

Stage at diagnosis and colorectal cancer survival in six high-income countries: a population-based study of patients diagnosed during 2000-7

Short title: Colorectal cancer survival by stage: international population-based study

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Key words: colorectal cancer; survival; stage at diagnosis; population-based

Word count: 4,291

For Peer Review Only

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3 **Stage at diagnosis and colorectal cancer survival in six high-income countries: a population-**
4 **based study, 2000-2007**
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7
8 **Abstract**
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10 Background: Large international differences in colorectal cancer survival exist, even between
11 countries with similar healthcare. We investigate the extent to which stage at diagnosis explains these
12 differences.
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16 Methods: Data from population-based cancer registries in Australia, Canada, Denmark, Norway,
17 Sweden and the UK were analysed for 313,852 patients diagnosed with colon or rectal cancer during
18 2000-7. We compared the distributions of stage at diagnosis. We estimated both stage-specific net
19 survival and the excess hazard of death up to three years after diagnosis, using flexible parametric
20 models on the log-cumulative excess hazard scale.
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25 Results: International differences in colon and rectal cancer stage distributions were wide: Denmark
26 showed a distribution skewed towards later-stage disease, while Australia, Norway and the UK
27 showed high proportions of 'regional' disease. One-year colon cancer survival was 67% in the UK
28 and ranged between 71% (Denmark) and 80% (Australia and Sweden) elsewhere. For rectal cancer,
29 one-year survival was also low in the UK (75%), compared to 79% in Denmark and 82-84%
30 elsewhere. International survival differences were also evident for each stage of disease, with the UK
31 showing consistently lowest survival at one and three years.
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37 Conclusion: Differences in stage at diagnosis partly explain international differences in colorectal
38 cancer survival, with a more adverse stage distribution contributing to comparatively low survival in
39 Denmark. Differences in stage distribution could arise because of differences in diagnostic delay and
40 awareness of symptoms, or in the thoroughness of staging procedures. Nevertheless, survival
41 differences also exist for each stage of disease, suggesting unequal access to optimal treatment,
42 particularly in the UK.
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50 Keywords: colorectal cancer; survival; stage at diagnosis; population-based
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Introduction

Colorectal cancer is the third most common cancer and cause of cancer death worldwide.[1;2] There are large differences in survival globally,[3] between European countries [4;5] and between Europe and the US.[6] The International Cancer Benchmarking Partnership (ICBP) is a consortium of epidemiologists, clinicians and policy-makers seeking to explain colorectal cancer survival differences between six high-income countries with similar health systems. Predicted five-year survival was 12% higher in Australia than in the UK for patients diagnosed during 2005-7; survival was low in Denmark, intermediate in Norway, and high in Canada and Sweden.[7] Understanding the reasons behind these differences should help improve cancer control strategies.[8] We have reported the impact of stage at diagnosis, a crucial prognostic factor, on ovarian cancer survival.[9] Here, we consider whether stage at diagnosis could explain the international differences in overall colorectal survival in 2000-7, by comparing the distribution of stage at diagnosis in each country. Survival may also differ for each stage of disease: this would suggest differences in treatment, the quality of staging procedures, or levels of co-morbidity.

We used population-based data from regional (Australia, Canada, Sweden, UK) and national (Denmark, Norway) cancer registries. In contrast to clinical trials, which routinely exclude older, more frail or marginalised patients, these data include all cancer patients in each region or country, thus enabling public health comparisons of the overall effectiveness of health systems. Stage at diagnosis is not routinely or consistently recorded by all cancer registries. Population-based studies of stage-specific survival have usually adopted a 'high-resolution' approach, in which investigators abstract detailed clinical data on stage directly from the medical records of large, random samples of patients derived from the cancer registry.[6;10;11] Here, we used data on stage held by the registries for all cancer patients in their territory. The data on stage were coded to a variety of classification systems. We therefore defined a repeatable process to consolidate these data into a common classification, in order to facilitate robust international comparisons of stage-specific survival[12]. We compared the distributions of stage at diagnosis in the six countries and overall and stage-specific

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3 survival at one and three years after diagnosis. Using routine data on stage at diagnosis in
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5 international cancer survival comparisons should enable future cancer survival surveillance world-
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7 wide.

8 9 **Material and Methods**

10 11 *Data*

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15 The International Cancer Benchmarking Partnership (ICBP) collected data on 788,311 patients
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17 diagnosed with colorectal cancer during 1995-2007 in Australia (Victoria; New South Wales),
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19 Canada (Alberta, British Columbia, Manitoba, Ontario), Denmark, Norway, Sweden (Uppsala-Örebro
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21 and Stockholm-Gotland health regions), and the UK (England, Northern Ireland, Wales). Overall,
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23 these registries covered 80.5% of the combined population of these six countries: details have been
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25 published[7].
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29 Data were cleaned and analysed centrally to a common protocol. We collected data on primary,
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31 invasive, malignant cancers of the colon (ICD-10 C18.0-C18.9), rectosigmoid junction (C19) and
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33 rectum (C20), but not cancers of the anus or anal canal (C21). We excluded patients whose tumour
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35 was benign (behaviour code 0), of uncertain behaviour (1) or *in situ* (2). Patients were excluded if
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37 their vital status was unknown or if their cancer was only registered from a death certificate. Full
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39 details of quality control have been published.[7]
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42 We restricted attention to the 468,258 patients diagnosed during 2000-7, when stage data were more
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44 complete. We excluded registries that had recorded stage data for less than 50% of patients in this
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46 period: thus Victoria (Australia), British Columbia and Ontario (Canada) and Wales (UK) were
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48 excluded from the analyses for colon cancer, while Victoria (Australia), Ontario (Canada), Thames
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50 (England, UK) and Wales (UK) were excluded from the analyses for rectal cancer. For Canada and
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52 Denmark, the availability of stage data increased markedly from 2004, following changes in policy, so
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54 we further excluded patients diagnosed during 2000-3 in those two countries. The final analyses
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56 included 208,281 colon cancer patients and 105,571 patients with rectal cancer.
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3 The ICBP study protocol required both pathological and clinical T, N and M values, and/or Dukes'
4 stage where available. We defined a standard procedure[12] to determine which stage variables to use
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6 where the registry supplied more than one, prioritising individual T, N and M data over Dukes' stage,
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8 and preferring pathological T and N over clinically-based values. The New South Wales registry uses
9
10 a locally-specified coding system wherein tumours are classified as 'localised, regional, distant'.

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12 Norway also uses its own coding system for colon cancer. Both systems could be translated to the US
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14 Surveillance, Epidemiology and End Results program's Summary Stage 2000 (SEER SS2000); this is
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16 similar to the New South Wales system, but better documented and more widely known. By
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18 additionally mapping both TNM and Dukes' systems to SEER SS2000, we were able to include all
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20 countries in comparative analyses. The analyses we present using SEER SS2000 therefore include all
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22 six countries; but where possible, we also present the results using the Dukes' system, which is more
23
24 familiar to clinicians.
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28 We present survival estimates for colon and rectal cancers separately, because they differ in stage
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30 distribution, treatment options and clinical behaviour. We consider three age groups: 15-49, 50-69 and
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32 70-99 years at diagnosis. For simplicity, we will use stages A-D when referring to Dukes' stage, and
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34 'localised', 'regional' or 'distant' when referring to SEER SS2000.
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37 *Statistical analyses*

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39 A major difficulty in international comparisons of cancer survival is that data on the cause of death
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41 may be incomplete, and death certification may not record cancer as the underlying cause of death
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43 with comparable accuracy between countries or over time.[14] Relative survival techniques have been
44
45 used for many years to estimate net survival, which is the probability of survival for cancer patients in
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47 the hypothetical situation where cancer is the only cause of death. These techniques have recently
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49 been shown to incorporate bias in longer-term survival estimation due to "informative censoring." [13]
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51 To estimate net survival by stage at diagnosis, age and country whilst avoiding this bias, we used
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53 flexible parametric excess hazard models on the log-cumulative excess hazard scale, implemented
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55 with the *stpm2* command[15] in Stata version 12.0 (StataCorp LP, College Station, Texas). The
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3 expected risk of death (background mortality) by sex and single year of age at death was estimated
4 from life tables specific to the population of each registry's territory and each calendar year.[7] Net
5 survival for a given group of patients is then the mean of the individual net survival probabilities
6 predicted by the model at a given point in time since diagnosis. We also estimated the mortality
7 counterpart of net survival, the excess hazard of death, which is the instantaneous risk of dying from
8 cancer, over and above the expected risk of dying from all other causes, for up to three years after
9 diagnosis.

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11 Stage-specific analyses were conducted with stage categorised either to Dukes' or SEER SS2000.
12 Patients with no data on stage were initially treated as a distinct category. Age was modelled as a
13 continuous variable. We used polynomial functions (splines) to allow for the non-linear effects of
14 time since diagnosis and the potentially non-linear effects of age on the excess hazard. We fitted
15 interactions with time since diagnosis to allow for potentially non-proportional effects of age and
16 country. The final models were selected using various measures of goodness of fit, including the
17 Akaike Information Criterion (AIC) and the Schwarz Bayesian Information Criterion (BIC)[16]. We
18 used a likelihood ratio test to test for the interaction between age and country, allowing a 20%
19 probability of type I error. Final models were compared with slightly more flexible models to reveal
20 any excessive constraints, such as proportional effects or lack of flexibility, but the survival estimates
21 were not changed by this increased flexibility. We examined plots of the Martingale residuals to
22 ensure correct specification of the functional form used to model the effect of age. In order to assess
23 the validity of our final models, we also modelled the data from each country separately, and obtained
24 very similar results; therefore, we present only the results from the final models that include country.
25 The availability of follow-up data beyond the last boundary for which we want to estimate survival is
26 important for the stability of the model, so we present survival estimates up to three years, even
27 though we had longer follow-up for some patients.[17]

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29 To determine the probable stage for patients with missing data we performed multiple imputation by
30 chained equations, using the *ice* command[18] in Stata 12. For each country in turn, we specified an
31 ordered logistic regression model including vital status, the non-linear effect of the log-cumulative
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3 excess hazard, and the non-linear effect of age, as well as all covariables that significantly predicted
4 stage for patients in that country with known stage, or that predicted the absence of stage (potentially:
5 sub-site, sex, year of diagnosis and any interactions between these covariables and the excess
6 hazard).[19;20] We ran the imputation procedure 15 times on each data set and combined the results
7 under Rubin's rules.[21]

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12 We used the same modelling strategy to estimate stage-specific net survival in each of the 15 imputed
13 datasets and compared the range of estimates to the survival estimates obtained for patients for whom
14 stage had been reported in the original data.

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20 For each category of stage, all-ages survival estimates were standardised with weights derived from
21 the distribution of patients in the age categories 15-44, 45-54, 55-64, 65-74, 75-84 and 85-99 years in
22 all jurisdictions combined (web appendix, Tables 1 and 2).

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28 Differences between paired survival estimates, and overall ranges, are given as the simple arithmetic
29 value, e.g. 12% would be 2% (and not 20%) higher than 10%. Survival estimates are rounded to
30 integer values in the text, but differences and ranges are based on the exact underlying values. The
31 statistical significance of differences in survival was assessed at the 5% level on the basis of the
32 excess hazard ratios derived from the models; we present 95% confidence intervals for most
33 estimates.

34 35 36 37 38 39 40 **Results**

41 42 43 *Stage and age distributions*

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46 The proportion of patients for whom data on stage at diagnosis were missing was highest in the UK
47 (colon: 27.8%; rectum: 30.6%) and lowest in Sweden for colon cancer (3.4%) and Norway for rectal
48 cancer (7.1%) (Table 1). The proportion increased with age (web appendix Figure 1). For colon
49 cancer, the mean age at diagnosis was slightly higher in Norway and Sweden (72.6 years) than in
50 Canada or Australia (70.5 years), while for rectal cancer the range was from 67.7 years (Australia) to
51 70.6 years (Sweden) (Table 1).

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3 *Insert Table 1*

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6 *Insert Figure 1*

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9 Imputation of stage where it was missing did not substantially alter the stage distributions, either for
10 colon or rectal cancer.

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13 Colon cancer was more commonly diagnosed at an early stage (A) in Canada, at intermediate stages
14 (B and C) in Sweden and the UK, and at an advanced stage (D) in Denmark (Table 1). The proportion
15 with advanced disease was low in the UK (20% vs. 24-31% elsewhere), but the proportion in stage C
16 was high (36% vs. 26-29% elsewhere). The distribution of stage in SEER SS2000 varied more widely:
17 the proportion of patients with 'regional' disease was 54% in Norway and 46% in Australia, but 30-
18 37% elsewhere. In Denmark, 31% of patients had 'distant' disease, compared with 19-27% in the
19 other five countries.
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28 The stage distributions for rectal cancer were similar in Canada, Norway and Sweden, for both Dukes'
29 and SEER SS2000 categorisations. The distribution was more heavily skewed towards later stage in
30 Denmark than in other countries, again with both classifications. The proportion of patients diagnosed
31 in stage D was lower in the UK (19%) and Australia (17%) than elsewhere (23-29%), and the
32 proportion in stage C was much higher (35%), whereas these proportions were more similar in other
33 countries. The proportion of patients with 'regional' tumours ranged from 40-42% in Australia and
34 Denmark to 30-36% elsewhere.
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43 *Net survival*

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46 Overall, one-year age-standardised net survival from colon cancer was lowest in the UK (67.4%),
47 followed by Denmark (71.3%) (Table 2). Survival was intermediate in Norway (75.5%) and Canada
48 (76.2%) and highest in Sweden (79.9%) and Australia (80.2%). Similarly, survival from rectal cancer
49 was lowest in the UK (75.2%) and Denmark (79.0%), intermediate in Norway (82.3%) and highest in
50 Canada (84.0%), Sweden (84.4%) and Australia (83.6%) (Table 3). For both colon and rectal cancers,
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3 the same patterns of survival by country were found three years after diagnosis (web appendix, Tables
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5 3 and 4).
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8 *Insert Table 2 and Table 3*
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10 One-year net survival from both colon and rectal cancer was statistically significantly lower for each
11 age group in the UK than in all other countries (except compared to the youngest age group in
12 Denmark), and the differences were widest for patients aged 70-99 years (5-15%, Tables 2 and 3). For
13 both cancers, the largest between-country difference in one-year net survival was twice as wide for
14 70-99 year-olds as it was for 15-49 year-olds.
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21 International differences in age-standardised net survival at one year were wider for patients with
22 more advanced stage of disease at diagnosis. Thus in the UK, survival for colon cancer patients with
23 stage A disease was similar to that in other countries, but up to 5% lower than elsewhere for stage B,
24 while the deficits with respect to Denmark, Canada and Sweden for more advanced stages of disease
25 were large and statistically significant (7-11% for stage C and 5-8% for stage D) (Table 2). The
26 Dukes' stage-specific age-standardised one-year net survival estimates were also low in Denmark, but
27 the differences with other countries were not generally statistically significant. A similar pattern of
28 wider international differences for patients with more advanced disease was also observed with SEER
29 SS2000 stage (Table 2) and three years after diagnosis in both stage classifications (web appendix
30 Table 3).
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43 For rectal cancer, international differences in net survival at one and three years were also wider for
44 patients with more advanced stage at diagnosis (Table 3; web appendix Table 4). Age-standardised
45 one-year net survival for 'localised' disease was up to 5% lower in the UK than elsewhere, but 7-14%
46 lower for patients with 'distant' disease (Table 3).
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51 Among patients for whom SEER SS2000 stage data were not available, the international range in one-
52 year net survival was as wide as 30% for colon cancer and 21% for rectal cancer, with the lowest
53 values in the UK and the highest in Australia (Tables 2 and 3). The international range in survival was
54 also wide among patients for whom Dukes' stage was not available. For colon cancer, survival for
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3 patients missing SEER SS2000 in Canada was low, as was survival among rectal cancer patients with
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5 missing stage in Sweden.
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8 *Excess hazard*
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11 The excess hazard of death at one month after diagnosis was approximately 10 times higher for
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13 patients with advanced disease than those with early-stage disease (Figures 1 and 2). There was a
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15 noticeable decrease in the excess hazard of death between one and six months after diagnosis,
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17 particularly for patients diagnosed at an early stage. As a result, the difference in the excess hazard of
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19 death between early and advanced disease widened to almost 100-fold by 3 years after diagnosis. This
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21 pattern was observed for both colon and rectal cancer, and in each country.
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24 For each stage at diagnosis, international differences in the excess hazard of death diminished with
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26 time since diagnosis. An exception was seen for patients with stage A colon cancer, where the excess
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28 hazard in Sweden declined continuously with time, resulting in a particularly low excess hazard 3
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30 years after diagnosis.
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33 For colon cancer, the excess hazard of death was relatively stable from 6 months to 3 years after
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35 diagnosis, in each country and within each stage category.
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38 *Insert Figures 2 and 3*
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41 For rectal cancer, the excess hazard of death at one month was similar for stage B and C (Figure 2) in
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43 all countries except Sweden. From six months onwards, the excess hazard of death was higher for
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45 patients in each successive category of stage at diagnosis.
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48 *Net survival following imputation*
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51 After imputation of stage where it was missing from the original record, net survival estimates were
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53 generally similar to, or lower than, the estimates for patients with known stage, for both colon and
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55 rectal cancer. The only exception was survival for patients with stage D in Norway. However, the
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57 international range in stage-specific survival became wider (Figures 3 and 4). Imputation had an
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3 especially large effect on one-year net survival in the UK, where the estimates were reduced by as
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5 much as 15.5% for stage C colon cancer and 9.6% for stage C rectal cancer. Similar findings were
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7 observed at three years (web appendix, Figures 2 and 3).
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10 *Insert Figures 4 and 5*
11

12 **Discussion**

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15 Cancer survival varied widely between these six countries. For colon cancer, age-standardised one-
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17 year net survival was highest in Australia and Sweden, intermediate in Canada and Norway, lower in
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19 Denmark and lowest in the UK, with a range of 13%. For rectal cancer, survival was lowest in the
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21 UK, intermediate in Denmark and Norway, and highest in Australia, Canada and Sweden, with a
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23 range of 9%. These international differences in survival are partly explained by differences in the
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25 distribution of stage at diagnosis. For each stage at diagnosis, however, international variation in
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27 survival was also wide, particularly for patients with more advanced disease.
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30 Before considering the implications of these findings, we describe how we have addressed three
31
32 aspects of data quality: the lack of comparability between the various classifications of stage at
33
34 diagnosis, differences in clinical staging procedures, and incompleteness of data on stage.
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37 Data on stage were provided in four different classifications. We developed an algorithm to translate
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39 these to a common standard before survival analysis[12]. For a few categories of stage, a small degree
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41 of misclassification was unavoidable. For example, in mapping Dukes' stage to SEER Summary
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43 Stage 2000, it is unavoidable that about 2-3% of colorectal patients are misclassified as 'localised'
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45 rather than 'regional', because it is not possible to distinguish between T3 and T4 among tumours
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47 assigned to Dukes' B if the component T, N and M codes are not available. This may partly explain
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49 why Australia and Norway have higher proportions of patients with 'regional' tumours. Incomplete
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51 documentation on the categories of stage used for colon cancer in Norway may have increased this
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53 type of misclassification and contributed to the unusual stage distribution.
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3 The thoroughness of clinical investigation to determine the stage at diagnosis may also differ between
4 countries. This can affect the observed distribution of stage, and both stage-specific and overall
5 survival. For example, it is possible that sub-optimal staging in the UK (leading to misclassification of
6 some Dukes' stage D tumours as stage C) explains both the particularly low proportion of metastatic
7 tumours (Dukes' D), and the unusually high proportion of Dukes' C. This may be why patients in
8 both stage categories had substantially lower survival than elsewhere (stage migration[22]). Sub-
9 optimal staging of colorectal cancer in England has been identified in an international study of clinical
10 records, which showed that fewer lymph nodes were examined pathologically than elsewhere in
11 Europe, and liver imaging was performed less often.[10] More accurate staging would be expected to
12 result in treatment that is more appropriate for stage, and thus higher survival. Concern about the
13 consistency of staging quality in England has also been noted by a parliamentary committee.[8]
14 Cancer registries should routinely record the investigations that were performed to ascertain the stage
15 at diagnosis (as has been done in Sweden since 2007). At the very least, registries should record
16 whether stage was defined before or after histological investigation. This would improve
17 comparability in international studies of stage at diagnosis and stage-specific survival.
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34 We restricted the inclusion of data in these analyses to registries in which at least 50% of all patients
35 were staged, in order to improve the generalisability of the results. In these data sets, stage was
36 missing for 3-31% of patients. We imputed stage where it was missing, in order to reduce potential
37 bias in stage-specific survival. Imputation is the most robust method for dealing with missing data,
38 even when there are few variables with which to predict the missing values.[20] Patients with missing
39 data on stage tended to be older, and to have lower survival, which is why survival is lower in all
40 stage categories after the inclusion of patients whose stage data were imputed.
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49 Standard methods were used to deal with other issues of comparability and consistency that affect any
50 population-based comparisons of cancer survival. Potential confounding by age was handled by age-
51 standardisation. Consistent exclusion criteria were applied to cancer registrations from all countries
52 and quality control was conducted centrally according to a common protocol. The completeness of
53 registration of incident cancers is high in all these registries, but small differences could still
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3 contribute to differences in survival. In Sweden, cancer registrations are not initiated from death
4 certificates, as elsewhere: some patients with poor survival could be missed as a result, but the
5 completeness of the Swedish data is very high,[23] and the effect on overall survival will be
6 minimal.[24] A more serious issue for the survival comparisons was that sufficient information on
7 stage was only available in the Canadian registries and Denmark for patients diagnosed during 2004-
8 7, compared to 2000-7 in the other jurisdictions. Since survival was improving over time,[7] we
9 would expect this to confer a slight advantage to Canada and Denmark in the survival comparisons,
10 but a comparison of one-year survival for patients diagnosed during 2004-7 in all jurisdictions did not
11 change the international pattern of survival reported here (results available on request).
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22 International differences in clinical staging procedures and data comparability may contribute
23 marginally to international differences in stage distribution and survival, but they cannot fully explain
24 the large international inequalities in survival and the pattern of those inequalities by stage. The stage
25 distributions that we describe using these routinely collected cancer registry data are consistent with
26 those found previously in population-based studies in the same countries.[25-28] The survival
27 estimates are clinically coherent in terms of age, stage and time since diagnosis, and they echo
28 previous findings where available.[10;29;30] Particularly high excess mortality at one month after
29 diagnosis has also been reported before.[31-33] The observation that older patients generally have a
30 more favourable stage distribution than younger patients, even after the imputation of missing stage, is
31 also consistent with previous studies.[34-36] Therefore, while it is important that consistency in
32 staging is improved for future population-based studies of colorectal cancer survival, this study shows
33 overwhelming evidence of survival inequalities by stage of disease, as well as in the stage
34 distribution. Both inequalities require policy attention.
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49 During 2000-7, no country had implemented a national screening programme using the faecal occult
50 blood test (FOBT), but most were running pilot programmes in selected regions, for example in
51 Odense (Denmark), since 1985 and in Nottingham (UK), since 1981. Gradual implementation of a
52 national FOBT screening programme began in England from mid-2006, but the impact on national
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3 distributions of stage and overall survival during the overall period 2000-7 is likely to have been
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5 small.[37]

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8 Age-standardised one-year net survival ranged by 13% between the UK and Australia for colon
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10 cancer and by 9% between the UK and Sweden for rectal cancer, and patients in the UK consistently
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12 had the lowest survival at one and three years. The difference between the UK and the other five
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14 countries was statistically significant for each age group, except compared to the youngest age group
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16 in Denmark. The low survival in the UK cannot be fully explained by a more adverse stage
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18 distribution; survival in the UK was significantly lower than elsewhere for Dukes' stage C and D
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20 cancers and survival was also statistically significantly lower for each category of SEER SS2000,
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22 except for the comparison with 'localised' rectal cancer in Denmark. We have alluded to the possible
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24 contribution of sub-optimal staging, but problems with access to optimal treatment may also
25
26 contribute to the low survival in the UK.
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29 Improvement in colorectal cancer survival has been attributed to three main factors: rising resection
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31 rates, falling post-operative mortality and the increased use of adjuvant chemotherapy.[27;38]

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33 Variation in these factors may help to explain international differences in stage-specific survival,
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35 particularly the low survival observed in the UK. EUROCARE data from the early 1990s have shown
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37 that resection rates in the UK were lower than in other European countries,[10] and post-operative
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39 mortality in the UK remains relatively high.[28] Current treatment guidelines are similar in the
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41 UK[39] and in countries with higher stage-specific survival like Canada,[40] but research is needed
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43 on their implementation.
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46 In Denmark, age-standardised one-year net survival for colon cancer was statistically significantly
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48 lower by 4-9% than in the other countries except the UK, and 3-6% lower for rectal cancer. Stage-
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50 specific survival was also often slightly lower than elsewhere, but not consistently, and differences
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52 were only statistically significant for one-year survival from colon cancer. Denmark had the most
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54 adverse stage distribution for both colon and rectal cancer. A more advanced stage distribution has
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3 been noted previously in Denmark for colorectal cancer[41] and other cancers.[42] The reorganisation
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5 of cancer services in Denmark, which began in 2007, may improve this situation.[43]
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8 Age-specific one-year net survival was higher for colon cancer in Australia and Sweden than
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10 elsewhere, and for rectal cancer in Canada and Sweden. Sweden and Canada had an unremarkable
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12 stage distribution, but high stage-specific survival, suggesting that other countries should aim for the
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14 stage-specific outcomes achieved in those countries.
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17 In conclusion, there are wide international inequalities in survival from colorectal cancer, even
18
19 between economically developed countries. Stage at diagnosis is crucial to prognosis. International
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21 surveillance of cancer survival by stage would be greatly improved by global consensus on a single
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23 cancer staging classification, and by consistent recording in cancer registries of stage at diagnosis and
24
25 the procedures used to determine it.
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28 Stage at diagnosis is an important contributing factor to low overall survival in Denmark. Elsewhere,
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30 the international differences in overall survival are also reflected within each category of stage, and
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32 this is more likely to be attributable to differences in the quality of staging and treatment. The UK in
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34 particular should consider its performance in this regard.
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Acknowledgements

We thank the cancer registry staff in all jurisdictions, whose sustained efforts in data collection and quality control over many years have enabled colorectal cancer survival to be compared by stage at diagnosis. The authors would like to thank Martine Bomb, Catherine Foot and Donia Sadik at Cancer Research UK for their logistical support.

Funding

This work was supported by the Department of Health, England. Cancer Research UK supports the Cancer Survival Group (C1336/A11700). The Northern Ireland Cancer Registry is funded by the Northern Ireland Public Health Agency.

Conflicts of interest

Sir Michael A Richards is the National Cancer Director (England), funded by the Department of Health. Other authors declare that they have no conflicts of interest.

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3 Figure titles and legends
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5 **Figure 1.** Age-standardised excess hazard of death (per 1,000 person-years, log scale) from colon
6 cancer, by stage, country and time since diagnosis: Dukes' stage (upper graphic) and SEER Summary
7 Stage 2000 (lower graphic)
8

9 Notes

10
11 1. National data are used for Denmark and Norway. Other countries are represented by regional
12 registries: Australia: New South Wales; Canada: Alberta and Manitoba; Sweden: Uppsala-Örebro and
13 Stockholm-Gotland health regions; UK: England and Northern Ireland. In Canada and Denmark we
14 analysed data for patients diagnosed in 2004-7
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16
17 2. For each country, the size of the “bubble” represents the proportion of cancers in each stage at
18 diagnosis (see legend at bottom right of graphic). The relative size of the bubbles is therefore the same
19 at each time since diagnosis.
20

21 **Figure 2.** Age-standardised excess hazard of death (per 1,000 person-years, log scale) from rectal
22 cancer, by stage, country and time since diagnosis: Dukes' stage (upper graphic) and SEER Summary
23 Stage 2000 (lower graphic)
24

25 Notes

26
27 1. National data are used for Denmark and Norway. Other countries are represented by regional
28 registries: Australia: New South Wales; Canada: Alberta, British Columbia and Manitoba; Sweden:
29 Uppsala-Örebro and Stockholm-Gotland health regions; UK: Northern Ireland and all cancer
30 registries in England except the Thames Cancer Registry. In Canada and Denmark we analysed data
31 for patients diagnosed in 2004-7
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33
34 2. For each country, the size of the “bubble” represents the proportion of cancers in each stage at
35 diagnosis (see legend at bottom right of graphic). The relative size of the bubbles is therefore the same
36 at each time since diagnosis.
37

38 **Figure 3.** Colon cancer: age-standardised one-year net survival for patients diagnosed 2000-7, by
39 stage at diagnosis and country, Dukes' stage (A: upper graphic) and SEER Summary Stage 2000 (B:
40 lower graphic)

41 X - survival estimate derived from those patients for whom the stage was recorded at diagnosis
42 I - range of survival estimates for all patients, both those with known stage and those for whom it was
43 imputed, derived from 15 data sets after imputation (see text for details)
44

45 Notes:

46 National data are used for Denmark and Norway. Other countries are represented by regional
47 registries: Australia: New South Wales; Canada: Alberta and Manitoba; Sweden: Uppsala-Örebro and
48 Stockholm-Gotland health regions; UK: England and Northern Ireland. In Canada and Denmark, data
49 are for patients diagnosed in 2004-7
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51
52 **Figure 4.** Rectal cancer: age-standardised one-year net survival for patients diagnosed 2000-7, by
53 stage at diagnosis and country, Dukes' stage (A: upper graphic) and SEER Summary Stage 2000 (B:
54 lower graphic)

55 X - survival estimate derived from those patients for whom the stage was recorded at diagnosis
56 I - range of survival estimates for all patients, both those with known stage and those for whom it was
57 imputed, derived from 15 data sets after imputation (see text for details)
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Notes:
National data are used for Denmark and Norway. Other countries are represented by regional registries: Australia: New South Wales; Canada: Alberta, British Columbia and Manitoba; Sweden: Uppsala-Örebro and Stockholm-Gotland health regions; UK: Northern Ireland and all cancer registries in England except the Thames Cancer Registry. In Canada and Denmark, data are for patients diagnosed in 2004-7

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Table 1. Number and mean age at diagnosis of colon and rectal cancer patients diagnosed during 2000-2007: country and stage at diagnosis (Dukes' stage and SEER Summary Stage 2000)

Stage	Dukes' stage								SEER Summary Stage 2000								
	Colon				Rectum				Colon				Rectum				
	Number ⁶	Mean age	%		Number ⁶	Mean age	%		Number ⁶	Mean age	%		Number ⁶	Mean age	%		
			Observed	After imputation			Observed	After imputation			Observed	After imputation			Observed	After imputation	
Australia																	
All patients	5,784	70.5			6,405	67.8			All patients	5,784	70.5			6,405	67.8		
Missing stage	364	73.4	6.3		1,633	70.4	25.5		Missing stage	364	73.4	6.3		1,633	70.4	25.5	
Canada																	
A	951	70.8	17.5	17.3	1,050	68.3	22.0	21.2	Localised	2,305	71.3	42.5	41.9	1,983	68.4	41.6	40.4
B	1,654	71.4	30.5	30.2	1,108	68.4	23.2	22.3	Regional	1,707	70.2	31.5	31.5	1,678	65.9	35.2	34.9
C	1,407	70.2	26.0	26.0	1,503	65.7	31.5	31.8	Distant	1,408	68.9	26.0	26.5	1,111	65.6	23.3	24.7
D	1,408	68.9	26.0	26.5	1,111	65.6	23.3	24.8									
All patients	10,057	71.8			5,744	69.3			All patients	10,057	71.8			5,744	69.3		
Missing stage	2,007	75.5	20.0		1,338	73.5	23.3		Missing stage	2,007	75.5	20.0		1,338	73.5	23.3	
Denmark																	
A	891	71.4	11.1	11.0	590	69.5	13.4	13.2	Localised	2,933	71.9	36.4	36.2	1,483	69.1	33.7	33.3
B	2,450	72.2	30.4	30.2	1,061	68.8	24.1	23.7	Regional	2,617	70.5	32.5	32.5	1,775	66.8	40.3	40.1
C	2,209	70.1	27.4	27.4	1,607	66.7	36.5	36.5	Distant	2,500	70.3	31.1	31.3	1,148	68.3	26.1	26.5
D	2,500	70.3	31.1	31.4	1,148	68.3	26.1	26.6									
All patients					8,756	70.4			All patients	17,450	72.6			8,756	70.4		
Missing stage					2,627	71.4	30.0		Missing stage	1,348	76.0	7.7		625	75.4	7.1	
Norway																	
A					1,528	70.6	24.9	21.6	Localised	3,117	73.0	19.4	19.2	3,875	70.8	47.7	46.9
B					1,684	71.0	27.5	24.9	Regional	8,779	72.7	54.5	54.4	2,480	69.5	30.5	30.8
C					1,540	69.1	25.1	24.9	Distant	4,206	70.9	26.1	26.4	1,776	69.0	21.8	22.3
D					1,377	69.0	22.5	28.6									
All patients	10,653	72.6			5,519	70.6			All patients	10,653	72.6			5,519	70.6		
Missing stage									Missing stage								
Sweden																	
A	361	77.2	3.4		541	78.6	9.8		Missing stage	361	77.2	3.4		541	78.6	9.8	
B	1,178	72.8	11.4	11.4	1,153	70.2	23.2	22.4	Localised	4,852	73.5	47.1	46.8	2,449	70.4	49.2	47.9
C	3,788	73.8	36.8	36.6	1,330	70.5	26.7	26.0	Regional	3,043	72.1	29.6	29.7	1,462	69.3	29.4	29.5
D	2,929	72.0	28.5	28.6	1,428	69.3	28.7	28.7	Distant	2,397	70.7	23.3	23.5	1,067	68.7	21.4	22.6
	2,397	70.7	23.3	23.5	1,067	68.7	21.4	22.9									

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	All patients	142,140	72.3		67,399	70.4			All patients	142,140	72.3		67,399	70.4				
	Missing								Missing									
	stage	39,585	74.8	27.8	20,630	73.3	30.6		stage	39,585	74.8	27.8	20,630	73.3	30.6			
UK	A	9,644	71.2	9.4	8.4	9,693	69.5	20.7	19.1	Localised	48,299	72.2	47.1	43.2	22,796	69.9	48.7	45.5
	B	39,588	72.4	38.6	35.7	13,355	70.1	28.6	26.9	Regional	36,970	70.7	36.0	37.3	16,054	68.2	34.3	35.5
	C	36,037	70.7	35.1	36.4	15,802	68.2	33.8	34.9	Distant	17,286	70.6	16.9	19.6	7,919	68.9	16.9	19.0
	D	17,286	70.6	16.9	19.5	7,919	68.9	16.9	19.2									

¹ Australia: New South Wales
² Canada (Colon): Alberta and Manitoba; Canada (Rectum): Alberta, British Columbia and Manitoba
³ Sweden: Uppsala-Örebro and Stockholm-Gotland health regions
⁴ United Kingdom (Colon): Northern Ireland and all cancer registries in England; United Kingdom (Rectum): Northern Ireland and all cancer registries in England except the Thames Cancer Registry
⁵ In Canada and Denmark we analysed patients diagnosed in 2004-7
⁶ Number of patients before imputation

Table 2. All-ages, age-specific and age-standardised one-year net survival (%) by stage at diagnosis and country for colon cancer patients diagnosed during 2000-2007

	Australia ¹		Canada ^{2,5}			Denmark ⁵		Norway		Sweden ³			UK ⁴		
	NS (%)	95% CI	NS (%)	95% CI	NS (%)	95% CI	NS (%)	95% CI	NS (%)	95% CI	NS (%)	95% CI			
Dukes' stage															
All patients	All ages		76.9	75.8	78.1	71.8	70.9	72.8		79.8	79.0	80.6	67.3	67.1	67.6
	Age-standardised		76.2	75.4	77.1	71.3	70.6	72.1		79.9	79.3	80.5	67.4	67.2	67.6
	15-49		85.6	83.3	87.9	82.8	80.3	85.4		85.7	83.7	87.6	80.6	79.9	81.4
	50-69		83.0	81.6	84.3	79.8	78.6	80.9		83.6	82.6	84.6	76.5	76.1	76.8
	70-99		72.0	70.5	73.6	66.3	65.0	67.5		77.5	76.5	78.5	61.6	61.3	61.9
Dukes' stage A	All ages		95.4	93.8	97.1	92.3	90.1	94.5		97.4	96.1	98.7	95.8	95.2	96.3
	Age-standardised		95.4	94.1	96.8	92.3	90.6	94.0		97.8	97.0	98.7	95.7	95.3	96.2
	15-49		99.0	97.0	100.0	99.5	98.4	100.0		99.8	99.1	100.0	98.8	98.0	99.6
	50-69		98.2	96.9	99.6	97.2	95.5	98.8		99.0	97.7	100.0	97.8	97.3	98.3
	70-99		93.2	90.4	95.9	88.9	85.6	92.3		96.5	94.7	98.3	94.4	93.5	95.2
Dukes' stage B	All ages		92.9	91.5	94.3	91.2	89.8	92.5		94.9	94.0	95.8	90.1	89.8	90.5
	Age-standardised		92.7	91.9	93.6	91.0	90.2	91.8		95.1	94.7	95.6	90.1	89.8	90.4
	15-49		97.7	97.1	98.3	97.1	96.4	97.8		98.5	98.1	98.9	96.8	96.2	97.4
	50-69		96.1	95.3	97.0	94.8	94.0	95.7		97.3	96.8	97.8	94.4	94.0	94.7
	70-99		90.7	88.8	92.6	88.7	87.0	90.5		93.7	92.6	94.8	87.6	87.1	88.0
Dukes' stage C	All ages		87.4	85.6	89.2	84.0	82.3	85.6		86.2	85.0	87.5	76.8	76.4	77.2
	Age-standardised		87.6	86.3	88.9	83.4	82.1	84.7		86.9	86.1	87.7	76.8	76.4	77.1
	15-49		95.3	93.0	97.5	95.7	93.3	98.0		94.1	92.4	95.8	87.2	86.0	88.3
	50-69		94.0	92.4	95.5	89.5	87.8	91.2		91.7	90.5	92.8	83.6	83.1	84.1
	70-99		82.1	79.4	84.9	78.6	76.1	81.1		82.5	80.7	84.2	71.4	70.8	72.0
Dukes' stage D	All ages		41.0	38.6	43.4	41.0	39.1	42.9		41.8	40.0	43.6	34.1	33.4	34.7
	Age-standardised		39.3	37.6	41.0	40.6	39.3	42.0		42.1	40.8	43.4	34.2	33.7	34.7
	15-49		63.5	57.8	69.2	58.3	52.7	64.0		56.5	51.0	62.0	50.8	48.4	53.2
	50-69		52.2	48.7	55.7	51.2	48.5	53.9		52.1	49.5	54.8	43.6	42.6	44.7
	70-99		28.5	25.5	31.5	31.6	29.3	34.0		33.2	30.9	35.5	26.0	25.2	26.8
Missing stage	All ages		60.4	55.6	65.2	64.0	61.9	66.2		63.3	58.3	68.3	43.0	42.5	43.4
	Age-standardised		59.0	55.0	62.9	64.5	62.8	66.2		65.7	61.7	69.6	42.9	42.6	43.3
	15-49		89.6	82.3	96.9	88.8	82.4	95.1		96.1	85.9	100.0	72.4	70.6	74.1
	50-69		77.9	71.2	84.5	80.4	77.6	83.3		83.8	77.8	89.9	58.9	58.1	59.7
	70-99		49.0	42.7	55.3	57.1	54.4	59.8		56.6	50.5	62.6	35.3	34.7	35.8

SEER Summary Stage 2000

6	All patients	All ages	81.0	80.4	81.5	76.9	75.8	78.1	71.9	70.9	72.8	75.1	74.5	75.8	79.8	79.0	80.6	67.4	67.1	67.6
7		Age-standardised	80.2	79.8	80.6	76.3	75.4	77.2	71.5	70.7	72.2	75.5	75.0	76.0	79.9	79.4	80.5	67.5	67.3	67.7
8		15-49	88.9	87.8	90.0	85.6	83.3	87.9	82.8	80.3	85.4	84.4	82.9	86.0	85.6	83.7	87.5	80.6	79.8	81.3
9		50-69	86.0	85.4	86.6	83.0	81.6	84.3	79.7	78.6	80.9	81.6	80.8	82.5	83.6	82.6	84.6	76.5	76.1	76.8
10		70-99	76.8	76.0	77.5	72.1	70.5	73.6	66.3	65.1	67.6	71.3	70.4	72.1	77.5	76.5	78.5	61.6	61.3	62.0
11	Localised	All ages	94.9	94.3	95.6	95.1	94.0	96.2	92.7	91.6	93.9	93.3	92.2	94.4	95.5	94.8	96.3	91.3	91.0	91.6
12		Age-standardised	94.7	94.1	95.2	95.0	94.1	95.8	92.5	91.6	93.5	93.7	92.9	94.5	95.8	95.3	96.3	91.3	91.1	91.5
13		15-49	99.1	98.7	99.5	99.1	98.2	100.0	98.5	97.3	99.8	99.0	98.2	99.7	99.4	99.0	99.9	97.3	96.8	97.8
14		50-69	97.7	97.2	98.2	97.9	97.1	98.8	96.7	95.7	97.7	97.8	97.0	98.5	97.8	97.2	98.4	95.1	94.8	95.4
15		70-99	92.8	91.7	93.8	93.1	91.5	94.8	90.0	88.3	91.8	90.9	89.3	92.4	94.4	93.3	95.4	88.9	88.5	89.4
16	Regional	All ages	87.1	86.4	87.8	86.5	84.8	88.2	83.5	82.0	85.1	87.7	86.9	88.4	86.2	85.0	87.5	77.1	76.7	77.5
17		Age-standardised	86.9	86.4	87.5	86.6	85.4	87.8	83.0	81.8	84.2	88.5	88.0	89.0	86.8	86.0	87.7	76.9	76.5	77.2
18		15-49	94.6	93.6	95.6	95.1	93.1	97.2	95.7	93.4	97.9	95.5	94.5	96.5	94.3	92.7	95.9	87.7	86.6	88.7
19		50-69	91.2	90.5	91.8	93.3	91.7	94.8	89.3	87.7	90.9	93.2	92.5	93.9	91.8	90.7	92.9	84.0	83.5	84.5
20		70-99	83.6	82.6	84.7	81.0	78.5	83.6	78.2	75.9	80.5	84.5	83.5	85.5	82.5	80.8	84.2	71.7	71.0	72.3
21	Distant	All ages	42.6	41.1	44.1	41.1	38.7	43.5	41.1	39.2	43.0	38.5	37.1	39.9	41.9	40.0	43.7	34.1	33.5	34.8
22		Age-standardised	42.0	40.9	43.0	39.5	37.8	41.2	40.7	39.4	42.1	39.0	38.0	40.0	42.1	40.8	43.5	34.2	33.7	34.7
23		15-49	61.9	57.9	65.9	63.3	57.6	69.0	58.1	52.5	63.8	56.2	51.9	60.4	56.4	50.9	61.8	50.5	48.1	52.8
24		50-69	53.2	51.1	55.3	52.4	48.9	55.9	51.4	48.7	54.0	49.8	47.7	51.8	52.4	49.8	55.0	43.8	42.8	44.8
25		70-99	32.2	30.3	34.0	28.6	25.6	31.6	31.7	29.4	34.1	29.6	28.0	31.3	33.2	30.9	35.4	26.0	25.2	26.8
26	Missing stage	All ages	76.2	74.3	78.2	49.4	43.9	55.0	64.2	62.0	66.4	65.4	62.9	67.9	63.5	58.5	68.5	43.4	42.9	43.8
27		Age-standardised	73.7	72.0	75.4	48.6	44.2	53.1	64.7	63.0	66.4	67.3	65.4	69.1	65.9	62.0	69.8	43.4	43.0	43.8
28		15-49	93.0	90.0	96.0	86.7	77.5	95.8	88.9	82.6	95.2	90.5	84.9	96.0	96.1	85.9	100.0	72.7	70.9	74.4
29		50-69	87.8	85.9	89.7	63.8	53.9	73.8	80.4	77.6	83.3	85.5	82.5	88.5	83.9	77.9	89.9	59.1	58.3	59.9
30		70-99	68.3	65.6	71.0	40.1	33.4	46.8	57.3	54.7	60.0	57.6	54.5	60.7	56.8	50.7	62.8	35.7	35.2	36.2

¹ Australia: New South Wales

² Canada: Alberta and Manitoba

³ Sweden: Uppsala-Örebro and Stockholm-Gotland health regions

⁴ United Kingdom: Northern Ireland and all cancer registries in England

⁵ In Canada and Denmark we analysed patients diagnosed in 2004-7

Table 3. All-ages, age-specific and age-standardised one-year net survival (%) by stage at diagnosis and country for rectal cancer patients diagnosed during 2000-2007

	Australia ¹		Canada ^{2,5}			Denmark ⁵		Norway		Sweden ³			UK ⁴				
	NS (%)	95% CI	NS (%)	95% CI	NS (%)	95% CI	NS (%)	95% CI	NS (%)	95% CI	NS (%)	95% CI	NS (%)	95% CI			
Dukes' stage																	
All patients			84.8	83.9	85.7	79.6	78.5	80.7	81.8	80.9	82.6	84.1	83.1	85.1	74.9	74.6	75.2
	Age-standardised		84.0	83.3	84.7	79.0	78.2	79.9	82.3	81.7	82.8	84.4	83.7	85.1	75.2	75.0	75.5
	15-49		91.6	90.1	93.0	88.5	86.0	91.0	90.8	89.3	92.2	89.5	87.4	91.6	86.0	85.2	86.9
	50-69		89.2	88.2	90.1	87.3	86.2	88.4	88.0	87.2	88.9	89.2	88.2	90.1	83.2	82.8	83.6
	70-99		79.2	77.8	80.7	71.6	69.8	73.3	76.3	75.1	77.5	79.9	78.4	81.3	67.7	67.2	68.2
Dukes' stage A	All ages		97.1	96.0	98.3	96.0	93.8	98.1	97.4	96.5	98.4	98.8	97.8	99.9	95.7	95.1	96.2
	Age-standardised		97.1	96.4	97.7	96.0	94.8	97.1	97.6	97.1	98.1	98.9	98.3	99.4	95.7	95.4	96.0
	15-49		99.4	99.1	99.7	99.2	98.7	99.7	99.5	99.3	99.8	99.8	99.6	100.0	99.2	98.9	99.4
	50-69		98.4	97.7	99.1	97.7	96.4	99.0	98.6	98.1	99.2	99.4	98.8	99.9	97.5	97.1	97.9
	70-99		95.6	93.8	97.4	94.1	90.9	97.2	96.4	95.0	97.7	98.4	96.9	99.9	93.8	93.0	94.6
Dukes' stage B	All ages		94.3	93.0	95.7	92.3	90.6	94.0	92.8	91.6	94.1	97.7	96.6	98.8	91.4	90.9	91.9
	Age-standardised		94.1	93.2	95.0	91.8	90.6	93.0	93.5	92.8	94.2	97.8	97.2	98.3	91.5	91.1	91.8
	15-49		99.3	98.9	99.8	98.8	98.0	99.6	99.3	99.0	99.6	99.0	98.4	99.6	98.1	97.8	98.5
	50-69		97.4	96.6	98.3	95.9	94.7	97.2	97.2	96.6	97.9	98.3	97.6	99.0	95.0	94.5	95.4
	70-99		90.5	87.9	93.0	88.2	85.2	91.1	89.4	87.4	91.4	97.1	95.6	98.7	88.2	87.4	89.0
Dukes' stage C	All ages		93.3	91.9	94.6	90.8	89.3	92.3	90.9	89.4	92.4	93.8	92.3	95.3	87.3	86.8	87.9
	Age-standardised		92.7	91.6	93.7	90.0	88.7	91.2	91.5	90.5	92.4	94.2	93.3	95.0	87.4	87.0	87.8
	15-49		97.4	96.0	98.7	95.7	93.3	98.0	97.6	96.5	98.7	98.4	97.5	99.4	94.5	93.4	95.5
	50-69		95.7	94.5	96.8	94.9	93.7	96.2	95.1	94.1	96.2	97.0	96.1	97.8	92.1	91.6	92.6
	70-99		89.3	86.8	91.8	84.7	81.8	87.6	86.5	84.1	89.0	90.5	88.2	92.9	81.7	80.8	82.6
Dukes' stage D	All ages		58.9	56.1	61.7	52.3	49.4	55.2	49.7	47.3	52.1	51.9	49.1	54.7	42.6	41.5	43.6
	Age-standardised		56.9	55.4	58.4	52.2	50.8	53.7	50.6	49.3	51.8	52.4	51.0	53.8	43.2	42.5	43.8
	15-49		69.9	66.9	72.8	66.0	62.8	69.2	64.7	61.7	67.7	65.8	62.4	69.2	57.9	55.2	60.7
	50-69		66.0	63.3	68.6	61.0	58.3	63.8	60.1	57.7	62.4	61.4	58.7	64.1	52.5	51.2	53.8
	70-99		46.4	43.0	49.8	41.4	38.2	44.7	38.9	36.3	41.6	41.2	38.1	44.3	31.7	30.4	32.9
Missing stage	All ages		79.8	77.8	81.8	72.7	70.2	75.2	76.6	74.8	78.3	56.3	52.0	60.7	57.1	56.4	57.8
	Age-standardised		79.8	78.3	81.3	75.1	73.3	76.9	77.4	76.1	78.6	61.3	58.0	64.7	59.4	58.9	59.9
	15-49		92.4	89.2	95.7	92.9	87.9	97.9	92.3	88.9	95.6	68.5	44.8	92.1	79.4	77.3	81.4
	50-69		88.7	86.6	90.8	86.5	83.8	89.2	87.9	86.0	89.8	73.2	66.3	80.1	70.1	69.2	71.1
	70-99		71.7	68.7	74.7	64.4	60.9	67.8	67.6	65.0	70.1	52.1	47.2	56.9	49.0	48.1	49.8

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SEER Summary Stage 2000

All patients	All ages	84.6	84.0	85.3	84.3	83.5	85.2	79.1	78.1	80.2	81.7	80.9	82.5	84.0	83.0	85.0	75.1	74.8	75.4
	Age-standardised	83.6	83.1	84.2	83.5	82.8	84.2	78.6	77.7	79.4	82.2	81.6	82.8	84.3	83.6	85.0	75.4	75.2	75.7
	15-49	90.3	89.2	91.5	91.3	89.8	92.8	88.3	85.7	90.8	90.7	89.2	92.2	89.4	87.3	91.5	86.2	85.4	87.0
	50-69	89.0	88.4	89.7	88.8	87.9	89.8	87.0	85.9	88.1	88.0	87.2	88.9	89.1	88.2	90.1	83.5	83.1	83.8
	70-99	79.2	78.1	80.3	78.6	77.1	80.0	70.9	69.2	72.6	76.2	75.0	77.4	79.7	78.3	81.2	67.9	67.4	68.4
Localised	All ages	94.1	93.4	94.8	96.5	95.6	97.4	94.4	93.0	95.7	94.3	93.6	95.1	98.3	97.5	99.1	93.2	92.9	93.6
	Age-standardised	93.9	93.4	94.3	96.4	95.8	97.0	94.1	93.2	95.1	94.9	94.5	95.4	98.4	97.9	98.8	93.3	93.0	93.5
	15-49	99.2	98.9	99.5	99.7	99.5	99.9	99.4	98.9	99.9	99.5	99.3	99.7	99.3	98.9	99.7	98.6	98.4	98.9
	50-69	97.1	96.6	97.6	98.6	98.1	99.2	97.4	96.5	98.4	97.9	97.5	98.3	98.8	98.2	99.3	96.1	95.8	96.4
	70-99	90.6	89.3	91.9	94.0	92.3	95.7	91.0	88.6	93.4	91.4	90.1	92.8	97.9	96.8	99.0	90.5	89.9	91.1
Regional	All ages	91.2	90.3	92.0	92.6	91.4	93.9	90.0	88.5	91.5	89.9	88.6	91.2	93.8	92.3	95.3	87.3	86.8	87.8
	Age-standardised	91.0	90.4	91.6	92.1	91.1	93.1	89.2	88.0	90.4	90.7	89.9	91.5	94.2	93.4	95.1	87.4	87.0	87.7
	15-49	95.8	94.8	96.9	97.1	95.8	98.4	95.2	92.8	97.7	97.2	96.0	98.4	98.4	97.4	99.4	94.4	93.4	95.4
	50-69	94.8	94.1	95.4	95.3	94.2	96.4	94.4	93.1	95.6	95.1	94.2	95.9	97.0	96.2	97.9	92.1	91.6	92.6
	70-99	86.4	84.8	87.9	88.3	86.0	90.7	83.6	80.8	86.4	84.9	82.8	86.9	90.5	88.2	92.9	81.6	80.7	82.5
Distant	All ages	52.1	49.9	54.3	58.9	56.1	61.8	52.3	49.4	55.2	49.3	47.1	51.5	51.9	49.2	54.7	42.6	41.6	43.6
	Age-standardised	50.9	49.7	52.1	57.0	55.5	58.4	52.4	50.9	53.8	50.4	49.2	51.5	52.5	51.1	54.0	43.3	42.7	44.0
	15-49	64.6	61.7	67.5	70.2	67.4	73.0	66.4	63.3	69.5	64.7	62.0	67.4	66.2	63.0	69.4	58.4	55.9	60.9
	50-69	60.2	58.0	62.3	66.0	63.4	68.6	61.1	58.3	63.8	59.7	57.5	61.8	61.4	58.8	64.1	52.6	51.3	53.8
	70-99	39.5	37.0	42.1	46.3	42.9	49.6	41.4	38.1	44.6	38.2	35.8	40.7	41.1	38.0	44.2	31.6	30.4	32.8
Missing stage	All ages	81.0	78.8	83.2	79.0	77.0	81.0	72.7	70.1	75.2	61.2	57.4	65.0	56.3	52.0	60.6	57.1	56.4	57.7
	Age-standardised	79.5	77.8	81.2	78.7	77.1	80.2	74.6	72.7	76.4	68.6	65.9	71.3	60.9	57.6	64.2	58.8	58.3	59.3
	15-49	94.2	91.6	96.9	92.0	88.6	95.4	92.9	87.9	97.9	91.1	83.3	98.9	68.4	44.7	92.1	79.2	77.2	81.3
	50-69	89.1	86.9	91.2	88.0	85.8	90.2	86.4	83.8	89.1	86.6	82.0	91.1	73.1	66.2	80.0	70.1	69.1	71.0
	70-99	72.2	68.9	75.6	70.8	67.7	73.9	64.3	60.9	67.8	49.3	44.5	54.1	52.1	47.2	56.9	49.0	48.1	49.8

¹ Australia: New South Wales

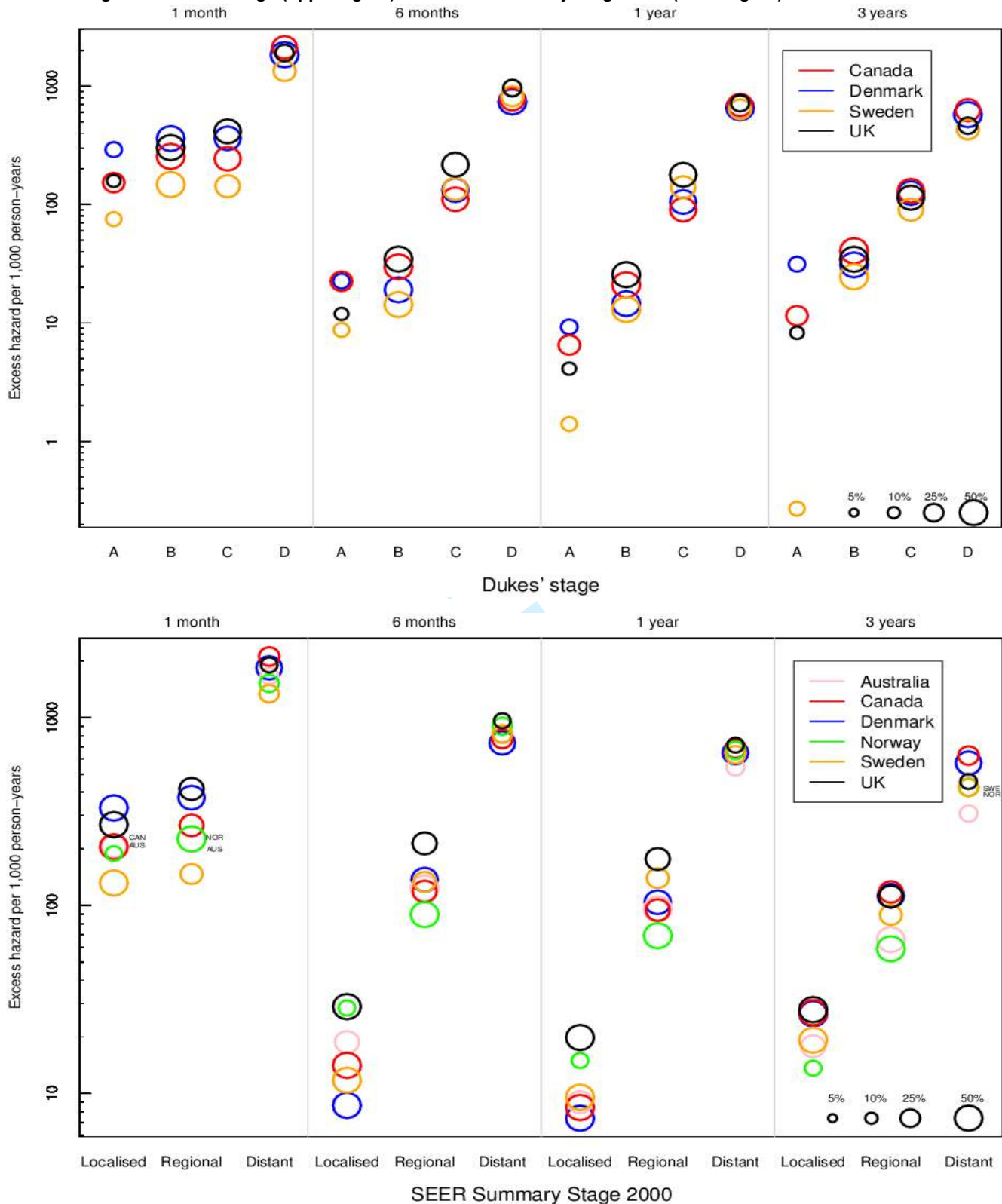
² Canada: Alberta, British Columbia and Manitoba

³ Sweden: Uppsala-Örebro and Stockholm-Gotland health regions

⁴ United Kingdom: Northern Ireland and all cancer registries in England except the Thames Cancer Registry

⁵ In Canada and Denmark we analysed patients diagnosed in 2004-7

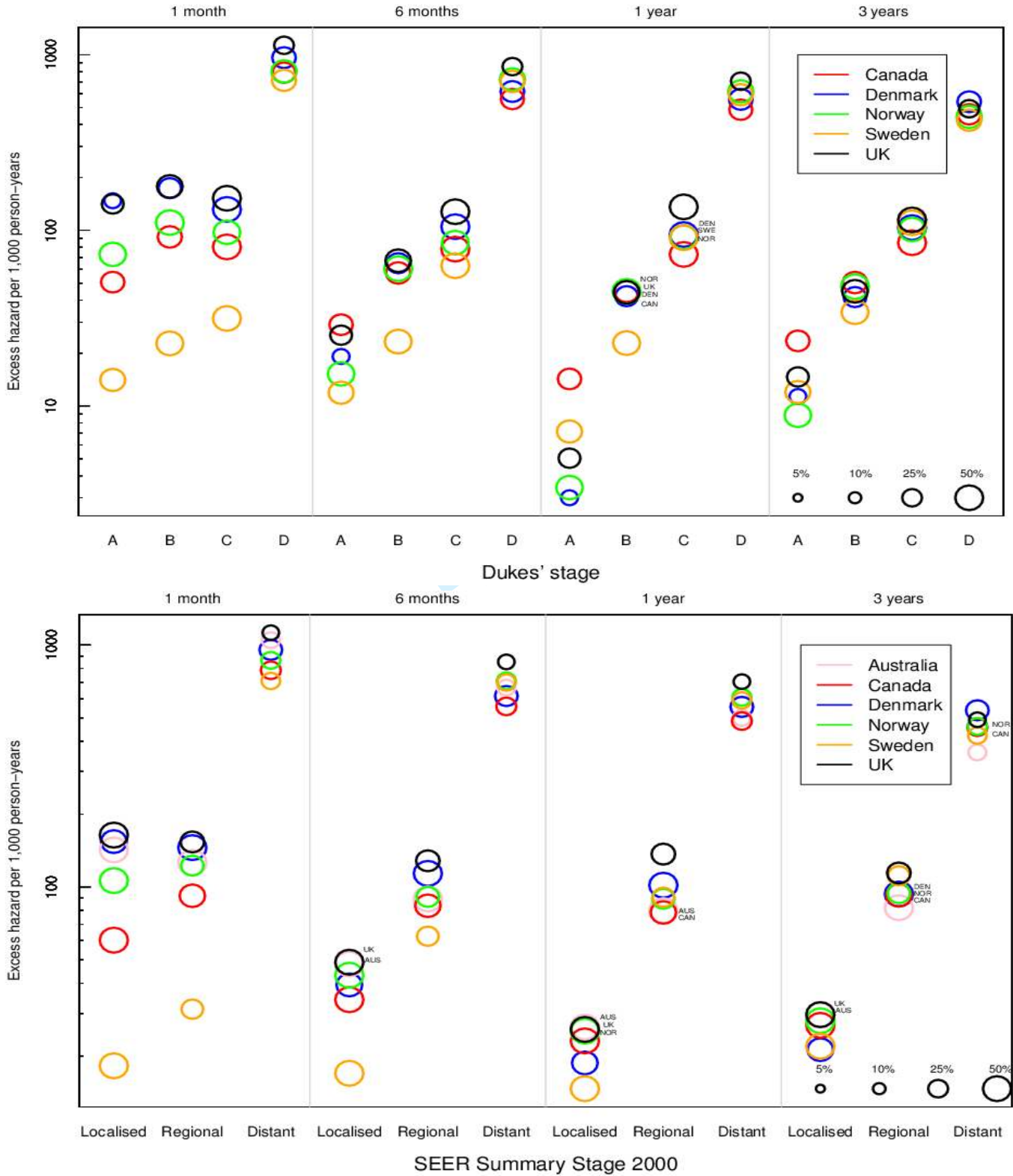
Figure 1. Age-standardised excess hazard of death (per 1,000 person-years, log scale) from colon cancer by stage, country and time since diagnosis: Dukes' stage (upper figure) and SEER Summary Stage 2000 (lower figure)



Notes

- National data are used for Denmark and Norway. Other countries are represented by regional registries: Australia: New South Wales; Canada: Alberta and Manitoba; Sweden: Uppsala-Örebro and Stockholm-Gotland health regions; UK: England and Northern Ireland. In Canada and Denmark we analysed patients diagnosed in 2004-7
- For each country, the size of the "bubble" represents the proportion of cancers in each stage at diagnosis (see legend at bottom right of figure). The relative size of the bubbles is therefore the same at each time since diagnosis.

Figure 2. Age-standardised excess hazard of death (per 1,000 person-years, log scale) from rectal cancer by stage, country and time since diagnosis: Dukes' stage (upper figure) and SEER Summary Stage 2000 (lower figure)



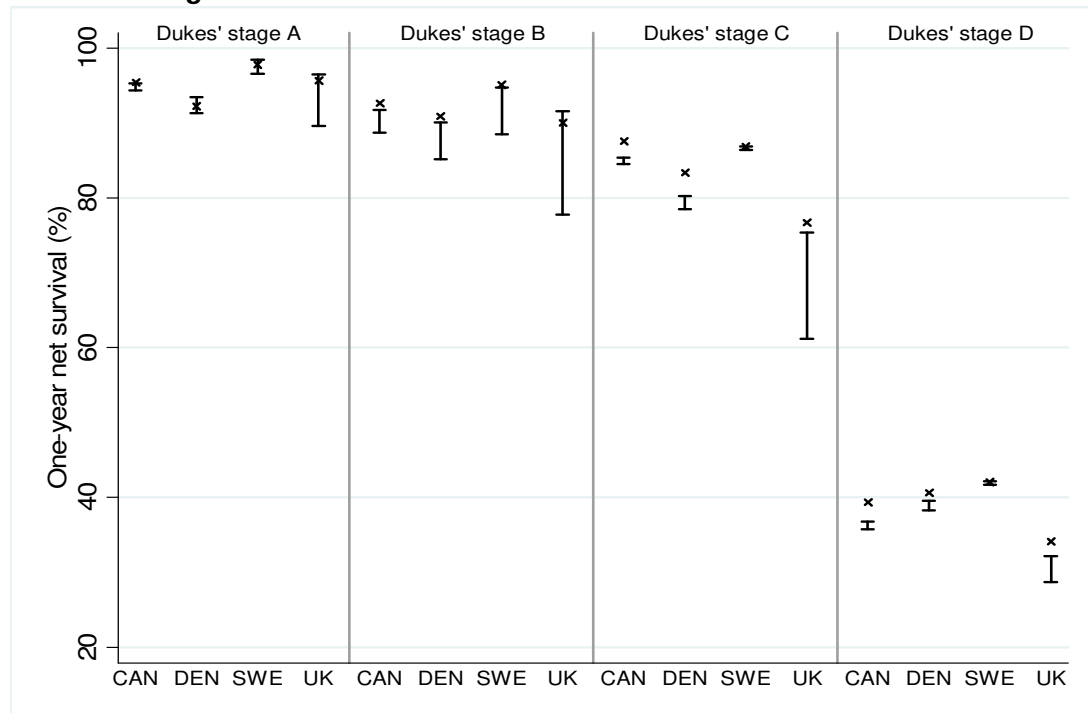
Notes

1. National data are used for Denmark and Norway. Other countries are represented by regional registries: Australia: New South Wales; Canada: Alberta, British Columbia and Manitoba; Sweden: Uppsala-Örebro and Stockholm-Gotland health regions; UK: Northern Ireland and all cancer registries in England except the Thames Cancer Registry. In Canada and Denmark we analysed patients diagnosed in 2004-7

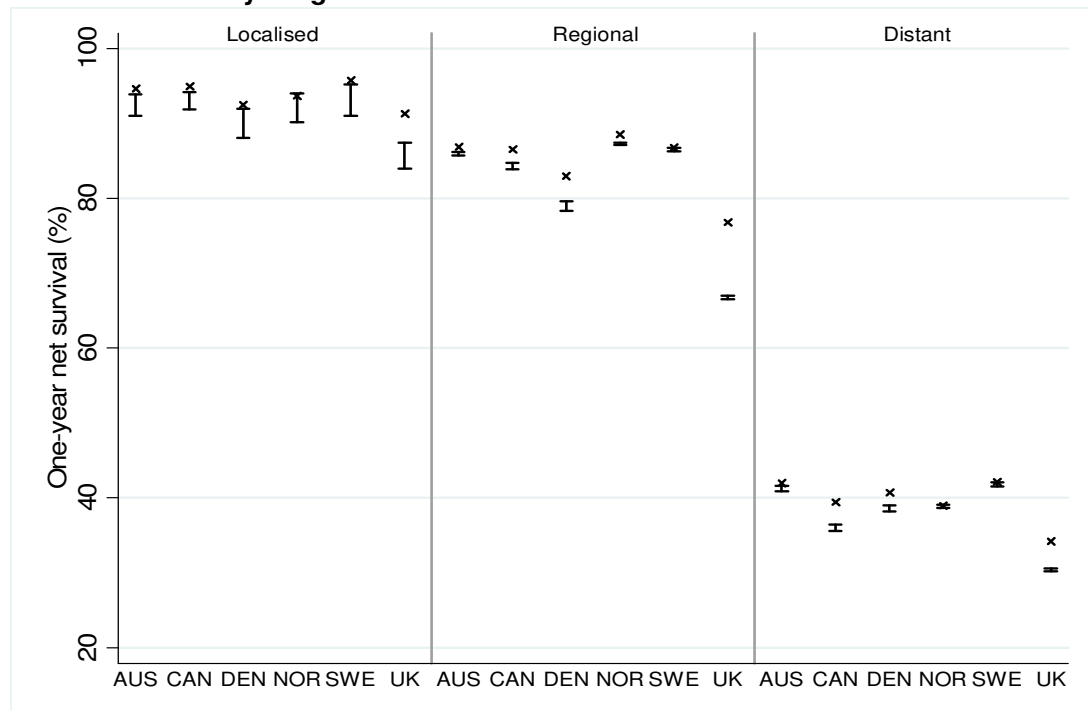
2. For each country, the size of the "bubble" represents the proportion of cancers in each stage at diagnosis (see legend at bottom right of figure). The relative size of the bubbles is therefore the same at each time since diagnosis.

Figure 3. Age-standardised one-year net survival from colon cancer by stage at diagnosis and country using known stage and imputed stage, Dukes' (upper figure) and SEER Summary Stage 2000 (lower figure)

A- Dukes' stage



B- SEER Summary Stage 2000



X survival estimate derived from patients with known stage

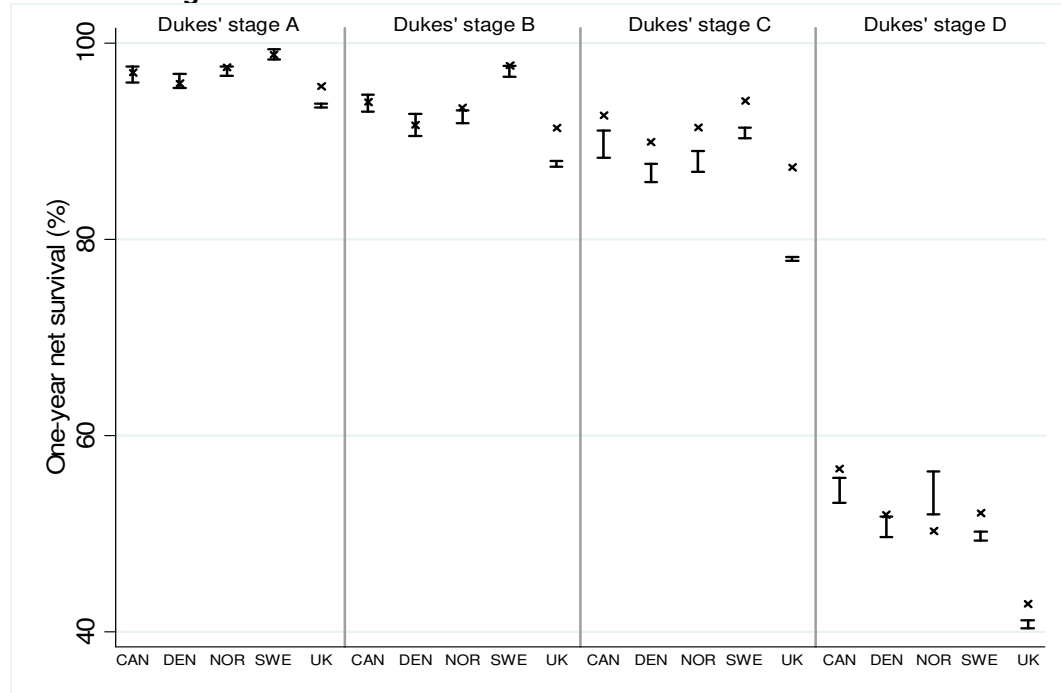
I range of survival estimates derived for all patients after imputation of stage where it was missing (see text)

Notes:

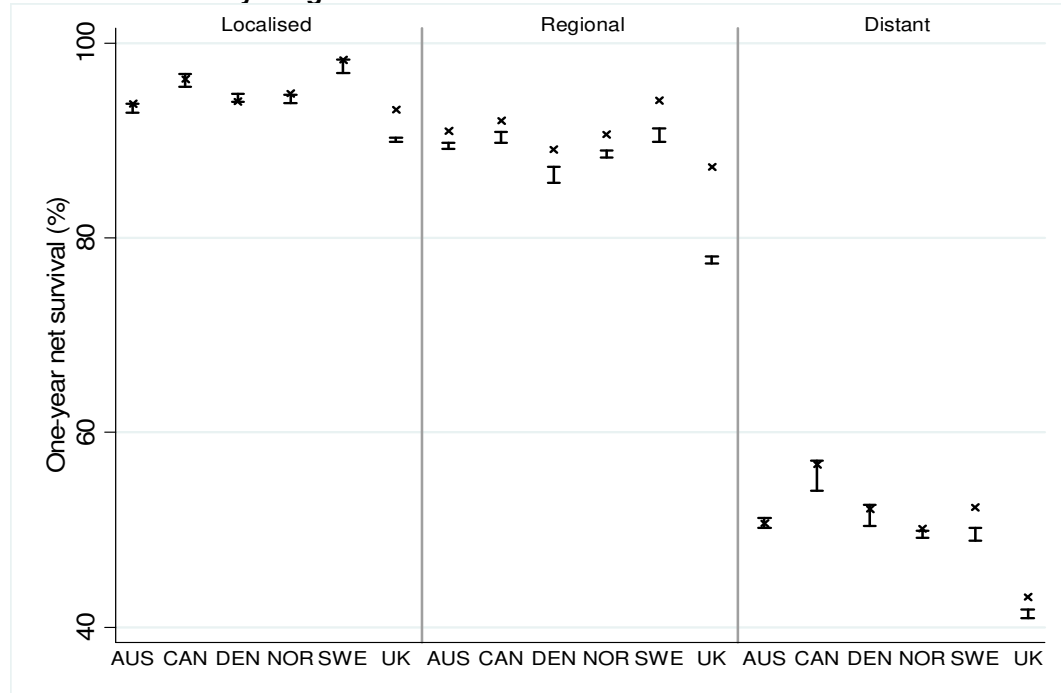
National data are used for Denmark and Norway. Other countries are represented by regional registries: Australia: New South Wales; Canada: Alberta and Manitoba; Sweden: Uppsala-Örebro and Stockholm-Gotland health regions; UK: England and Northern Ireland. In Canada and Denmark we analysed patients diagnosed in 2004-7

Figure 4. Age-standardised one-year net survival from rectal cancer by stage at diagnosis and country using known stage and imputed stage, Dukes' (upper figure) and SEER Summary Stage 2000 (lower figure)

A- Dukes' stage



B- SEER Summary Stage 2000



X survival estimate derived from patients with known stage

I range of survival estimates derived for all patients after imputation of stage where it was missing (see text)

Notes:

National data are used for Denmark and Norway. Other countries are represented by regional registries: Australia: New South Wales; Canada: Alberta, British Columbia and Manitoba; Sweden: Uppsala-Örebro and Stockholm-Gotland health regions; UK: Northern Ireland and all cancer registries in England except the Thames Cancer Registry. In Canada and Denmark we analysed patients diagnosed in 2004-7

1
2
3 **Stage at diagnosis and colorectal cancer survival in six high-income countries: a population-**
4 **based study, 2000-7**
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9 **WEB APPENDIX**

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11 **Web appendix table 1** Stage-specific sets of weights used for age standardisation of colon cancer
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17 **Web appendix figure 1** Proportions of colon cancer patients with missing data on stage (upper
18 figure) and cumulative stage distribution (lower figure) by age at diagnosis and country, Dukes' (left)
19 and SEER Summary Stage 2000 (right)
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21 **Web appendix table 3** All-ages, age-specific and age-standardised three-year net survival (%) by
22 stage at diagnosis, age and country for colon cancer patients diagnosed during 2000-2007
23

24 **Web appendix table 4** All-ages, age-specific and age-standardised three-year net survival (%) by
25 stage at diagnosis, age and country for rectal cancer patients diagnosed during 2000-2007
26

27 **Web appendix figure 2** Age-standardised three-year net survival from colon cancer by stage at
28 diagnosis and country using known stage and imputed stage, Dukes' (upper figure) and SEER
29 Summary Stage 2000 (lower figure)
30

31 **Web appendix figure 3** Age-standardised three-year net survival from rectal cancer by stage at
32 diagnosis and country using known stage and imputed stage, Dukes' (upper figure) and SEER
33 Summary Stage 2000 (lower figure)
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Web appendix table 1. Stage-specific sets of weights used for age standardisation of colon cancer estimates

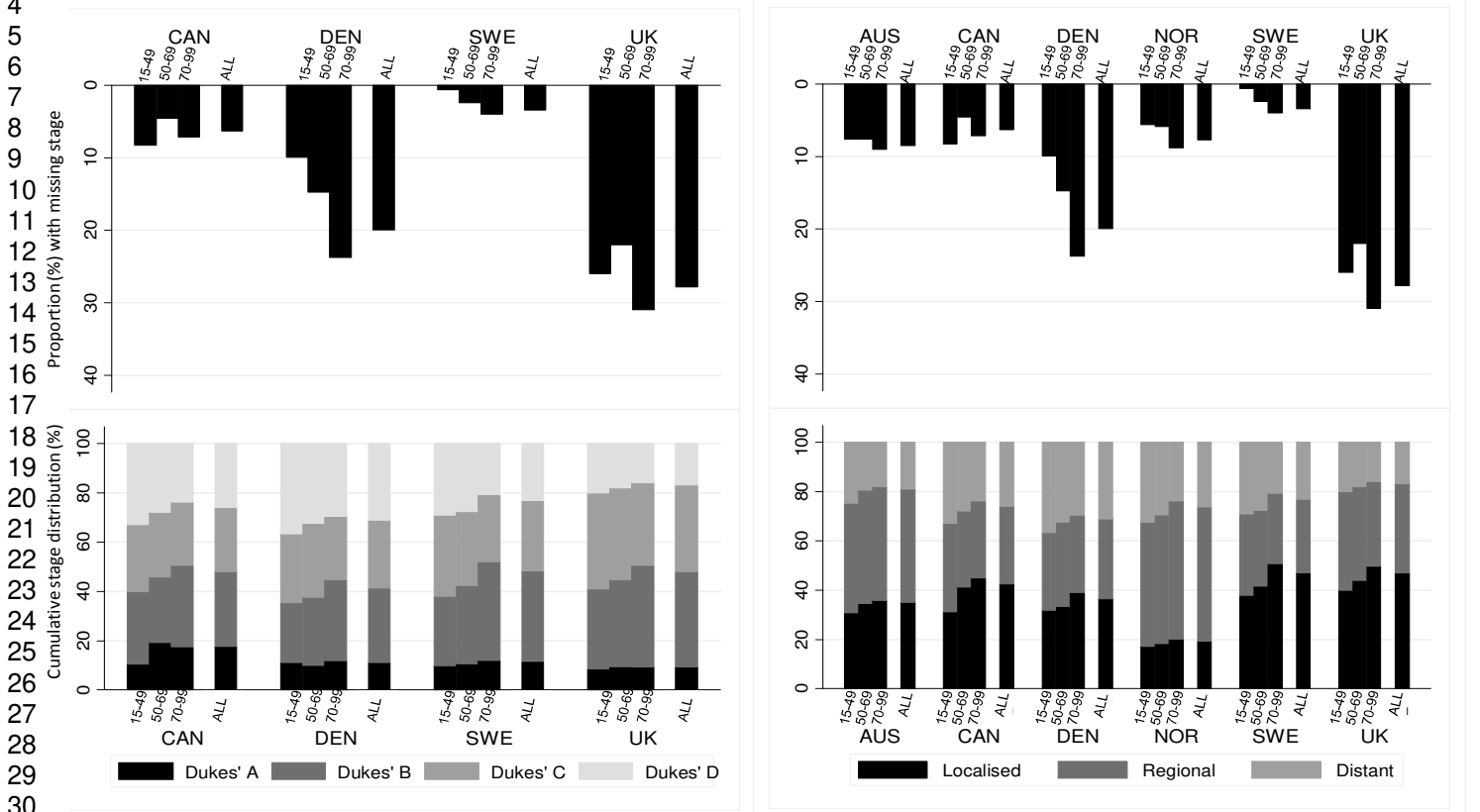
Dukes' stage	Age category	Weights	SEER Summary Stage 2000	Age category	Weights
All patients	15-44	0.03	All patients	15-44	0.03
	45-54	0.06		45-54	0.06
	55-64	0.16		55-64	0.17
	65-74	0.29		65-74	0.29
	75-84	0.34		75-84	0.33
	85-99	0.13		85-99	0.12
Dukes' stage A	15-44	0.02	Localised	15-44	0.02
	45-54	0.06		45-54	0.06
	55-64	0.17		55-64	0.16
	65-74	0.32		65-74	0.30
	75-84	0.34		75-84	0.36
	85-99	0.08		85-99	0.10
Dukes' stage B	15-44	0.02	Regional	15-44	0.03
	45-54	0.05		45-54	0.07
	55-64	0.15		55-64	0.18
	65-74	0.30		65-74	0.30
	75-84	0.36		75-84	0.32
	85-99	0.11		85-99	0.10
Dukes' stage C	15-44	0.03	Distant	15-44	0.03
	45-54	0.07		45-54	0.08
	55-64	0.19		55-64	0.19
	65-74	0.31		65-74	0.29
	75-84	0.32		75-84	0.30
	85-99	0.09		85-99	0.10
Dukes' stage D	15-44	0.03	Missing stage	15-44	0.03
	45-54	0.08		45-54	0.05
	55-64	0.19		55-64	0.13
	65-74	0.30		65-74	0.24
	75-84	0.30		75-84	0.35
	85-99	0.10		85-99	0.21
Missing stage	15-44	0.03		15-44	
	45-54	0.05		45-54	
	55-64	0.13		55-64	
	65-74	0.24		65-74	
	75-84	0.35		75-84	
	85-99	0.21		85-99	

Web appendix table 2. Stage-specific sets of weights used for age standardisation of rectal cancer estimates

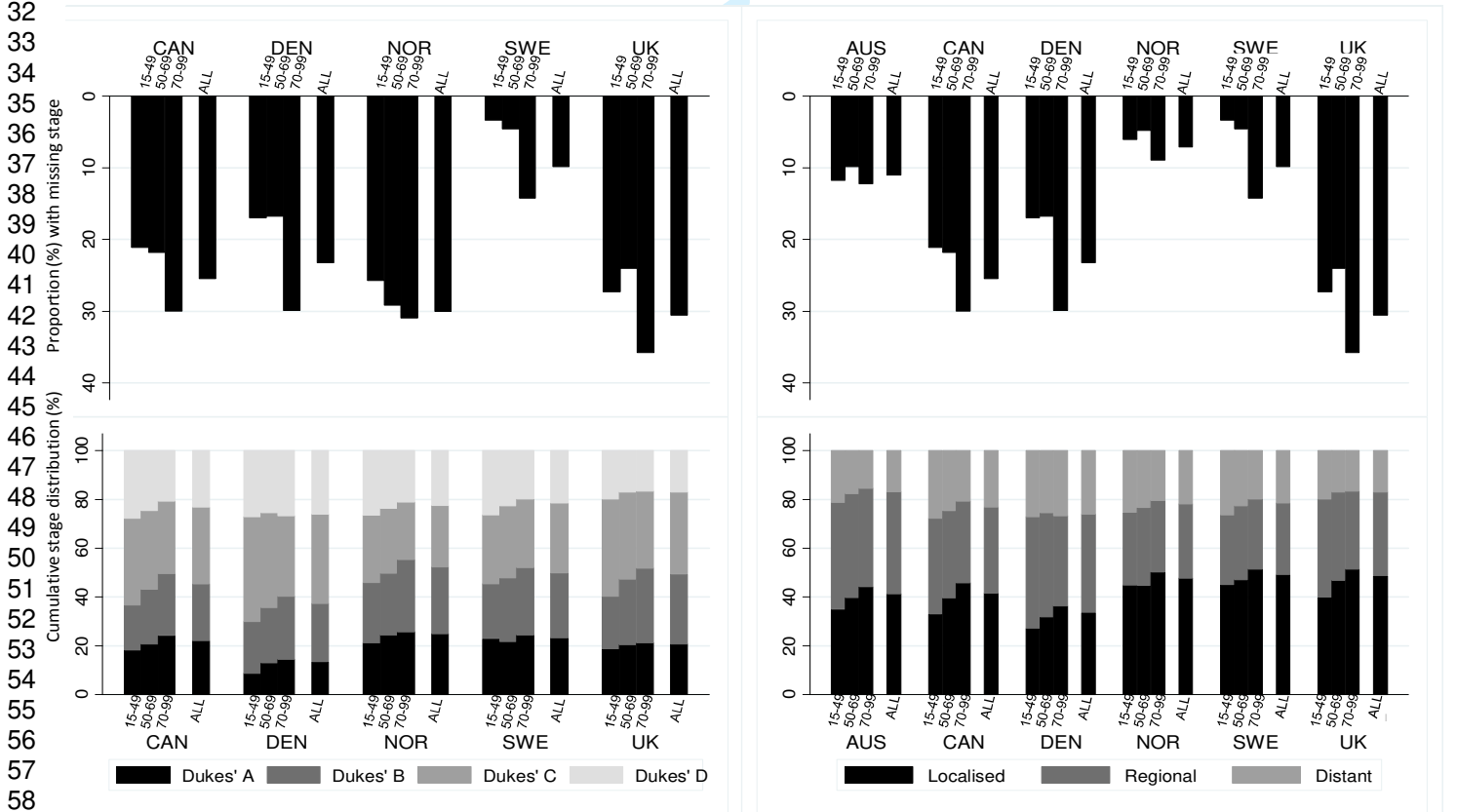
Dukes' stage	Age category	Weights	SEER Summary Stage 2000	Age category	Weights
All patients	15-44	0.03	All patients	15-44	0.03
	45-54	0.08		45-54	0.09
	55-64	0.21		55-64	0.21
	65-74	0.30		65-74	0.30
	75-84	0.28		75-84	0.28
	85-99	0.09		85-99	0.09
Dukes' stage A	15-44	0.03	Localised	15-44	0.02
	45-54	0.08		45-54	0.08
	55-64	0.22		55-64	0.22
	65-74	0.33		65-74	0.32
	75-84	0.28		75-84	0.28
	85-99	0.07		85-99	0.07
Dukes' stage B	15-44	0.02	Regional	15-44	0.03
	45-54	0.08		45-54	0.10
	55-64	0.21		55-64	0.24
	65-74	0.32		65-74	0.31
	75-84	0.30		75-84	0.26
	85-99	0.07		85-99	0.05
Dukes' stage C	15-44	0.03	Distant	15-44	0.04
	45-54	0.10		45-54	0.11
	55-64	0.24		55-64	0.23
	65-74	0.32		65-74	0.30
	75-84	0.26		75-84	0.26
	85-99	0.05		85-99	0.07
Dukes' stage D	15-44	0.03	Missing stage	15-44	0.02
	45-54	0.10		45-54	0.07
	55-64	0.23		55-64	0.16
	65-74	0.30		65-74	0.25
	75-84	0.26		75-84	0.31
	85-99	0.07		85-99	0.18
Missing stage	15-44	0.02			
	45-54	0.07			
	55-64	0.17			
	65-74	0.25			
	75-84	0.31			
	85-99	0.18			

Web appendix figure 1. Proportions of colon cancer patients with missing data on stage (upper figure) and cumulative stage distribution (lower figure) by age at diagnosis and country, Dukes' (left) and SEER Summary Stage 2000 (right)

A- COLON



B- RECTUM



Notes National data are used for Denmark and Norway. Other countries are represented by regional registries: Australia: New South Wales; Canada (Colon): Alberta and Manitoba; Canada (Rectum): Alberta, British Columbia and Manitoba; Sweden: Uppsala-Örebro and Stockholm-Gotland health regions; UK (Colon): England and Northern Ireland; UK (Rectum): Northern Ireland and all cancer registries in England except the Thames Cancer Registry. In Canada and Denmark we analysed patients diagnosed in 2004-7

Web appendix table 3. All-ages, age-specific and age-standardised three-year net survival (%) by stage at diagnosis, age and country for colon cancer patients diagnosed during 2000-2007

	Australia ¹			Canada ^{2,5}			Denmark ⁵			Norway			Sweden ³			UK ⁴		
	NS (%)	95% CI		NS (%)	95% CI		NS (%)	95% CI		NS (%)	95% CI		NS (%)	95% CI		NS (%)	95% CI	
Dukes' stage																		
All patients																		
All ages				62.8	61.1	64.5	58.1	56.8	59.5				68.1	67.1	69.1	54.9	54.6	55.2
Age-standardised				62.2	61.0	63.4	57.7	56.7	58.7				68.2	67.4	69.0	54.9	54.7	55.1
15-49				70.0	65.8	74.2	66.9	62.5	71.2				71.0	67.6	74.4	65.1	64.1	66.1
50-69				67.9	65.7	70.1	64.9	63.1	66.7				70.1	68.7	71.6	62.0	61.6	62.5
70-99				58.6	56.4	60.8	53.4	51.7	55.1				66.9	65.5	68.2	50.4	50.0	50.7
Dukes' stage A																		
All ages				94.0	91.0	97.1	88.8	84.8	92.7				98.2	96.7	99.8	94.9	94.1	95.7
Age-standardised				94.0	91.9	96.1	88.7	85.8	91.6				98.4	97.5	99.3	94.9	94.2	95.5
15-49				96.7	90.5	100.0	98.2	94.5	100.0				99.7	98.4	100.0	96.7	95.1	98.3
50-69				96.1	93.4	98.8	93.1	89.4	96.8				98.7	96.7	100.0	95.9	95.1	96.7
70-99				92.4	87.8	97.0	85.6	79.8	91.4				97.9	96.2	99.7	94.2	92.9	95.4
Dukes' stage B																		
All ages				87.3	84.7	89.9	87.0	84.6	89.3				91.3	90.0	92.6	84.8	84.3	85.3
Age-standardised				87.1	85.7	88.5	86.8	85.6	88.1				91.5	90.8	92.2	84.8	84.4	85.2
15-49				91.7	89.7	93.7	91.5	89.7	93.4				94.6	93.6	95.7	90.1	88.9	91.4
50-69				90.1	88.1	92.2	89.6	87.7	91.5				93.5	92.4	94.5	88.1	87.5	88.6
70-99				85.3	82.4	88.3	85.2	82.5	87.8				90.3	88.8	91.8	82.8	82.1	83.5
Dukes' stage C																		
All ages				70.5	67.2	73.9	67.2	64.3	70.0				68.7	66.7	70.7	58.2	57.6	58.8
Age-standardised				70.7	68.2	73.2	66.5	64.4	68.7				69.6	68.1	71.0	58.1	57.7	58.6
15-49				81.8	74.1	89.5	86.1	78.8	93.3				78.7	73.5	84.0	65.8	63.9	67.7
50-69				81.0	76.9	85.2	73.4	69.9	77.0				76.0	73.5	78.5	64.4	63.6	65.2
70-99				62.2	57.5	67.0	60.5	56.4	64.5				63.8	61.0	66.5	53.4	52.6	54.2
Dukes' stage D																		
All ages				12.9	10.7	15.2	12.9	11.1	14.7				15.6	14.1	17.2	11.6	11.1	12.1
Age-standardised				11.9	10.6	13.2	12.8	11.6	13.9				15.7	14.7	16.8	11.6	11.3	12.0
15-49				26.3	19.2	33.3	21.2	15.4	27.1				21.8	16.4	27.2	18.3	16.3	20.3
50-69				18.4	14.9	21.9	18.1	15.4	20.8				21.4	18.9	23.9	16.0	15.1	16.8
70-99				6.4	4.6	8.3	8.2	6.5	10.0				11.1	9.4	12.8	8.0	7.4	8.5
Missing stage																		
All ages				47.3	41.1	53.5	56.3	53.4	59.3				50.7	44.4	56.9	31.3	30.8	31.8
Age-standardised				45.8	41.1	50.5	56.8	54.7	59.0				53.6	48.8	58.4	31.2	30.8	31.6
15-49				81.9	69.8	94.0	83.1	73.7	92.4				92.9	74.5	100.0	58.2	56.2	60.2
50-69				66.2	57.0	75.4	73.4	69.6	77.3				74.8	66.2	83.5	44.8	43.9	45.7
70-99				34.5	26.9	42.2	49.1	45.6	52.7				42.7	35.3	50.1	24.6	24.0	25.1
SEER Summary Stage 2000																		
All patients																		
All ages	69.9	69.2	70.6	62.8	61.1	64.5	58.1	56.8	59.5	63.0	62.1	63.8	68.1	67.1	69.1	54.9	54.6	55.2
Age-standardised	69.2	68.7	69.8	62.3	61.0	63.5	57.8	56.8	58.8	63.2	62.6	63.9	68.2	67.4	69.0	55.0	54.8	55.2
15-49	77.2	75.3	79.2	70.0	65.8	74.2	66.9	62.5	71.2	69.8	67.2	72.5	71.0	67.5	74.4	65.0	64.1	66.0
50-69	74.4	73.5	75.3	67.8	65.6	70.1	64.8	63.1	66.6	67.9	66.7	69.1	70.1	68.6	71.5	62.0	61.5	62.4
70-99	66.2	65.2	67.2	58.7	56.5	60.9	53.5	51.7	55.2	60.0	58.9	61.1	66.9	65.5	68.3	50.4	50.0	50.8
Localised																		
All ages	92.5	91.5	93.4	91.9	89.9	93.8	89.6	87.5	91.7	90.9	89.4	92.5	92.8	91.7	93.9	87.0	86.6	87.5
Age-standardised	92.2	91.5	92.9	91.6	90.2	93.1	89.4	87.9	90.9	91.3	90.2	92.4	93.0	92.2	93.8	87.0	86.7	87.4
15-49	97.1	95.7	98.5	96.6	93.2	99.9	95.5	91.5	99.4	96.7	94.2	99.2	97.9	96.4	99.5	91.5	90.4	92.6
50-69	95.0	94.1	95.9	94.8	92.9	96.8	93.3	91.3	95.2	95.4	94.0	96.8	94.8	93.6	96.0	89.9	89.4	90.4
70-99	90.4	89.0	91.8	89.7	86.8	92.5	87.1	84.1	90.0	88.5	86.3	90.7	91.7	90.2	93.2	85.3	84.7	85.9
Regional																		
All ages	74.7	73.6	75.7	70.4	67.4	73.5	67.6	64.9	70.3	77.2	76.1	78.3	68.8	66.8	70.7	58.5	58.0	59.1
Age-standardised	74.5	73.7	75.3	70.4	68.2	72.7	67.1	65.1	69.1	78.1	77.3	78.9	69.5	68.1	71.0	58.4	57.9	58.8
15-49	83.5	80.8	86.3	82.0	75.2	88.7	86.1	79.3	93.0	86.1	83.3	89.0	78.8	73.6	84.1	65.9	64.0	67.7
50-69	78.6	77.3	79.9	80.0	76.2	83.9	73.8	70.5	77.1	83.5	82.1	84.9	76.0	73.5	78.5	64.6	63.8	65.4
70-99	71.2	69.6	72.7	62.7	58.4	67.0	61.4	57.7	65.1	73.6	72.1	75.2	64.0	61.3	66.7	53.9	53.1	54.7
Distant																		
All ages	20.1	18.7	21.4	12.9	10.6	15.1	12.9	11.0	14.7	14.2	13.1	15.3	15.7	14.1	17.3	11.6	11.1	12.1
Age-standardised	19.6	18.7	20.6	11.9	10.6	13.2	12.8	11.6	13.9	14.4	13.6	15.2	15.8	14.7	16.9	11.7	11.3	12.0
15-49	32.8	28.1	37.4	26.4	19.4	33.5	21.3	15.4	27.2	22.9	18.8	27.1	22.1	16.7	27.5	18.5	16.5	20.6
50-69	26.2	24.2	28.3	18.0	14.6	21.5	17.7	15.0	20.4	19.8	18.0	21.6	21.1	18.7	23.6	15.7	14.9	16.6
70-99	13.8	12.3	15.3	6.5	4.6	8.4	8.4	6.7	10.2	9.7	8.6	10.9	11.3	9.6	13.0	8.2	7.6	8.7
Missing stage																		
All ages	64.2	61.9	66.6	32.3	25.4	39.1	56.0	53.0	59.0	56.7	53.7	59.7	50.6	44.4	56.9	31.3	30.8	31.8
Age-standardised	61.0	59.0	63.0	31.3	26.4	36.2	56.6	54.5	58.8	58.8	56.6	61.0	53.6	48.9	58.4	31.3	30.9	31.7
15-49	86.4	80.9	92.0	75.6	59.9	91.3	83.0	73.6	92.4	84.7	76.0	93.3	92.9	74.5	100.0	58.3	56.3	60.2
50-69	79.0	76.1	81.9	44.9	32.5	57.4	73.2	69.3	77.0	79.3	75.2	83.3	74.9	66.2	83.5	44.8	44.0	45.7
70-99	54.1	50.9	57.2	22.4	14.8	30.1	48.8	45.2	52.3	47.9	44.2	51.6	42.6	35.2	50.0	24.6	24.0	25.1

50¹ Australia: New South Wales
 51² Canada: Alberta and Manitoba
 52³ Sweden: Uppsala-Örebro and Stockholm-Gotland health regions
 53⁴ United Kingdom: Northern Ireland and all cancer registries in England
 54⁵ In Canada and Denmark we analysed patients diagnosed in 2004-7

Web appendix table 4. All-ages, age-specific and age-standardised three-year net survival (%) by stage at diagnosis, age and country for rectal cancer patients diagnosed during 2000-2007

	Dukes' stage	Australia ¹			Canada ^{2,5}			Denmark ⁵			Norway			Sweden ³			UK ⁴		
		NS (%)	95% CI		NS (%)	95% CI		NS (%)	95% CI		NS (%)	95% CI		NS (%)	95% CI		NS (%)	95% CI	
5	All patients				71.9	70.5	73.3	63.1	61.4	64.9	68.3	67.1	69.4	70.4	69.0	71.8	59.5	59.1	60.0
6					71.1	70.0	72.1	62.4	61.2	63.7	68.8	68.0	69.6	70.7	69.6	71.7	59.9	59.5	60.2
7					79.4	76.1	82.6	72.0	66.7	77.3	78.0	75.0	81.1	74.3	70.0	78.6	69.7	68.3	71.0
8					76.6	74.8	78.3	72.5	70.4	74.5	74.9	73.5	76.3	76.2	74.5	77.9	67.8	67.2	68.3
9					65.8	63.6	68.0	53.7	51.1	56.2	62.4	60.8	64.1	65.8	63.7	67.9	52.5	51.9	53.1
10	Dukes' stage A	All ages			94.0	91.5	96.4	94.8	91.0	98.6	96.4	94.9	97.9	97.1	95.5	98.7	94.0	93.2	94.8
11		Age-standardised			93.8	92.5	95.1	94.8	92.8	96.8	96.5	95.8	97.3	97.2	96.4	98.0	94.0	93.5	94.5
12		15-49			97.5	96.3	98.7	98.0	96.4	99.5	98.7	98.0	99.3	98.9	98.2	99.6	97.7	97.0	98.3
13		50-69			95.5	93.6	97.3	96.1	93.3	99.0	97.4	96.4	98.5	97.9	96.8	99.1	95.6	95.0	96.2
14		70-99			91.9	88.6	95.2	93.3	88.3	98.3	95.4	93.5	97.3	96.4	94.3	98.4	92.3	91.1	93.5
15	Dukes' stage B	All ages			86.6	83.7	89.5	85.5	82.2	88.7	85.0	82.8	87.1	92.5	90.4	94.5	84.0	83.2	84.8
16		Age-standardised			86.1	84.2	88.0	84.9	82.8	87.0	85.8	84.6	87.1	92.5	91.3	93.7	84.1	83.6	84.6
17		15-49			96.1	93.7	98.6	94.7	91.5	97.9	96.2	94.7	97.7	93.0	89.7	96.3	91.9	90.9	93.0
18		50-69			91.2	88.5	93.8	89.4	86.3	92.5	91.1	89.4	92.8	92.6	90.8	94.4	87.2	86.4	88.0
19		70-99			80.7	75.7	85.7	80.7	75.8	85.6	80.0	76.7	83.2	92.3	89.3	95.2	81.0	79.8	82.2
20	Dukes' stage C	All ages			80.3	77.4	83.1	75.5	72.3	78.8	74.6	72.1	77.2	75.1	72.3	77.8	67.4	66.5	68.3
21		Age-standardised			79.5	77.2	81.7	74.4	71.8	76.9	75.3	73.5	77.1	76.0	74.1	77.9	67.5	66.8	68.2
22		15-49			87.1	81.6	92.7	80.6	71.5	89.7	87.7	82.9	92.4	87.9	81.8	93.9	75.8	73.4	78.2
23		50-69			83.0	79.7	86.3	81.6	78.1	85.1	80.6	77.9	83.4	82.4	79.5	85.3	72.7	71.6	73.7
24		70-99			75.2	70.4	79.9	67.0	61.6	72.5	67.9	64.0	71.9	67.4	63.2	71.7	61.1	59.8	62.5
25	Dukes' stage D	All ages			24.4	21.1	27.8	18.4	15.2	21.5	18.6	16.6	20.7	20.3	17.8	22.8	14.2	13.3	15.0
26		Age-standardised			23.1	21.4	24.7	18.3	16.7	19.9	19.1	18.0	20.1	20.6	19.3	21.8	14.4	13.9	15.0
27		15-49			30.6	26.4	34.8	25.1	20.8	29.4	26.0	22.7	29.2	27.1	23.2	30.9	20.3	17.9	22.7
28		50-69			29.2	25.5	32.8	23.4	19.7	27.0	24.6	22.1	27.0	26.0	23.1	28.9	18.9	17.8	20.1
29		70-99			16.4	13.4	19.4	12.3	9.6	15.1	12.7	10.8	14.5	14.0	11.7	16.3	9.1	8.3	10.0
30	Missing stage	All ages			70.4	67.6	73.1	54.7	51.0	58.5	64.0	61.5	66.4	41.5	36.4	46.6	38.1	37.3	38.8
31		Age-standardised			70.4	68.4	72.4	58.3	55.8	60.9	65.0	63.3	66.7	47.5	43.5	51.4	40.7	40.1	41.2
32		15-49			87.0	81.5	92.4	85.0	74.8	95.2	85.3	79.3	91.3	52.6	24.1	81.0	63.2	60.6	65.8
33		50-69			82.2	79.0	85.3	74.6	70.1	79.2	79.2	76.2	82.2	61.0	52.2	69.8	52.4	51.3	53.6
34		70-99			59.7	55.6	63.7	42.7	37.9	47.4	51.8	48.4	55.1	36.6	30.9	42.3	29.1	28.2	30.0
35	SEER Summary Stage 2000	All patients	All ages		72.1	71.2	73.0	72.2	70.8	73.7	63.6	61.9	65.4	68.2	67.1	69.3	70.1	68.7	71.5
36			Age-standardised		71.1	70.4	71.8	71.4	70.3	72.5	62.9	61.6	64.2	68.7	67.9	69.6	70.4	69.3	71.4
37			15-49		77.2	75.0	79.5	79.6	76.4	82.8	72.4	67.2	77.6	77.9	74.8	81.0	73.9	69.6	78.3
38			50-69		76.8	75.7	77.9	76.8	75.0	78.5	72.8	70.7	74.8	74.8	73.4	76.3	75.9	74.2	77.6
39			70-99		66.5	65.1	68.0	66.3	64.1	68.5	54.3	51.8	56.8	62.4	60.7	64.0	65.4	63.4	67.5
40	Localised	All ages			89.5	88.3	90.7	92.4	90.4	94.3	91.0	88.5	93.5	89.8	88.4	91.1	95.0	93.6	96.3
41		Age-standardised			89.2	88.4	89.9	92.1	90.8	93.4	90.7	89.2	92.3	90.4	89.6	91.2	95.0	94.2	95.8
42		15-49			96.7	95.7	97.7	98.4	97.3	99.6	97.7	96.0	99.4	97.8	97.0	98.6	95.6	93.7	97.6
43		50-69			92.8	91.8	93.8	95.6	94.0	97.2	94.2	92.1	96.4	94.3	93.3	95.3	95.2	94.0	96.3
44		70-99			85.4	83.4	87.4	88.3	84.9	91.7	87.2	83.4	91.1	85.9	83.8	88.0	94.7	92.7	96.7
45	Regional	All ages			77.8	76.3	79.3	78.7	76.0	81.3	74.8	71.7	77.9	74.6	72.4	76.8	75.1	72.4	77.8
46		Age-standardised			77.7	76.6	78.8	77.9	75.9	80.0	73.8	71.4	76.2	75.6	74.1	77.2	76.0	74.1	77.9
47		15-49			82.3	79.0	85.5	85.8	80.3	91.4	79.8	70.9	88.6	86.5	81.7	91.3	87.5	81.3	93.7
48		50-69			81.9	80.2	83.5	81.6	78.4	84.8	80.7	77.3	84.0	81.8	79.4	84.2	82.4	79.5	85.2
49		70-99			72.5	70.0	75.0	73.3	68.8	77.8	66.7	61.6	71.9	67.5	64.1	70.9	67.4	63.2	71.7
50	Distant	All ages			23.6	21.6	25.6	24.5	21.2	27.8	18.4	15.2	21.6	18.2	16.3	20.0	20.3	17.8	22.8
51		Age-standardised			22.9	21.8	24.0	23.2	21.5	24.8	18.5	16.9	20.0	18.7	17.7	19.7	20.6	19.4	21.9
52		15-49			30.8	27.6	34.0	31.6	27.5	35.8	26.2	22.0	30.5	26.5	23.5	29.5	28.4	24.7	32.1
53		50-69			28.5	26.2	30.8	29.0	25.4	32.7	23.3	19.6	26.9	23.8	21.6	26.1	25.9	23.0	28.7
54		70-99			16.1	14.2	18.1	16.4	13.3	19.4	12.4	9.6	15.1	12.1	10.5	13.8	14.0	11.7	16.3
55	Missing stage	All ages			69.0	66.4	71.7	69.2	66.4	72.1	54.6	50.9	58.3	47.0	42.2	51.8	41.4	36.2	46.5
56		Age-standardised			66.8	64.7	69.0	68.8	66.7	70.9	57.5	54.9	60.1	55.9	52.4	59.4	47.0	43.1	50.9
57		15-49			88.6	83.7	93.6	86.4	80.8	92.0	85.1	75.0	95.2	84.1	70.8	97.4	52.8	24.2	81.3
58		50-69			80.5	77.2	83.8	81.2	78.0	84.5	74.6	70.1	79.2	78.3	71.3	85.2	61.0	52.2	69.8
59		70-99			56.4	52.3	60.6	58.4	54.2	62.5	42.5	37.7	47.2	32.2	26.5	38.0	36.5	30.8	42.2
60																			

¹ Australia: New South Wales² Canada: Alberta, British Columbia and Manitoba³ Sweden: Uppsala-Örebro and Stockholm-Gotland health regions⁴ United Kingdom: Northern Ireland and all cancer registries in England except the Thames Cancer Registry⁵ In Canada and Denmark we analysed patients diagnosed in 2004-7