, Southern, South-Eastern and Western), by 10-31% annually in relative terms (age- and sex-adjusted). No significant trends were evident in the Midland, Mid-Western or North-Western regions.

Table 4.6.8 Average annual changes in the proportion of colorectal cancer patients having chemotherapy (within six months of diagnosis), overall and by region of residence, 1996-2001.

	1996-2001 annual RR (95% CI)	P
age- & sex-adjusted		
total	1.123 (1.101-1.146)	0.000
E	1.100 (1.066-1.135)	0.000
M	1.019 (0.939-1.102)	0.638
MW	1.020 (0.948-1.095)	0.591
NE	1.137 (1.059-1.219)	0.000
NW	0.979 (0.914-1.047)	0.555
S	1.309 (1.227-1.395)	0.000
SE	1.249 (1.176-1.325)	0.000
W	1.184 (1.109-1.263)	0.000
age-, sex-, stage-adjusted		
total	1.133 (1.109-1.158)	0.000

4.6.3 Regional variation

Regional variations in treatment use (relative risks compared with the Eastern region) are summarized in *Figures 4.6.1-3* for the overall period 1994-2001 and for the most recent diagnosis period, 1998-2001. Results of basic age- and sex-adjusted

models and of fully adjusted models are presented for overall treatment, surgical treatment, radiotherapy and chemotherapy. More detailed summaries, overall and for periods 1994-97 and 1998-2001, are presented in *Tables 4.6.9-12*.

Overall treatment

Regional variation in overall treatment was less marked than for individual treatment modalities (especially radiotherapy and chemotherapy). During 1994-2001 as a whole, patients from three regions (Midland, Southern and South-Eastern) were slightly but significantly less likely to be treated than those from the Eastern region, after adjustment for patients' age and sex (Table 4.6.9). This applied to two of these regions during 1994-97, and to four regions (additionally including North-Eastern and Western regions) in 1998-2001. Relative risk estimates (RRs) differed significantly between diagnosis periods for the North-Eastern and Western regions.

Regional patterns during 1994-2001 changed only slightly after further adjustment for stage-related variables, but this adjustment further accentuated regional differences specific to 1994-97 or 1998-2001. Fuller adjustment for patient and tumour variables reduced the amount of regional variation overall and for 1998-2001. In this final model, only the Midland and South-Eastern region has significant overall RRs (lower proportions treated) compared with the Eastern region, and only Midland and North-Eastern regions for 1998-2001. However, RRs differed significantly between diagnosis periods for three regions (Mid-Western, North-Eastern and Western).

Table 4.6.9 Risk ratios for overall treatment of colorectal cancer patients (within six months of diagnosis), by region of residence, for cases diagnosed 1994-2001. Relative risks in bold = significant difference from Eastern region (RR <1 = lower use of treatment than in Eastern region, RR >1 = higher use).

	1994-2001 ^a RR (95% CI)	P	1994-1997 RR (95% CI)	P	1998-2001 RR (95% CI)	P
basic model: sex-, age-adjusted ^b						
E	1.000		1.000		1.000	
M	0.950 (0.911-0.984)	0.003	0.959 (0.902-1.007)	0.103	0.940 (0.884-0.986)	0.010
MW	0.989 (0.957-1.017)	0.471	1.018 (0.972-1.056)	0.407	0.962 (0.916-1.001)	0.061
NE	0.991 (0.961-1.018)	0.554	1.023 (0.980-1.059)	0.259	0.962 (0.918-0.999)	0.044
NW	0.982 (0.949-1.011)	0.242	0.962 (0.912-1.005)	0.091	1.006 (0.962-1.041)	0.758
S	0.936 (0.910-0.961)	0.000	0.940 (0.901-0.975)	0.001	0.932 (0.895-0.965)	0.000
SE	0.937 (0.906-0.965)	0.000	0.907 (0.859-0.950)	0.000	0.966 (0.926-1.001)	0.059
W	0.977 (0.949-1.002)	0.076	1.012 (0.973-1.045)	0.493	0.942 (0.900-0.979)	0.001
fuller model: sex-, age-, stage-adjusted ^{b,c}						
E	1.000		1.000		1.000	
M	0.894 (0.832-0.948)	0.000	0.944 (0.862-1.009)	0.102	0.843 (0.743-0.927)	0.000
MW	1.006 (0.967-1.039)	0.727	1.070 (1.023-1.104)	0.005	0.928 (0.856-0.986)	0.013
NE	0.962 (0.918-1.000)	0.052	1.030 (0.975-1.073)	0.257	0.876 (0.801-0.940)	0.000
NW	0.963 (0.916-1.004)	0.082	0.982 (0.918-1.033)	0.532	0.954 (0.877-1.013)	0.143
S	0.941 (0.905-0.973)	0.000	0.945 (0.893-0.991)	0.018	0.932 (0.879-0.976)	0.002
SE	0.896 (0.849-0.938)	0.000	0.877 (0.808-0.938)	0.000	0.922 (0.857-0.975)	0.003
W	1.009 (0.976-1.037)	0.555	1.065 (1.026-1.096)	0.002	0.942 (0.883-0.991)	0.018
final multivariate model ^d						
E	1.000		1.000		1.000	
M	0.916 (0.852-0.971)	0.002	0.948 (0.860-1.017)	0.158	0.894 (0.795-0.972)	0.005
MW	1.013 (0.971-1.047)	0.516	1.070 (1.017-1.108)	0.012	0.945 (0.871-1.002)	0.064
NE	0.992 (0.951-1.027)	0.700	1.052 (1.000-1.092)	0.048	0.920 (0.848-0.979)	0.006
NW	0.992 (0.946-1.030)	0.715	1.026 (0.967-1.072)	0.340	0.950 (0.870-1.012)	0.130
S	0.989 (0.955-1.018)	0.480	0.993 (0.944-1.034)	0.772	0.983 (0.934-1.023)	0.446
SE	0.944 (0.900-0.982)	0.003	0.925 (0.858-0.982)	0.008	0.968 (0.908-1.016)	0.220
W	1.030 (0.999-1.057)	0.054	1.088 (1.052-1.115)	0.000	0.966 (0.908-1.012)	0.165

^aRisk ratios derived from adjusted odds ratios using the method of Zhang & Yu (1998). ^bAge-group 15-44, 45-54, 55-64, 65-74, or 75+.

^cT categories 1-4 & unknown; N category negative, positive, unknown; M category negative, positive, unknown.

^dAdjusted for age-group; T, N and M categories; grade; colon, rectosigmoid junction, or rectum/anus; microscopic verification status; marital status; individual year of diagnosis. [Sex, method of presentation and smoking status did not significantly improve model-fit and were excluded from the final model.]

*Significant difference in RR between diagnosis periods.

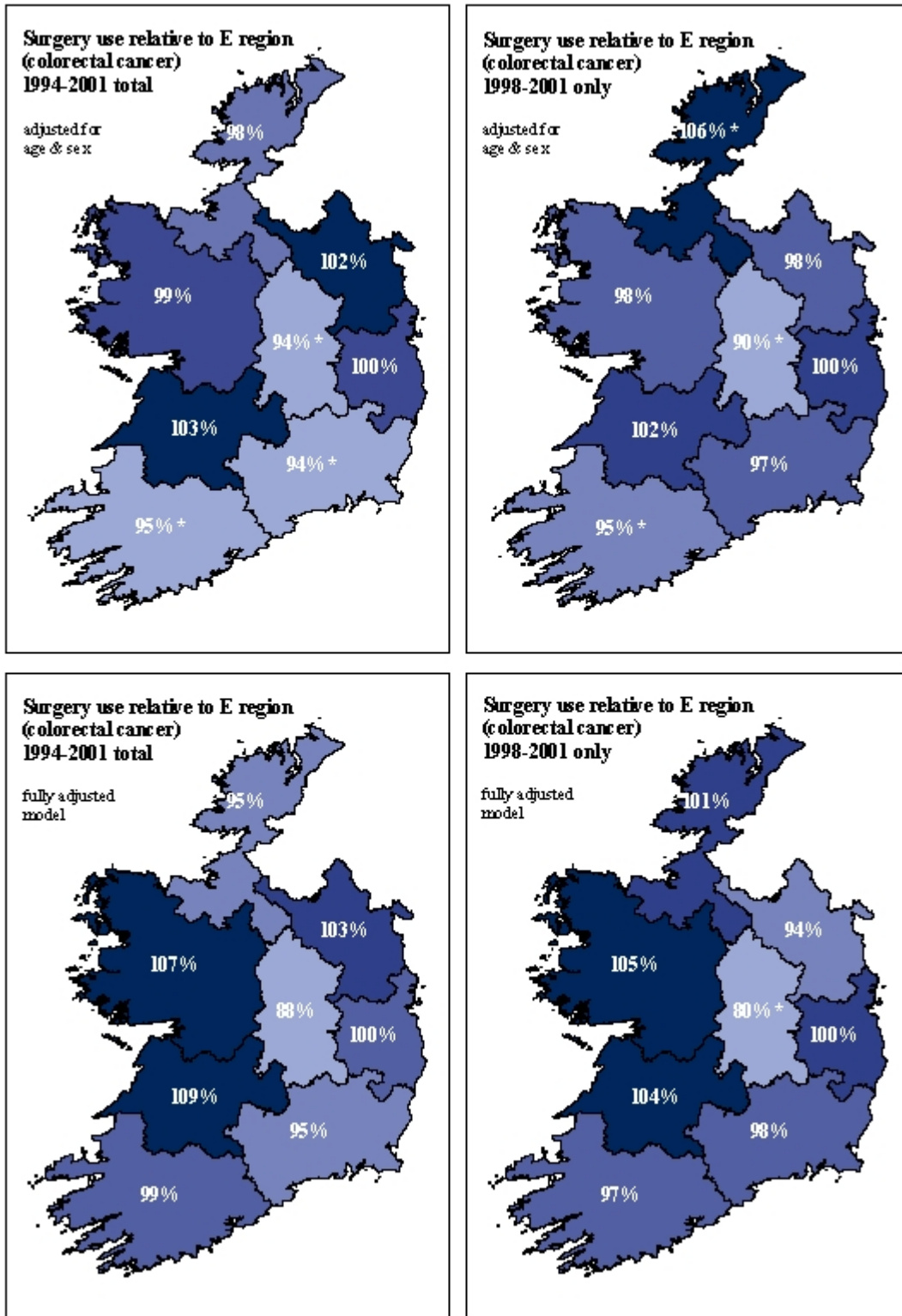


Figure 4.6.1 Regional variation in surgical treatment for colorectal cancer, expressed as risk ratios compared with patients from the Eastern region (100%): 1994-2001 total (left), 1998-2001 (right); basic age- and sex- adjusted model (top), fully-adjusted model (bottom). See *Table 4.6.10* for further details. * = significantly high or low values (P<0.05).

Surgical treatment

Patients from the Midland, Southern and South-Eastern regions, diagnosed during 1994-2001, were significantly *less* likely to receive surgical treatment than patients from the Eastern region (Figure 4.6.1, Table 4.6.10), allowing for regional variation in age or sex of patients. Regional patterns for 1994-97 and 1998-2001 differed in some details, but mainly involved lower use of surgery for patients from some regions. Relative risk estimates (RRs) differed significantly between periods for patients from the North-Eastern and North-Western regions.

Further adjustment for stage-related variables appeared to accentuate regional variations, and also the differences between diagnosis periods. But

somewhat less complex patterns were evident after fuller adjustment for a range of patient and tumour variables. For 1994-2001, there significantly low use of surgery in patients from the Midland and South-Eastern regions and significantly high use in those from the Mid-Western and Western regions, compared with the Eastern region. Based on variables included in the final models, regional variation appeared to be much less marked for cases diagnosed during 1998-2001 (significantly low use of surgery in the Midland region) than for 1994-97 (low use in two regions, high use in three regions). RRs for three regions (Midland, Mid-Western and North-Eastern) differed significantly between periods, although this involved an increase in RR for the Midland region.

Table 4.6.10 Risk ratios for surgical treatment of colorectal cancer patients (within six months of diagnosis), by region of residence, for cases diagnosed 1994-2001. Relative risks in bold = significant difference from Eastern region (RR <1 = lower use of treatment than in Eastern region, RR >1 = higher use).

	1994-2001 ^a RR (95% CI)	P	1994-1997 RR (95% CI)	P	1998-2001 RR (95% CI)	P
basic model: sex-, age-adjusted ^b						
E	1.000		1.000		1.000	
M	0.943 (0.898-0.984)	0.006	0.980 (0.919-1.032)	0.478	0.902 (0.834-0.963)	0.001
MW	1.029 (0.993-1.060)	0.102	1.045 (0.995-1.088)	0.073	1.016 (0.965-1.061)	0.500
NE	1.016 (0.981-1.047)	0.344	1.060 (1.013-1.099)	0.013	* 0.978 (0.927-1.024)	0.374
NW	0.979 (0.940-1.015)	0.278	0.908 (0.849-0.962)	0.000	* 1.058 (1.006-1.101)	0.029
S	0.948 (0.919-0.976)	0.000	0.952 (0.910-0.990)	0.013	0.946 (0.904-0.985)	0.006
SE	0.942 (0.907-0.974)	0.000	0.916 (0.865-0.962)	0.000	0.967 (0.918-1.011)	0.154
W	0.992 (0.960-1.022)	0.638	1.007 (0.962-1.047)	0.732	0.978 (0.931-1.021)	0.341
fuller model: sex-, age-, stage-adjusted ^{b,c}						
E	1.000		1.000		1.000	
M	0.846 (0.771-0.915)	0.000	0.977 (0.888-1.050)	0.577	* 0.687 (0.572-0.798)	0.000
MW	1.083 (1.042-1.118)	0.000	1.134 (1.087-1.169)	0.000	* 1.013 (0.936-1.076)	0.719
NE	0.992 (0.941-1.038)	0.773	1.088 (1.030-1.134)	0.005	* 0.881 (0.795-0.958)	0.002
NW	0.938 (0.876-0.993)	0.028	0.880 (0.791-0.959)	0.002	* 1.019 (0.931-1.089)	0.645
S	0.945 (0.901-0.985)	0.007	0.964 (0.904-1.016)	0.195	0.918 (0.849-0.979)	0.008
SE	0.907 (0.854-0.956)	0.000	0.892 (0.816-0.960)	0.001	0.925 (0.848-0.993)	0.031
W	1.041 (1.000-1.077)	0.046	1.075 (1.024-1.117)	0.006	1.003 (0.934-1.061)	0.913
final multivariate model ^d						
E	1.000		1.000		1.000	
M	0.880 (0.801-0.951)	0.000	0.974 (0.875-1.053)	0.558	* 0.796 (0.674-0.907)	0.000
MW	1.091 (1.047-1.127)	0.000	1.129 (1.074-1.169)	0.000	* 1.039 (0.964-1.100)	0.277
NE	1.032 (0.983-1.075)	0.180	1.108 (1.051-1.151)	0.001	* 0.942 (0.857-1.016)	0.133
NW	0.950 (0.885-1.006)	0.088	0.904 (0.810-0.984)	0.017	1.009 (0.915-1.083)	0.833
S	0.988 (0.944-1.028)	0.599	1.004 (0.944-1.056)	0.863	0.970 (0.900-1.030)	0.357
SE	0.952 (0.900-0.999)	0.049	0.930 (0.854-0.996)	0.039	0.982 (0.907-1.046)	0.611
W	1.069 (1.029-1.104)	0.001	1.094 (1.042-1.135)	0.001	1.047 (0.981-1.101)	0.146

^{a,b,c}See Table 3.6.11.

^dAge-group; T, N and M categories; grade; colon, rectosigmoid junction, or rectum/anus; microscopic verification status; method of presentation; smoking status; marital status; individual year of diagnosis. [Sex did not significantly improve model-fit and was excluded from the final model.]

*Significant difference in RR between diagnosis periods.

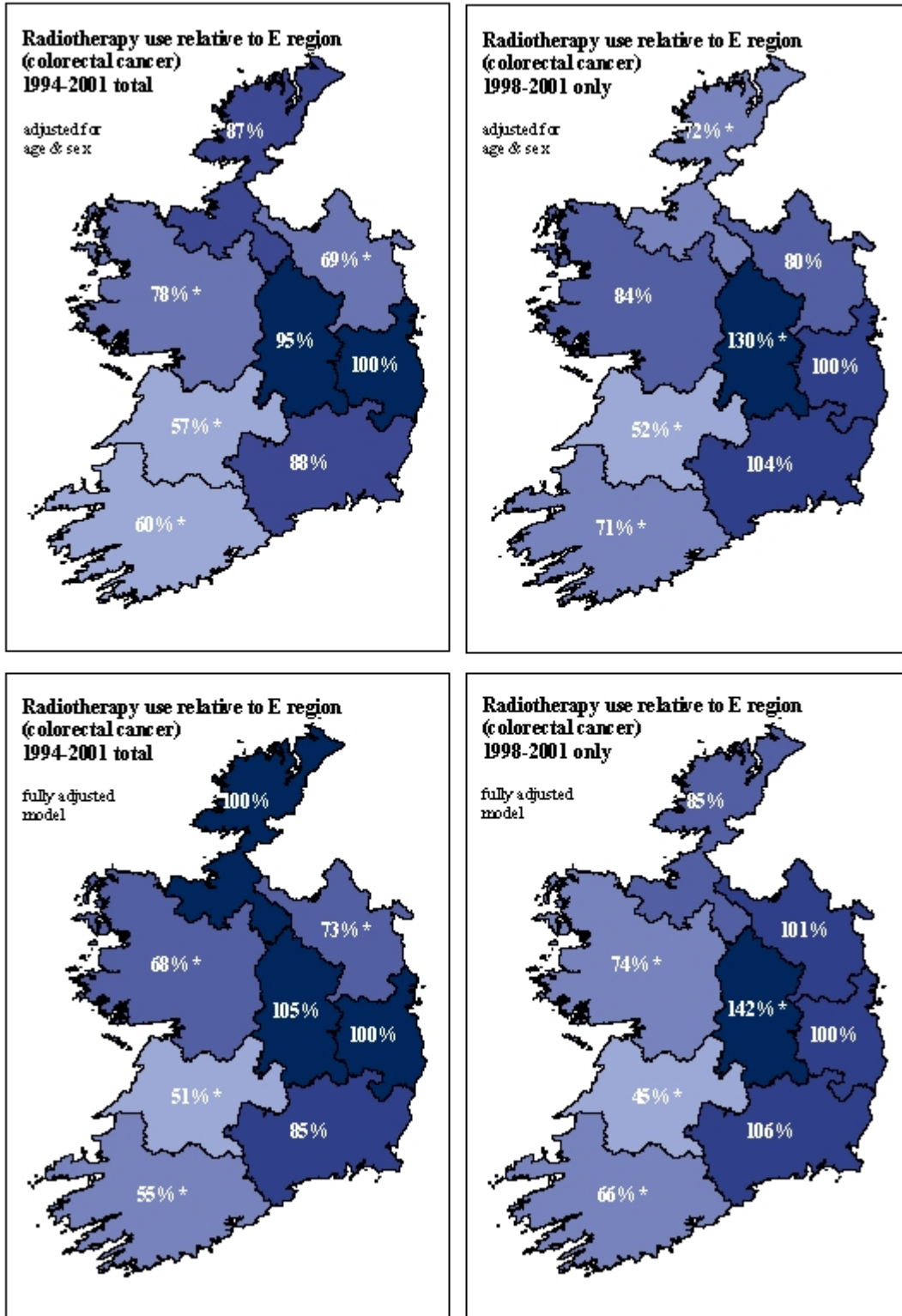


Figure 4.6.2 Regional variation in radiotherapy for colorectal cancer, expressed as risk ratios compared with patients from the Eastern region (100%): 1994-2001 total (left), 1998-2001 (right); basic age- and sex- adjusted model (top), fully-adjusted model (bottom). See Table 4.6.11 for further details. * = significantly high or low values (P<0.05).

Radiotherapy

Patients from four regions (Mid-Western, North-Eastern, Southern and Western) were significantly, and substantially (by 22-43%), less likely to have radiotherapy than patients from the Eastern region, based on an age- and sex-adjusted model for 1994-2001 as a whole (Figure 4.6.2, Table 4.6.11). Variation appeared to be most marked (and involved two further regions) in the 1994-97 diagnosis period, and relative risk estimates (RRs) differed significantly between 1994-97 and 1998-2001 for five regions. In the latter period, patients from the Midland region were actually more likely to have radiotherapy than those from the Eastern region, a reversal of the pattern seen in the earlier period.

These patterns of regional variation were little changed, and RRs modified only slightly, after further adjustment for stage-related variables. Fuller adjustment for a range of variables had little effect for 1994-2001 as a whole, but perhaps accentuated regional differences for the (same) four regions with significantly low RRs (now 27-49% lower than for the Eastern region). In one or other four-year period, patients from six regions were significantly less likely, and only those from the Midland region (in 1998-2001) more likely, to receive radiotherapy (compared with the Eastern region).

Table 4.6.11 Risk ratios for radiotherapy of colorectal cancer patients (within six months of diagnosis), by region of residence, for cases diagnosed 1994-2001. Relative risks in bold = significant difference from Eastern region (RR <1 = lower use of treatment than in Eastern region, RR >1 = higher use).

	1994-2001 ^a RR (95% CI)	P	1994-1997 RR (95% CI)	P	1998-2001 RR (95% CI)	P
basic model: sex-, age-adjusted ^b						
E	1.000		1.000		1.000	
M	0.952 (0.778-1.157)	0.628	0.522 (0.347-0.777)	0.001 *	1.302 (1.036-1.615)	0.024
MW	0.565 (0.454-0.700)	0.000	0.623 (0.443-0.869)	0.005	0.518 (0.389-0.684)	0.000
NE	0.692 (0.570-0.836)	0.000	0.478 (0.330-0.687)	0.000 *	0.804 (0.640-1.002)	0.053
NW	0.865 (0.710-1.048)	0.142	1.076 (0.814-1.406)	0.600 *	0.720 (0.542-0.947)	0.018
S	0.600 (0.512-0.702)	0.000	0.429 (0.322-0.569)	0.000 *	0.712 (0.588-0.859)	0.000
SE	0.882 (0.753-1.029)	0.112	0.674 (0.512-0.882)	0.004 *	1.042 (0.859-1.255)	0.668
W	0.783 (0.661-0.923)	0.003	0.683 (0.515-0.900)	0.007	0.843 (0.683-1.033)	0.102
fuller model: sex-, age-, stage-adjusted ^{b,c}						
E	1.000		1.000		1.000	
M	0.958 (0.781-1.167)	0.676	0.511 (0.339-0.763)	0.001 *	1.324 (1.049-1.647)	0.019
MW	0.550 (0.440-0.684)	0.000	0.625 (0.443-0.876)	0.006	0.499 (0.373-0.663)	0.000
NE	0.734 (0.603-0.888)	0.001	0.479 (0.329-0.691)	0.000 *	0.893 (0.708-1.117)	0.328
NW	0.849 (0.694-1.032)	0.102	1.040 (0.783-1.367)	0.781	0.703 (0.525-0.931)	0.013
S	0.610 (0.519-0.714)	0.000	0.427 (0.319-0.567)	0.000 *	0.744 (0.611-0.901)	0.002
SE	0.861 (0.733-1.009)	0.066	0.650 (0.491-0.855)	0.002 *	1.028 (0.843-1.245)	0.778
W	0.746 (0.628-0.883)	0.001	0.632 (0.472-0.839)	0.001	0.803 (0.647-0.991)	0.041
final multivariate model ^d						
E	1.000		1.000		1.000	
M	1.046 (0.826-1.313)	0.701	0.595 (0.380-0.917)	0.018 *	1.423 (1.073-1.844)	0.015
MW	0.508 (0.395-0.651)	0.000	0.635 (0.432-0.921)	0.016	0.448 (0.320-0.623)	0.000
NE	0.729 (0.587-0.899)	0.003	0.441 (0.296-0.652)	0.000 *	1.010 (0.781-1.291)	0.934
NW	0.997 (0.801-1.231)	0.980	1.188 (0.875-1.590)	0.264	0.854 (0.621-1.157)	0.318
S	0.552 (0.461-0.660)	0.000	0.424 (0.312-0.573)	0.000 *	0.656 (0.522-0.819)	0.000
SE	0.852 (0.712-1.017)	0.077	0.615 (0.456-0.826)	0.001 *	1.064 (0.846-1.323)	0.587
W	0.681 (0.561-0.822)	0.000	0.600 (0.436-0.818)	0.001	0.742 (0.580-0.941)	0.014

^{a,b,c}See Table 3.6.11.

^dAdjusted for age-group; sex; T, N and M categories; grade; colon, rectosigmoid junction, or rectum/anus; microscopic verification status; marital status; individual year of diagnosis. [Method of presentation and smoking status did not significantly improve model-fit and were excluded from the final model.]

*Significant difference in RR between diagnosis periods.

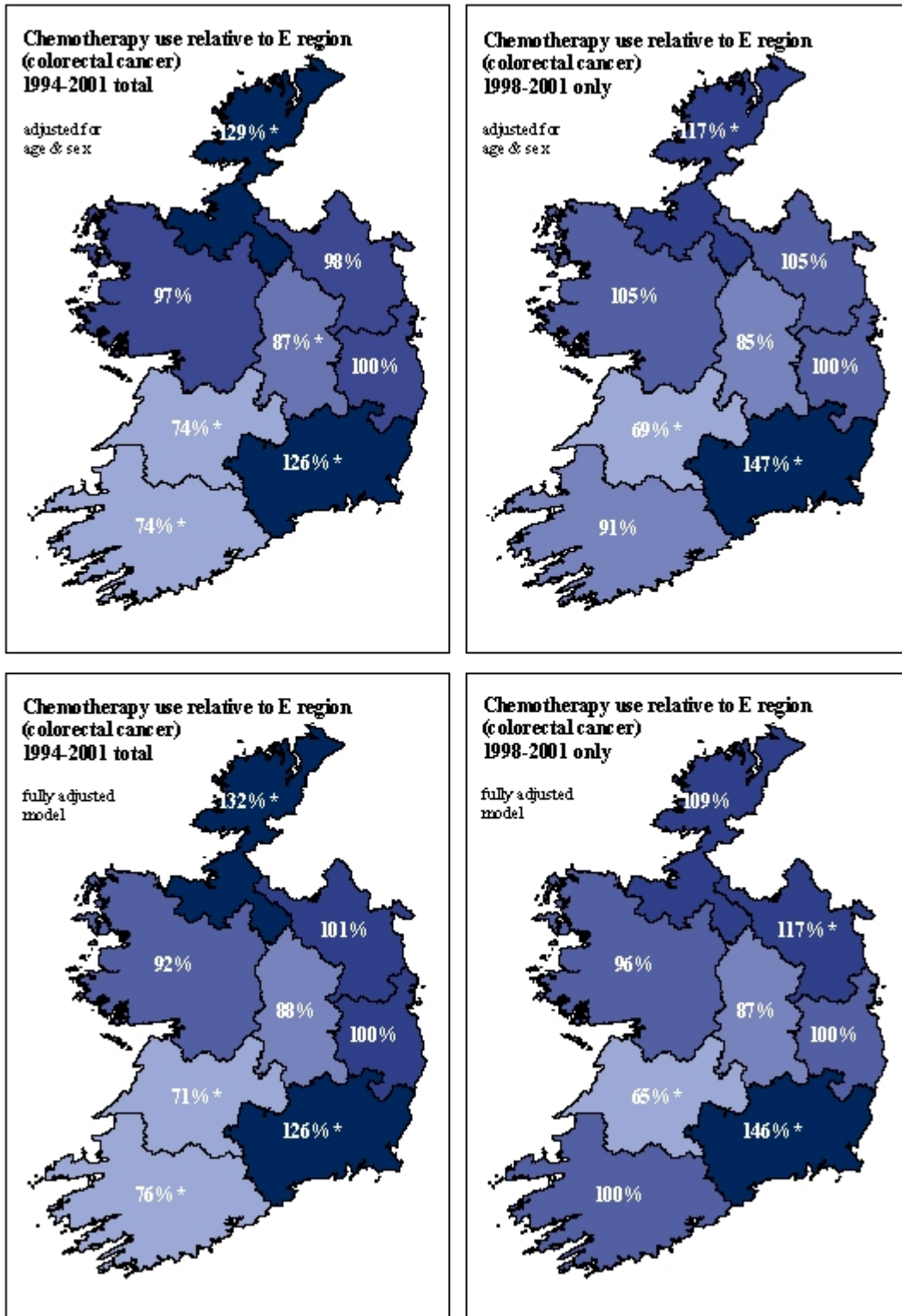


Figure 4.6.3 Regional variation in chemotherapy for colorectal cancer, expressed as risk ratios compared with patients from the Eastern region (100%): 1994-2001 total (left), 1998-2001 (right); basic age- and sex- adjusted model (top), fully-adjusted model (bottom). See *Table 4.6.12* for further details. * = significantly high or low values (P<0.05).

Chemotherapy

For three regions during 1994-2001 as a whole (Midland, Mid-Western and Southern), patients were significantly *less* likely (by 18-26% in relative terms) to receive chemotherapy than those from the Eastern region, after adjustment for patients' age and sex (Figure 4.6.3, Table 4.6.12). Patients from the North-Western and South-Eastern regions were significantly more likely (by 25-28%) to receive chemotherapy than those from Eastern region. The detailed patterns differed somewhat between the 1994-97 and 1998-2001 diagnosis periods, including significant differences in relative risk estimates (RRs) for four regions (North-Western, Southern, South-Eastern and Western).

In contrast to the other treatment modalities considered, the patterns of variation simplified slightly (rather than became more complex) after further adjustment for stage. However, changes were minor. Adjustment for a wider range of patient and tumour variables had little further effect. The overall pattern, based on this final model, involved significantly low use of chemotherapy among patients from the Mid-Western and Southern regions (24-29% lower than patients from the Eastern region), and significantly high use among those from the North-Western and South-Eastern regions (26-31% higher).

Table 4.6.12 Risk ratios for chemotherapy of colorectal cancer patients (within six months of diagnosis), by region of residence, for cases diagnosed 1994-2001. Relative risks in bold = significant difference from Eastern region (RR <1 = lower use of treatment than in Eastern region, RR >1 = higher use).

	1994-2001 ^a RR (95% CI)	P	1994-1997 RR (95% CI)	P	1998-2001 RR (95% CI)	P
basic model: sex-, age-adjusted ^b						
E	1.000		1.000		1.000	
M	0.867 (0.751-0.994)	0.041	0.892 (0.716-1.095)	0.283	0.846 (0.696-1.014)	0.072
MW	0.738 (0.646-0.839)	0.000	0.782 (0.633-0.958)	0.017	0.694 (0.583-0.820)	0.000
NE	0.982 (0.878-1.092)	0.746	0.842 (0.691-1.017)	0.076	1.047 (0.914-1.189)	0.491
NW	1.285 (1.154-1.420)	0.000	1.476 (1.261-1.704)	0.000	* 1.165 (1.002-1.337)	0.046
S	0.735 (0.665-0.811)	0.000	0.495 (0.411-0.594)	0.000	* 0.909 (0.807-1.017)	0.099
SE	1.255 (1.148-1.365)	0.000	1.005 (0.857-1.169)	0.944	* 1.466 (1.325-1.609)	0.000
W	0.972 (0.876-1.075)	0.596	0.846 (0.707-1.005)	0.057	* 1.053 (0.926-1.188)	0.417
fuller model: sex-, age-, stage-adjusted ^{b,c}						
E	1.000		1.000		1.000	
M	0.866 (0.743-1.002)	0.054	0.892 (0.708-1.108)	0.313	0.845 (0.684-1.027)	0.094
MW	0.756 (0.656-0.866)	0.000	0.874 (0.702-1.074)	0.207	* 0.646 (0.533-0.776)	0.000
NE	1.032 (0.917-1.155)	0.591	0.860 (0.697-1.049)	0.142	* 1.121 (0.970-1.281)	0.117
NW	1.282 (1.143-1.427)	0.000	1.571 (1.338-1.816)	0.000	* 1.067 (0.897-1.250)	0.450
S	0.776 (0.698-0.861)	0.000	0.508 (0.418-0.614)	0.000	* 0.998 (0.880-1.123)	0.982
SE	1.221 (1.108-1.338)	0.000	0.988 (0.833-1.161)	0.894	* 1.425 (1.270-1.581)	0.000
W	0.949 (0.848-1.058)	0.359	0.875 (0.724-1.048)	0.151	0.970 (0.838-1.112)	0.676
final multivariate model ^d						
E	1.000		1.000		1.000	
M	0.883 (0.751-1.030)	0.118	0.900 (0.703-1.133)	0.382	0.865 (0.693-1.059)	0.168
MW	0.714 (0.612-0.827)	0.000	0.870 (0.687-1.086)	0.227	* 0.648 (0.530-0.784)	0.000
NE	1.014 (0.897-1.140)	0.808	0.844 (0.681-1.034)	0.105	* 1.166 (1.009-1.332)	0.037
NW	1.315 (1.169-1.467)	0.000	1.586 (1.346-1.838)	0.000	* 1.089 (0.915-1.275)	0.325
S	0.762 (0.682-0.849)	0.000	0.491 (0.402-0.598)	0.000	* 1.000 (0.878-1.129)	0.999
SE	1.257 (1.139-1.380)	0.000	1.010 (0.849-1.189)	0.905	* 1.458 (1.299-1.617)	0.000
W	0.920 (0.816-1.032)	0.160	0.862 (0.708-1.039)	0.123	0.957 (0.822-1.102)	0.557

^{a,b,c}See Table 3.6.11.

^dAdjusted for age-group; sex; T, N and M categories; grade; colon, rectosigmoid junction, or rectum/anus; microscopic verification status; smoking status; marital status; individual year of diagnosis. [Method of presentation did not significantly improve model-fit and was excluded from the final model.]

*Significant difference in RR between diagnosis periods.

4.7 Discussion: colorectal cancer

The major findings here are:

- significant increases in relative survival of patients between the periods 1994-97 and 1998-2001, nationally and in the Western region;
- significant regional variation in relative survival throughout 1994-2001, involving lower survival of patients in some regions outside of the Eastern region;
- significant increases in the use of radiotherapy and chemotherapy between 1996 and 2001;
- significant regional variation in treatments, most notably involving lower use of radiotherapy therapy, and either lower or higher use of chemotherapy, for patients from four of the seven regions outside of the Eastern region.

Survival trends

Improvements seen in relative survival at national scale (representing about a 10% reduction in relative excess mortality risk) were also seen to a greater or less extent among patients from most individual regions. Adjustment for stage and other tumour or patient characteristics did not reduce (in fact increased) the apparent improvement. Much of the improvement in survival thus seems likely to reflect improvements in the quality of treatment and in proportions of patients receiving appropriate treatment. Data indicating increased chemotherapy and radiotherapy use, in particular, may support this. Population-based screening for colorectal cancer is not yet available in Ireland, thus there is currently only limited potential for earlier detection, but further improvements in survival can be expected once screening becomes more widespread.

Regional variation in survival

This was quite substantial, with significantly poorer relative survival in up to four regions, compared with the Eastern region, depending on the period considered or the extent of adjustment for patient

and tumour characteristics. Overall during 1994-2001, excess mortality risks associated with a colorectal cancer diagnosis were 12-20% higher in four regions (after basic adjustment for age and sex), or 10-24% higher in three regions (after fuller adjustment).

Regional variations in relative survival were not fully consistent between diagnosis periods 1994-97 and 1998-2001. Most notably, for the Mid-Western region lower survival compared with the Eastern region was largely confined to the more recent period. Overall, and within each period, fuller adjustment for patient and tumour characteristics appeared to moderate the extent and magnitude of regional variation in survival to some extent. The remaining variation may be accounted for by unmeasured variables, or regional variation in treatment, or both. It may relevant that patients from the two regions with the highest excess mortality risk (Mid-Western and Southern), in the final survival model, were the least likely to receive chemotherapy and radiotherapy.

Survival: international context

Five-year relative survival estimates for Irish men and women diagnosed with colorectal cancer during 1994-97 were similar to or slightly lower than European averages based on cases diagnosed during 1990-94 (EUROCARE-3 results summarized in *Table 4.7.1*). More recent Europe-wide figures are not yet available. Note that figures tabulated here are age-standardized to the EUROCARE-3 patient population, thus the Irish figures differ slightly from those tabulated earlier in this chapter.

Table 4.7.1 Comparison of five-year relative survival for colorectal cancer patients, Ireland 1994-97 and 1998-2001, and Europe 1990-94, age-adjusted to the EUROCARE-3 standard patient population for this cancer.^a

	Ireland 1994-97		Ireland 1998-2001		Europe 1990-94 ^b		
	5-yr survival (95% CI)		survival (95% CI)		survival (95% CI)		[range] ^c
male	47.2%	(44.9%-49.4%)	49.4%	(46.9%-51.9%)	47.6%	(46.7%-48.4%)	[26.8%-55.2%]
female	49.5%	(47.2%-51.7%)	52.1%	(49.7%-54.6%)	50.5%	(49.7%-51.3%)	[28.6%-60.0%]

^aCapocaccia *et al.* (2003) and unpublished. ^bEUROCARE-3: Sant *et al.* (2003).

^cRange of national figures: highest Switzerland (male), France (female).

Treatment trends

The major trends seen were significant and substantial increases (by 11-12% annually in relative terms) in the proportion of patients receiving radiotherapy and chemotherapy, between 1996 and 2001. Significant increases were also seen for radiotherapy in four of the eight regions and for chemotherapy in five regions. Trends for surgical treatment involved a small but significant annual decline nationally, although at regional scale this was significant for two regions only.

Standard treatment modalities for colorectal cancer

Evidence-based summaries of standard treatment options, by stage or other prognostic grouping, are available as part of the US National Cancer Institute's PDQ Cancer Information Summaries:

(<http://www.cancer.gov/cancertopics/pdq/cancerdatabase>).

A brief summary is provided below, by broad modality (see also *Appendix 1*).

Colon cancer

Surgery: Curative intent (as single modality) for stages I and II; curative in combination with adjuvant chemotherapy for stage III; palliative or curative for some stage IV cases.

Radiotherapy: Palliative for some stage IV cases.

Chemotherapy: Adjuvant for stage III, palliative for stage IV.

Rectal cancer

Surgery: Curative (as single modality or in combination with adjuvant radiotherapy and chemotherapy) for stage I; curative (in combination with adjuvant radiotherapy and chemotherapy) for stages II-III; mainly palliative for stage IV.

Radiotherapy: Adjuvant (sometimes curative) for stage I; adjuvant for stage II; adjuvant or palliative for stage III; palliative for stage IV.

Chemotherapy: Adjuvant for stages I-II, adjuvant or palliative for stages III-IV.

Regional variation in treatment

Marked regional variation was seen in the proportions of patients receiving treatment, particularly radiotherapy and chemotherapy. For radiotherapy, this involved significantly lower use (by c.20-50%) in four regions, compared with the Eastern region, during 1994-2001 as a whole. For chemotherapy over the same period, there was significantly lower use (by c.15-30%) in two or three regions but significantly higher use (by c.25-30%) in two regions (North-Western and South-Eastern). Patterns were broadly the same whether

basic or fuller adjustments were made for patient and tumour characteristics. However, for both these modalities the regional patterns differed substantially between diagnosis periods 1994-97 and 1998-2001. Regional variation in surgical treatment was less marked, i.e. of lower magnitude and including a mix of lower and higher use of surgery compared with the Eastern region.

As for other cancers, interpreting the variations seen in treatment, and the extent to which they can be accounted for by patient or tumour characteristics, is difficult. Some relevant variables may not have been measured or included in the statistical models (e.g. comorbidity or general patient condition). However, it seems likely that a substantial proportion of the 'unexplained' variation in radiotherapy and chemotherapy use for colorectal cancer reflects regional or institutional differences in the extent to which given treatments were offered or provided.

Treatment: international context

Comparisons are made here with first-course treatments reported for colon and rectal cancers in the USA as part of the National Cancer Data Base (<http://web.facs.org/ncdbbmr/ncdbbenchmarks7.cfm>). NCDB data have been extracted for cases other than stage 0, diagnosed during 1998-2001, to provide nearest-equivalent data on treatments of invasive colorectal cancers. Possible minor differences between the Irish and US data in the timing of treatment included should be borne in mind, but the data should be broadly comparable.

For both colon and rectal cancer, Irish patients were significantly less likely to receive overall treatment or surgical treatment than in the USA (*Table 4.7.2*). For rectal cancer, significantly smaller proportions of Irish patients had radiotherapy and chemotherapy. Surgery as the only treatment was significantly less frequent for Irish colon cancer cases, but more frequent for Irish rectal cancer cases. Use of the main multi-modal treatment for colon cancer (surgery plus chemotherapy) was similar in Ireland and the US. However, a significantly smaller proportion of Irish cases received the main multi-modal treatment for rectal cancer (surgery plus chemotherapy plus radiotherapy).

Further work is required to assess in more detail the extent to which treatment in Ireland reflects current international guidelines or best practice (cf. *Appendix 1* for a brief summary).

Table 4.7.2 Comparison of main treatment modalities and combinations for patients with invasive colon and rectal cancer, Ireland and USA, in diagnosis period 1998-2001. US data were not specified in detail for some treatments. Irish data here exclude rectosigmoid junction and anus, to facilitate comparisons with the US data.

	colon			rectum		
	Ireland 1998-2001		USA ^a 1998-2001	Ireland 1998-2001		USA ^a 1998-2001
any treatment	82.8%	***	92.6%	84.7%	***	91.4%
no treatment	17.2%	***	7.4%	15.3%	***	8.6%
any surgery ^b	78.4%	***	90.5%	74.1%	***	80.0%
any chemotherapy	31.5%	-	≥24.3%	36.3%	***	≥46.1%
any radiotherapy	3.8%	-	-	32.7%	***	≥45.6%
surgery only	49.6%	***	62.5%	39.4%	***	35.8%
surge + chemo	25.5%	ns	24.3%	10.2%	***	5.1%
surge + chemo + radio	2.0%	-	-	18.9%	***	33.6%
surge + radio	1.1%	-	-	5.3%	ns	4.6%
chemotherapy only	3.7%	-	-	2.3%	-	-
radiotherapy only	0.4%	-	-	3.7%	-	-
chemo + radio	0.2%	-	-	4.6%	***	7.4%
others	0.2%	-	5.8%	0.2%	-	4.9%

- = data not available or statistical comparison not possible.

^aSource of US data: National Cancer Data Base of first-course treatments reported by hospitals approved by the American College of Surgeons Commission on Cancer; cases of stage 0 have been excluded but cases of unknown stage have been included and assumed to be invasive; see <http://web.facs.org/ncdbbmr/ncdbbenchmarks7.cfm>.

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^bUS surgical data are for surgery of primary site only.

* (P<0.05), ** (P<0.01), *** (P<0.001): significant differences between Ireland and USA in proportion of patients treated (χ^2 tests, 1 d.f.).

≥ indicates that overall use of these treatments among patients in the USA may be higher than shown, as figures for less frequent single modalities are not quoted on the NCDB website.

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