Recent cancer survival in Europe: a 2000–02 period analysis of EUROCARE-4 data

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Summary

Background Traditional cancer-survival analyses provide data on cancer management at the beginning of a study period, and are often not relevant to current practice because they refer to survival of patients treated with older regimens that might no longer be used. Therefore, shortening the delay in providing survival estimates is desirable. Period analysis can estimate cancer survival by the use of recent data. We aimed to apply the period-analysis method to data that were collected by European cancer registries to estimate recent survival by country and cancer site, and to assess survival changes in Europe. We also compared our findings with data on cancer survival in the USA from the US SEER (Surveillance, Epidemiology, and End Results) programme.

Methods We analysed survival data for patients diagnosed with cancer in 2000–02, collected from 47 of the European cancer registries participating in the EUROCARE-4 study. 5-year period relative survival for patients diagnosed in 2000–02 was estimated as the product of interval-specific relative survival values of cohorts with different lengths of follow-up. 5-year survival profiles for patients diagnosed in 2000–02 were estimated for the European mean and for five European regions, and findings were compared with US SEER registry data for patients diagnosed in 2000–02. A 5-year survival profile for patients diagnosed in 1991–2002 and a 10-year survival profile for patients diagnosed in 1997–2002 were also estimated by the period method for all malignancies, by geographical area, and by cancer site.

Findings For all cancers, age-adjusted 5-year period survival improved for patients diagnosed in 2000–02, especially for patients with colorectal, breast, prostate, and thyroid cancer, Hodgkin's disease, and non-Hodgkin lymphoma. The European mean age-adjusted 5-year survival calculated by the period method for 2000–02 was high for testicular cancer (97·3% [95% CI 96·4–98·2]), melanoma (86·1% [84·3–88·0]), thyroid cancer (83·2% [80·9–85·6]), Hodgkin's disease (81·4% [78·9–84·1]), female breast cancer (79·0% [78·1–80·0]), corpus uteri (78·0% [76·2–79·9]), and prostate cancer (77·5% [76·5–78·6]); and low for stomach cancer (24·9% [23·7–26·2]), chronic myeloid leukaemia (32·2% [29·0–35·7]), acute myeloid leukaemia (14·8% [13·4–16·4]), and lung cancer (10·9% [10·5–11·4]). Survival for patients diagnosed in 2000–02 was generally highest for those in northern European countries and lowest for those in eastern European countries, although, patients in eastern European had the highest improvement in survival for major cancer sites during 1991–2002 (colorectal cancer from 30·3% [28·3–32·5] to 44·7% [42·8–46·7]; breast cancer from 60% [57·2–63·0] to 73·9% [71·7–76·2]; for prostate cancer from 39·5% [35·0–44·6] to 68·0% [64·2–72·1]). For all solid tumours, with the exception of stomach, testicular, and soft-tissue cancers, survival for patients diagnosed in 2000–02 was higher in the US SEER registries than for the European mean. For haematological malignancies, data from US SEER registries and the European mean were comparable in 2000–02, except for non-Hodgkin lymphoma.

Interpretation Cancer-service infrastructure, prevention and screening programmes, access to diagnostic and treatment facilities, tumour-site-specific protocols, multidisciplinary management, application of evidence-based clinical guidelines, and recruitment to clinical trials probably account for most of the differences that we noted in outcomes.

Introduction

The crude annual incidence of cancer in Europe has been estimated at 338 per 100 000 population for eastern Europe and 447 per 100 000 population in western Europe.[1] To measure the overall effect of the management of cancer, data on population-based survival are important. According to the EUROCARE studies,[2–7] survival varies greatly across Europe for common and rare malignancies. These variations can be explained by a number of factors, including differences in the quality of cancer-treatment facilities, in screening programmes, in evidence-based best-practice guidelines, in facilities for radiotherapy, and in access to new anticancer drugs. The results of the EUROCARE studies have encouraged governments in European Union (EU) member states to improve cancer services by increasing their organisation and investments, developing screening programmes, and providing more rapid access to state-of-the-art diagnostic facilities and treatment.[8,9]

One of the limitations of long-term survival estimates derived from conventional survival analyses is that they refer to cohorts of individuals diagnosed many years before and not to patients diagnosed more recently; therefore, time trends in survival cannot be detected early (eg, the effects that earlier diagnosis or treatment might have on survival patterns). To address this limitation, period survival analysis has been used.[10] Unlike traditional cohort analyses of survival, period analysis provides long-term

Country	Cancer registry	EUROCARE-4 patients, n	Diagnosis period	Quality indicators*										
				Diagnosed (1996–2002), n†	Discarded (1996–2002), %	MV, %		DCO‡		Lost to follow-up		JoinPoint analysis§		
						1996–99	2000–02	1996–99	2000–02	1996–99	2000–02	Trend change	EAPC	95% CI
North														
Finland	Finland¶ (NR)	416 309	1978–2002	137 672	0·4	93	92	2·6	3·2	0·0	0·0	1991	–3·1	–3·3 to –2·8
Iceland	Iceland¶ (NR)	19 734	1978–2002	6570	0·0	96	98	0·2	0·0	0·0	0·0	1996	–4·5	–6·0 to –2·9
Norway	Norway¶ (NR)	389 263	1978–2002	123 130	0·4	91	92	1·1	0·5	0·3	0·2	1988	–1·6	–1·7 to –1·3
Sweden	Sweden¶ (NR)	911 994	1978–2003	270 890	0·1	98	98	NA	NA	0·2	0·1	1996	–2·9	–3·3 to –2·4
UK and Ireland														
England	England¶ (NR)	1 454 367	1995–2002	1 285 592	0·0	NA	NA	NA	NA	0·1	0·1	1995	–1·7	–2·0 to –1·5
Ireland	Ireland (NR)	114 571	1994–2002	90 751	0·0	83	85	3·1	2·6	0·0	0·0	1999	–4·6	–5·6 to –3·6
Northern Ireland	Northern Ireland (NR)	60 965	1993–2002	42 933	0·1	79	80	1·6	1·4	0·0	0·0	1993	–1·4	–1·8 to –1·1
Scotland	Scotland¶ (NR)	543 321	1978–2002	165 000	0·0	83	85	1·1	0·6	0·0	0·0	1997	–1·0	–1·7 to –0·4
Wales	Wales¶ (NR)	304 640	1978–2002	93 436	0·6	46	64	12·9	10·6	0·0	0·0	1995	–2·4	–3·4 to –1·5
Central														
Austria	Austria¶ (NR)	596 056	1983–2001	199 717	0·1	84	85	10·0	7·1	0·0	0·0	1999	–4·9	–9·5 to 0·0
Belgium	Flemish	139 604	1997–2001	139 604	0·1	87	93	NA	NA	0·0	0·0	1997	–4·7	–5·7 to –3·8
France	Côte d'Or (Digestive)¶	11 928	1978–2002	3787	0·0	83	81	NA	NA	1·4	14·4	1999	–7·0	–13·7 to 0·3
Germany	Saarland¶	113 635	1978–2001	31 966	0·1	90	92	5·7	3·7	0·0	0·0	1978	–1·7	–1·8 to –1·5
Netherlands	Amsterdam¶	146 632	1988–2002	71 813	0·0	96	96	NA	NA	0·2	0·0	1988	–1·4	–1·6 to –1·1
Netherlands	Eindhoven¶	69 912	1978–2001	21 660	0·0	96	96	NA	NA	0·2	0·1	1978	–1·4	–1·6 to –1·2
Netherlands	North Netherlands	57 003	1995–2001	49 477	0·0	95	95	NA	NA	0·0	0·0	1995	–1·8	–2·9 to –0·7
Switzerland	Basel¶	34 334	1981–2001	10 327	0·4	99	100	NA	NA	1·2	1·0	1981	–2·5	–2·9 to –2·2
Switzerland	Geneva¶	37 308	1980–2003	12 269	0·0	92	93	0·6	0·4	5·0	3·0	1980	–2·5	–2·7 to –2·3
Switzerland	St Gallen¶	26 386	1988–2002	13 086	0·0	91	94	0·8	0·6	0·9	0·6	1993	–3·5	–4·3 to –2·7
Switzerland	Ticino	11 620	1996–2003	10 135	0·0	91	91	3·7	2·3	1·8	1·7	1996	–1·2	–3·4 to 1·1
Eastern														
Czech Republic	West Bohemia¶	49 744	1988–2001	22 701	0·0	85	86	3·8	2·5	0·6	0·6	1988	–3·3	–4·1 to –2·4
Poland	Cracow¶	52 154	1978–2002	18 644	0·3	73	72	0·2	0·5	2·4	0·6	1994	–0·1	–1·1 to 1·0
Poland	Kielce	30 894	1995–2002	27 933	0·9	78	81	NA	NA	0·1	0·1	1995	–1·2	–3·4 to 1·1
Poland	Warsaw¶	79 371	1989–2002	38 926	0·3	78	85	5·3	0·0	0·0	0·3	2000	0·5	–7·0 to 8·5

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survival estimates that also take into consideration survival of more recently diagnosed patients.

In the current study, we applied the period-analysis method to data, collected by the European cancer registries, of patients diagnosed from 1978 to 2002 to estimate recent survival by country and cancer site, and to assess survival changes in Europe. Survival 5 years after diagnosis was used as the indicator of outcome. We also compared our findings with data on cancer survival in the USA from the US SEER (Surveillance, Epidemiology, and End Results) programme.

Methods

Data sources and procedures

The data source for this analysis was the EUROCARE-4 study database, which includes data on the incidence of cancer and follow-up information on patients with cancer who were diagnosed from Jan 1, 1978, to Dec 31, 2002, collected by 83 cancer registries throughout Europe. This included the 47 cancer registries that had collected data in a more recent period (1996–2002) and followed patients until Dec 31, 2003 (table 1). These registries consisted of 12 national registries that had 100% national coverage, and 35 regional cancer registries representing nine countries (Belgium, Czech Republic, France, Germany, Italy, Netherlands, Poland, Spain, and Switzerland) that had coverage ranging from 1% for Germany and France, to 58% for Belgium (3% for Spain, 8% for Czech Republic, 9% for Poland, 24% for Italy and Switzerland, and 34% for Netherlands). Three regional cancer registries were specific for cancer site: Cote d'Or in France (digestive cancer) and Albacete and Castellón in Spain (breast cancer).

(Continued from previous page)

Southern														
Italy	Alto Adige	16 716	1995–2002	14 698	0·0	88	90	0·9	0·8	0·0	0·0	1995	–2·7	–4·0 to –1·4
Italy	Biella	9422	1995–2002	8261	0·0	84	86	1·5	1·3	0·1	0·1	1995	–0·3	–1·5 to 1·1
Italy	Ferrara	26 189	1991–2002	16 003	0·0	85	85	1·9	0·9	1·0	0·7	1991	–1·6	–3·0 to –0·2
Italy	Friuli Venezia Giulia	69 465	1995–2003	54 082	0·0	89	90	0·9	0·3	0·7	0·5	1995	–2·6	–3·2 to –1·9
Italy	Genoa¶	75 057	1986–2000	29 669	0·1	79	80	2·2	1·6	0·0	0·0	1986	–1·7	–1·9 to –1·6
Italy	Modena¶	48 882	1988–2002	24 703	0·0	86	88	0·7	0·4	1·3	0·9	1988	–2·3	–2·7 to –1·9
Italy	Naples	7500	1996–2000	7500	0·3	72	71	4·6	2·7	3·2	3·3	1996	–1·5	–4·0 to 1·1
Italy	Parma¶	53 755	1978–2002	17 464	0·0	83	86	1·4	0·6	0·5	0·1	1978	–1·8	–2·0 to –1·6
Italy	Ragusa¶	18 744	1981–2002	7423	0·0	75	80	2·3	2·9	0·0	0·0	1988	–2·0	–2·4 to –1·6
Italy	Reggio-Emilia	20 755	1996–2003	17 913	0·0	85	87	0·4	0·2	0·1	0·0	1996	–0·9	–3·4 to 1·6
Italy	Romagna¶	78 254	1986–2002	41 687	0·0	86	86	3·6	1·9	0·2	0·1	1986	–1·7	–2·0 to –1·4
Italy	Salerno	23 543	1996–2001	23 543	0·0	75	75	2·8	2·9	6·7	6·5	1996	0·6	–2·6 to 1·5
Italy	Sassari	18 914	1992–2002	12 619	0·0	80	83	4·1	2·8	0·0	0·0	1992	–1·9	–2·7 to –1·1
Italy	Turin¶	78 319	1985–2001	29 999	0·0	85	87	2·5	1·5	0·3	0·1	1985	–2·6	–2·9 to –2·3
Italy	Tuscany¶	113 707	1985–2002	46 763	0·2	78	80	1·3	0·8	0·1	0·0	1985	–1·7	–1·9 to –1·6
Italy	Trento	14 403	1995–2000	12 129	0·2	82	84	2·4	1·6	0·6	0·7	1995	–2·2	–4·0 to –0·3
Italy	Umbria	41 545	1994–2002	32 712	0·0	81	83	1·0	0·6	0·6	0·7	1994	–1·7	–2·7 to –0·7
Italy	Veneto¶	135 378	1987–2000	55 500	0·0	85	85	1·7	1·8	0·3	0·4	1987	–2·4	–2·6 to –2·3
Malta	Malta (NR)	11 633	1993–2002	8410	0·0	88	87	1·7	2·2	0·0	0·0	1993	–1·8	–2·8 to –0·9
Slovenia	Slovenia¶ (NR)	141 164	1978–2002	47 978	0·0	90	92	2·4	0·0	0·1	0·1	1991	–2·1	–2·5 to –1·7
Spain	Albacete (Breast cancer)	1894	1995–2002	1698	0·0	91	87	3·7	6·3	0·0	0·0	1995	–4·0	–8·1 to 0·3
Spain	Castellón (Breast cancer)	1457	1995–2002	1287	0·0	95	95	5·1	4·7	0·0	0·0	1995	–13·1	–29·7 to 7·5
Spain	Girona	21 330	1994–2002	16 846	0·0	87	88	3·9	4·3	0·1	0·2	1994	–2·2	–3·2 to –1·1
EUROCARE–4 total		6 699 771	1978–2002	3 416 906	0·1	90	91	1·8	1·4	0·2	0·2	..	..	..

MV=microscopically verified. DCO=death certificate only. EAPC=estimated annual percent change. NR=national registry. NA=not available. *Comparison of data-quality indicators between 1996–99 and 2000–02 periods, and data completeness evaluation based on the JoinPoint analysis. †Patients included in the period analysis with data for 2000–02. ‡Cases recorded by cancer registries by death certificate only. §JoinPoint analysis applied to registry-specific trends of the proportion of deaths in the first year since diagnosis: changing year of the time trend and the corresponding EAPC with 95% CI. ¶Cancer registries included in the trend analysis over time (for England, four regional registries were used rather than the national registry [East Anglia, Oxford, Northern and Yorkshire, and West Midlands]).

***Table 1*: European adult patients included in the EUROCARE–4 period analysis, by geographical area, country and registry, with data-quality indicators**

Only 30 of these 47 registries that had data dating back to 1989 were included in the survival analysis over time (table 1). The National Cancer Registry of England was excluded from the analysis of survival changes because data were available only since 1995, but four regional English registries were included instead: East Anglia, Northern and Yorkshire, Oxford, and West Midlands, all of which had data available for 1978–2002. For Austria (national registry), Saarland (local registry that covers 1% of the German population), and West Bohemia (local registry that covers 8% of the Czech Republic population), because follow-up ended on Dec 31, 2002, the incidence for 2002 was not included in the analysis in case of incomplete follow-up.

The number of patients with cancer diagnosed by each registry in 1996–2002 (ie, the most recent data, which had not been subjected previously to quality control) are shown in table 1; also shown are the following standard indicators of data quality: the proportion of invalid, ie, discarded, records and proportion of cases recorded by

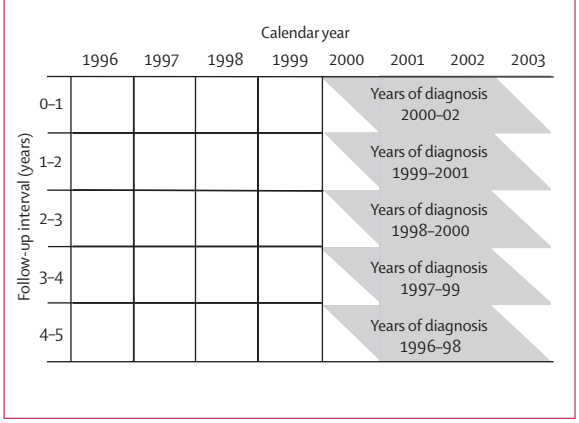

***Figure 1*: Lexis diagram showing the period analysis layout implemented in SEER*Stat**

Grey area represents the information used for estimating 5-year period survival in the calendar years 2000–02: relative survival for each interval of follow-up is based on a 3-year period of diagnosis.

Age at diagnosis, years	Interval-specific period relative survival (cohorts of diagnosis)					5-year period relative survival
	0–1 year (2000–02)	1–2 years (1999–2001)	2–3 years (1998–2000)	3–4 years (1997–99)	4–5 years (1996–98)	0–5 years
15–44	0·58	0·78	0·88	0·86	0·97	0·33
45–54	0·58	0·71	0·83	0·99	0·94	0·32
55–64	0·53	0·76	0·85	0·92	0·93	0·29
65–74	0·51	0·75	0·82	0·96	0·97	0·29
75–99	0·44	0·73	0·77	0·90	0·93	0·21

The cohort of diagnosed patients used for each interval estimate is in parentheses. Last column reports the 5-year cumulative relative survival in 2000–02 by age, which is calculated as the product of the interval-specific relative survivals of the five cohorts of diagnosis.

Table 2: **Interval-specific period relative survival estimates for analysis in 2000-02 by age at diagnosis and follow-up interval**

cancer registries through death certificates only (these were excluded from the survival analysis); the proportion of patients lost to follow-up; and the proportion of those with microscopically confirmed diagnosis. The quality of some of these data was also assessed for two periods: 1996–99 and 2000–02 (table 1).

To ascertain whether data from 2000–02 were complete, we used the JoinPoint technique.[11,12] Specifically, we assessed whether the completeness of the registry varied according to the life status of patients by analysing registry-specific time trends in deaths within the first year of diagnosis to detect unexpected changes, especially in the more recent period of 2000–02. The estimated annual percent changes (EAPC) with the 95% CI and the corresponding calendar year of change in the trend are reported in table 1. For example, for Finland, a significant linear declining trend of completeness of 3·1% a year started in 1991 and persisted to 2002. We also analysed data from patients treated in 2000–02 collected in the US SEER public-use database in the USA for comparison.

The period analysis was done by use of SEER*Stat software.[13] We used the method that was first applied by Brenner and Gefeller[14] in 1996 to obtain up-to-date estimates of cancer survival. In our analysis, only survival data from 2000–02 was used for deriving survival estimates (figure 1). Survival in the first year after diagnosis was based on patients diagnosed in 2000–02 (and followed to Dec 31, 2003). Conditional survival in the second year after diagnosis (ie, conditional on being alive at the beginning of the second year of follow-up) was based on patients diagnosed in 1999–2001. Conditional survival in the third, fourth, and fifth year after diagnosis was based on patients diagnosed in, respectively, 1998–2000, 1997–99, and 1996–98. 5-year survival estimates for period 2000–02 were obtained as the product of these conditional survival estimates. 10-year survival estimates for the same period were obtained in a similar way and were based on the survival of the cohorts of patients diagnosed in 1991–93 up to 2000–02. By referring to previous empirical assessments,[15–18] we expected the period survival estimates for 2000–02 to be good predictors of the long-term survival of patients diagnosed in that time period. However, if survival increases greatly, predictions based on the period method might be underestimated. The SEER*Stat software incorporating period analysis has been shown to provide very similar results to the original and extensively evaluated algorithm proposed by Brenner and co-workers.[19]

Age at diagnosis, years	5-year period relative survival (A)	Standard 1 population weight (B)	A×B
15–44	0·33	7	2·3
45–54	0·32	12	3·8
55–64	0·29	23	6·7
65–74	0·29	29	8·4
75–99	0·21	29	6·1
Age-adjusted 5-year relative survival			27·3%

Table 3: **Example of computation of the age-adjusted 5-year cumulative relative survival for stomach cancer in Finland 2000–02**

In accordance with standard practice in comparative population-based cancer-survival analyses, relative survival rather than absolute survival was calculated. Relative survival was calculated as the ratio of absolute survival of patients with cancer to the expected survival of a group of people of the corresponding sex and age in the general population.[20,21] This is a common way to adjust for the effect of different competing causes of death that bias the comparisons between different countries. Expected survival was estimated according to the Hakulinen method,[22] which is based on registry-specific official mortality data.

Because the age structure of patients with cancer varies between countries and because relative survival varies by age for most cancers, all relative-survival estimates were age-adjusted to ensure comparability. Age-adjustment was done with the direct method by use of the European standard cancer populations proposed by Corazziari and colleagues.[23]

For 2000–02, in addition to country-specific survival, we calculated weighted-mean survival by cancer site for the pooled sum of 47 cancer registries included in the analysis. These estimates were obtained after a two-step procedure: first, site-specific survival were estimated for five broad geographical areas (northern Europe, eastern

Europe, southern Europe, central Europe, and UK and Ireland; table 1); then the EUROCARE-4 weighted mean for the pool of 47 registries was derived by use of the populations of the areas as weights.[24] The survival estimates of the EUROCARE-4 weighted mean were also standardised by age by use of the same method as previously described for country-specific estimates.

Furthermore, the 5-year period survival estimate for patients diagnosed in 1991–2002 and 10-year period survival estimate for patients diagnosed in 1997–2002 were calculated as weighted estimates for major cancer sites, for the overall European mean, and also for broad geographical areas.

Role of the funding source

The sponsor played no role in the study design, data collection, data analysis, data interpretation, or in the writing of the report. SF had access to the raw data. The corresponding author had full access to all of the data and had final responsibility to submit for publication.

Standard	Age class, years	Weight	Cancer site
1	15–44, 45–54, 55–64, 65–74, ≥75	7, 12, 23, 29, 29	All (except those included in standards 2, 3, 4)
2	15–44, 45–54, 55–64, 65–74, ≥75	28, 17, 21, 20, 14	Soft tissues, melanoma, cervix uteri, thyroid gland
3	15–44, 45–54, 55–64, 65–74, ≥75	60, 10, 10, 10, 10	Testicular, Hodgkin's disease
4	15–54, 55–64, 65–74, 75–84, ≥85	19, 23, 29, 23, 6	Prostate

Table 4: **International Cancer Survival Standards (ICSS) standard weights**

	Stomach		Colorectum		Lung		Soft-tissue		Skin melanoma	
	RS	95%CI	RS	95% CI	RS	95% CI	RS	95% CI	RS	95% CI
North										
Finland	27·3	24·8–29·4	59·4	57·8–61·1	9·2	8·2–10·3	58·5	53·1–64·4	84·8	82·0–87·1
Iceland	NA	NA	58·9	52·6–65·9	16·8	12·8–22·2	NA	NA	83·6	72·1–96·9
Norway	24·7	22·1–27·5	59·5	58·2–60·9	11·2	10·3–12·3	61·8	54·2–70·6	86·8	85·0–88·6
Sweden	21·5	19·8–23·5	59·8	58·8–60·9	13·9	13·0–14·9	62·1	58·2–66·3	90·3	89·1–91·5
UK and Ireland										
England	16·9	16·3–17·6	51·8	51·4–52·2	8·4	8·1–8·6	57·5	55·4–59·6	84·8	84·0–85·5
Ireland	18·8	16·5–21·5	54·3	52·6–56·0	10·9	9·8–12·2	60·2	52·4–69·3	85·9	83·1–88·8
Northern Ireland	18·9	15·6–22·8	54·5	52·1–57·0	10·7	NA	59·2	49·2–71·3	91·4	87·5–95·5
Scotland	16·6	14·9–18·6	54·1	52·8–55·4	8·2	7·5–8·9	55·9	49·3–63·3	90·7	88·6–93·0
Wales	18·3	15·8–21·1	53·3	51·6–55·1	10·4	9·1–11·8	58·6	51·4–66·8	78·3	74·8–81·9
Central Europe										
Austria	29·2	26·9–31·6	59·3	57·8–60·9	14·1	13·0–15·3	57·5	51·1–64·7	83·3	80·8–85·9
Belgium	32·7	30·2–35·4	60·7	59·5–62·0	16·3	15·4–17·2	65·3	59·5–71·7	81·4	78·8–84·2
France*	20·7	13·9–30·9	59·9	55·5–64·6	NA	NA	NA	NA	NA	NA
Germany	31·4	25·3–39·1	61·2	57·7–65·0	14·7	12·1–17·8	NA	NA	89·4	82·1–97·3
Netherlands	20·1	18·1–22·4	58·5	57·1–59·9	12·9	12·1–13·8	59·8	54·4–65·6	90·0	87·9–92·1
Switzerland	25·6	21·9–29·8	63·8	61·4–66·2	15·3	13·6–17·2	72·0	61·9–83·7	89·7	87·1–92·4
Eastern Europe										
Czech Republic	NA	NA	45·2	41·0–49·9	NA	NA	NA	NA	75·1	66·6–84·7
Poland	20·0	17·7–22·6	46·0	44·0–48·0	14·0	12·8–15·3	60·4	51·5–70·8	65·8	61·5–70·4
Southern Europe										
Italy	33·2	32·1–34·3	59·4	58·6–60·1	13·4	12·8–14·0	61·8	58·3–65·6	85·3	84·0–86·6
Malta	NA	NA	51·5	45·8–57·9	4·6	2·7–7·8	61·0	49·3–75·5	94·8	84·5–106·4
Slovenia	23·2	20·5–26·2	50·5	48·2–53·0	9·9	8·6–11·3	64·0	53·7–76·2	79·2	75·0–83·7
Spain	31·8	25·9–39·2	61·5	57·7–65·5	12·2	10·1–14·8	50·7	35·0–73·5	85·9	79·0–93·5
EUROCARE–4 mean	24·9	23·7–26·2	56·2	55·3–57·2	10·9	10·5–11·4	61·2	58·3–64·2	86·1	84·3–88·0
US SEER-13 registries	25·0	23·8–26·2	65·5	64·9–66·1	15·7	15·3–16·1	65·1	62·8–67·5	92·3	91·5–93·1

RS=relative survival. NA=not available (due to missing data in one or more age classes impeding the age standardisation). SEER=Surveillance, Epidemiology, and End Results. *Data from France was represented by the digestive cancer registry of Côte d'Or. In some instances, *SEER*Stat fails to compute a CI for specific age classes that have few patients. Reported figures are age-adjusted, but in these calculations CIs are not available.

Table 5: **Age-adjusted 5-year relative survival of stomach, colorectal, lung, soft-tissue, and skin melanoma for period analysis 2000–02**

	Breast		Cervix		Corpus uteri		Prostate	
	RS	95% CI	RS	95% CI	RS	95% CI	RS	95% CI
North								
Finland	85·7	84·4–87·0	65·8	60·9–71·0	79·8	77·3–82·4	84·3	82·7–85·9
Iceland	93·4	87·4–99·8	70·6	61·1–81·6	69·7	56·5–86·1	84·4	79·6–89·4
Norway	84·1	82·6–85·5	67·5	63·7–71·4	86·1	83·2–89·1	79·0	77·5–80·6
Sweden	86·3	85·4–87·2	66·7	63·8–69·6	83·9	82·2–85·7	82·5	81·5–83·6
UK and Ireland								
England	77·8	77·4–78·2	58·6	57·3–59·9	75·7	74·7–76·8	NA	NA
Ireland	76·2	74·3–78·2	63·8	58·8–69·3	77·0	72·3 –81·9	NA	NA
Northern Ireland	79·5	77·0–82·1	63·5	56·6–71·2	70·2	64·4–76·6	NA	NA
Scotland	77·3	76·0–78·6	61·0	57·3–65·0	76·6	73·1–80·1	71·0	68·8–73·3
Wales	78·4	76·7–80·1	52·6	47·8–57·8	75·7	71·7–79·9	71·8	69·1–74·5
Central Europe								
Austria	81·4	79·9–82·8	64·2	60·4–68·2	76·1	73·1–79·2	88·9	87·6–90·3
Belgium	79·7	78·6–80·9	66·0	62·6–69·6	79·5	76·9–82·1	NA	NA
France*	NA	NA	NA	NA	NA	NA	NA	NA
Germany	78·2	74·5–82·1	55·5	47·4–65·1	82·7	75·0–91·2	85·3	80·7–90·2
Netherlands	83·1	81·8–84·3	69·2	64·8–73·9	79·3	76·2–82·6	81·7	79·3–84·2
Switzerland	84·5	82·6–86·5	66·8	60·0–74·5	79·2	74·5–84·3	87·3	84·6–90·1
Eastern Europe								
Czech Republic	68·9	62·9–75·4	59·8	53·0–67·5	80·5	70·4–92·1	58·4	50·1–68·0
Poland	73·9	71·7–76·1	56·0	52·6–59·5	74·5	70·3–78·8	70·7	66·5–75·2
Southern Europe								
Italy	83·7	83·1–84·4	67·0	64·7–69·4	77·4	75·7–79·0	85·0	83·5–86·4
Malta	76·0	70·7–81·8	46·5	32·5–66·6	76·5	66·7–87·7	NA	NA
Slovenia	75·3	72·7–78·1	65·2	60·8–69·9	78·7	74·3–83·3	63·3	59·2–67·6
Spain	82·8	79·8–85·8	60·4	48·6–75·0	73·6	66·4–81·5	NA	NA
EUROCARE-4 mean	79·0	78·1–80·0	60·4	57·7–63·2	78·0	76·2–79·9	77·5	76·5–78·6
US SEER-13 registries	90·1	89·6–90·5	65·8	64·1–67·6	82·3	81·2–83·4	99·3	98·9–99·8

RS=relative survival. NA=not available (due to missing data in one or more age classes impeding the age standardisation). SEER=Surveillance, Epidemiology, and End Results.
*Data from France was represented by the digestive cancer registry of Côte d'Or.

Table 6: **Age-adjusted 5-year relative survival of breast, cervical, corpus uteri, and prostate cancer for period analysis 2000–02**

Results

Since 2002, about 6·7 million patients from 21 countries with incident cancer, who were grouped into five geographical areas, were included in the European pool (table 1). The first year that the registries began to record incidence of cancer varied between 1978 and 1997. The percentage of invalid records was 0·1% overall and ranged from 0% to 0·9 % for individual registries. When data from the periods 1996–99 and 2000–02 were compared, the total percentage of microscopically confirmed patients increased slightly from 90% to 91%; for only four registries, the percentage was still below 80% during the more recent period of 2000–02. The percentage of patients for whom death certificates were the only data source for the registry was very low (<2%); this percentage either decreased or remained stable for nearly all registries. The proportion of patients lost to follow-up was very low (<1%) and remained stable. The EAPC of the proportion of deaths in 1 year of diagnosis was negative for nearly all registries. A significant linear decreasing trend indicates no under-reporting or over-reporting of deceased patients for the most recent period. However, for some registries, the trend in deaths within 1 year of diagnosis changed in the most recent period.

A numerical example of computation of 5-year age-adjusted period relative survival for patients treated in 2000–02 is given in table 2, to show a calculation by use of the period method and the SEER*Stat software. The example refers to stomach cancer in Finland, for which we estimated a relative survival at 5 years since diagnosis of 27·3% (95% CI 24·8–29·4). 5-year period relative survival for 2000–02 for each age at diagnosis was obtained as the product of interval-specific relative survival for the five cohorts of diagnosis (table 2). 5-year period relative survival was then weighted by use of standard population weights[23] for different groups according to age at diagnosis (ie, for the age class of 15–44 years: 0·33 was multiplied by the weight of 7 to give 2·3). These weighted survivals were then summed to obtain age-adjusted 5-year period survivals for 2000–02 (ie, 27·3% for stomach cancer in

	Testicular*		Kidney		Thyroid		Hodgkin's disease		Non-Hodgkin lymphoma	
	RS	95% CI	RS	95% CI	RS	95% CI	RS	95% CI	RS	95% CI
North										
Finland	94·5	89·7–99·2	62·0	58·2–65·9	87·5	84·3–90·9	86·2	82·3–90·3	56·3	53·2–59·5
Iceland	NA	NA	60·8	43·1–85·7	96·0	85·6–107·8	NA	NA	56·8	39·5–81·7
Norway	97·4	95·4–99·4	49·5	44·8–54·8	84·2	NA	87·1	82·3–92·2	57·0	53·2–61·1
Sweden	98·1	96·8–99·5	57·0	53·9–60·4	82·3	79·2–85·4	NA	NA	60·1	57·6–62·8
UK and Ireland										
England	96·8	96·0–97·6	46·7	45·2–48·4	80·5	NA	79·5	78·0–81·0	53·4	52·2–54·5
Ireland	NA	NA	54·1	47·8–61·2	75·8	69·3–82·9	77·2	72·0–82·7	52·0	47·5–56·9
Northern Ireland	NA	NA	54·1	46·1–63·4	80·9	72·6–90·1	72·4	63·9–82·1	54·6	49·2–60·6
Scotland	98·7	97·3–100·5	45·9	41·6–50·5	81·4	NA	80·9	76·3–85·9	53·5	50·2–57·0
Wales	NA	NA	53·8	47·9–60·4	74·1	67·5–81·3	76·5	70·8–82·5	51·3	46·8–56·3
Central Europe										
Austria	NA	NA	71·6	68·8–74·6	85·1	81·7–88·6	83·7	77·7–90·2	48·8	45·6–52·2
Belgium	96·8	94·2–99·4	60·0	56·1–64·2	73·1	68·4–78·2	83·7	79·5–88·1	58·4	55·0–62·0
France†	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Germany	NA	NA	66·0	NA	NA	NA	NA	NA	63·4	55·5–72·4
Netherlands	96·5	94·3–98·8	57·0	52·2–62·3	76·7	71·5–82·3	81·6	77·8–85·6	52·0	48·4–55·8
Switzerland	96·2	93·3–99·2	66·5	NA	85·5	80·0–91·2	86·4	80·8–92·4	64·0	58·6–70·0
Eastern Europe										
Czech Republic	NA	NA	59·9	NA	73·5	63·7–84·8	NA	NA	60·5	48·2–75·9
Poland	91·5	87·1–95·8	53·8	48·2–60·2	89·7	85·8–93·9	NA	NA	44·2	38·5–50·8
Southern Europe										
Italy	94·5	92·3–96·6	68·0	NA	89·5	88·0–91·1	80·7	78·4–83·0	58·0	56·6–59·4
Malta	NA	NA	65·7	45·0–96·0	NA	NA	NA	NA	58·4	45·1–75·6
Slovenia	NA	NA	59·2	NA	93·3	87·4–99·5	84·2	75·1–94·3	55·5	48·9–63·0
Spain	NA	NA	73·2	NA	82·9	67·0–102·5	87·2	84·0–90·6	63·2	53·2–74·9
EUROCARE-4 mean	97·3	96·4–98·2	55·7	53·6–58·0	83·2	80·9–85·6	81·4	78·9–84·1	54·6	52·7–56·6
US SEER-13 registries	95·4	94·0–96·8	62·6	61·3–63·9	93·5	92·2–94·8	80·6	78·8–82·4	62·0	61·0–63·0

RS=relative survival. NA=not available (due to missing data in one or more age classes impeding the age standardisation). SEER=Surveillance, Epidemiology, and End Results. *RS estimates were calculated from data on patients aged 15–64 years. †Data from France was represented by the digestive cancer registry of Côte d'Or. In some instances, *SEER*Stat fails to compute a CI for specific age classes that have few patients. Reported figures are age-adjusted, but in these calculations CIs are not available.

Table 7: **Age-adjusted 5-year relative survival of testicular, kidney, thyroid, Hodgkin's disease, and non-Hodgkin lymphoma for period analysis 2000–02**

Finland), as reported in table 3. 10-year period survival was computed in the same way by extending the number of intervals up to ten, thereby involving patients diagnosed up to the years 1991–93. We adjusted by age to enable valid comparisons between survival from different groups (eg, different countries) to be made, thereby removing the confounding effect of differences in age distribution. Table 4 shows all site-specific population standards used for the age-adjustment of survival presented in this report.

The results of the comparison of age-adjusted 5-year relative survival in 2000–02 between patients in European countries by cancer site are shown in tables 5, 6, 7, and 8, in addition to the EUROCARE-4 mean (the weighted mean for the 47 registries) and US SEER estimates. Results are shown for 16 of 47 cancer sites that were analysed. The EUROCARE-4 mean was high (≥77·5%) for melanoma, female breast, corpus uteri, prostate, testicular, and thyroid cancer, and Hodgkin's disease; intermediate (54·6%–61·2%) for cancers of the colon and rectum, soft tissues, cervix, and kidney, and non-Hodgkin lymphoma; and low for stomach cancer (24·9% [95% CI 23·7–26·2]) and chronic myeloid leukaemia (32·2% [29·0–35·7]). Survival was especially low for lung cancer (10·9% [10·5–11·4]) and acute myeloid leukaemia (14·8% [13·4–16·4]). Overall, survival for all cancers combined was significantly higher in women (55·8% [55·3–56·2]) compared with that of men (47·3% [46·8–47·8]).

Survival was highest in northern Europe (especially in Sweden) and lowest in eastern Europe (which consisted of the Czech Republic and Poland). Large variations in survival in countries were noted for melanoma, and prostate and breast cancer, with absolute differences of 29%, 30%, and 26%, respectively. For all of the solid tumours—except testicular, stomach, and soft-tissue cancer—survival was significantly higher in US patients than in European patients. For haematological tumours,

	Acute myeloid leukaemia		Chronic myeloid leukaemia		All malignancies (men)		All malignancies (women)	
	RS	95% CI	RS	95% CI	RS	95% CI	RS	95% CI
North								
Finland	NA	NA	28·1	21·3–37·1	55·9	55·1–56·6	61·4	60·7–62·1
Iceland	NA	NA	NA	NA	57·7	54·6–61·0	61·8	58·3–65·4
Norway	13·4	9·1–19·7	38·4	30·4–48·6	53·0	52·3–53·8	58·4	57·7–59·2
Sweden	22·0	17·9–27·1	40·7	35·3–46·8	60·3	59·8–60·8	61·7	61·2–62·1
UK and Ireland								
England	13·9	12·4–15·6	33·8	31·4–36·4	44·8	44·6–45·0	52·7	52·5–52·9
Ireland	26·9	18·7–38·8	33·8	25·3–45·3	48·1	47·2–49·0	51·9	51·0–52·8
Northern Ireland	NA	NA	38·1	27·0–53·9	42·0	40·8–43·3	51·0	49·8–52·2
Scotland	14·8	10·8–20·3	40·1	NA	40·2	39·6–40·9	48·0	47·4–48·6
Wales	12·6	8·1–19·5	31·8	23·9–42·2	47·9	NA	54·1	53·3–55·0
Central Europe								
Austria	NA	NA	32·9	25·1–43·2	55·4	54·5–56·2	58·0	57·2–58·8
Belgium	NA	NA	37·5	30·8–45·7	53·2	52·5–53·8	61·6	61·0–62·3
France*	NA	NA	NA	NA	NA	NA	NA	NA
Germany	NA	NA	NA	NA	50·0	47·9–52·2	58·8	56·8–60·8
The Netherlands	18·7	13·7–25·4	41·8	33·5–52·2	47·1	NA	58·3	57·5–59·0
Switzerland	NA	NA	41·6	30·2–57·2	54·6	53·4–55·9	61·1	NA
Eastern Europe								
Czech Republic	NA	NA	NA	NA	37·7	35·3–40·3	49·3	46·6–52·0
Poland	NA	NA	34·5	25·1–47·2	38·8	37·8–39·8	48·3	NA
Southern Europe								
Italy	16·0	14·1–18·1	42·8	39·0–46·9	49·8	49·4–50·2	59·7	59·4–60·1
Malta	NA	NA	NA	NA	42·3	39·5–45·3	54·6	51·7–57·5
Slovenia	8·0	4·4–14·4	18·8	9·8–35·9	36·6	NA	52·9	51·7–54·1
Spain	NA	NA	NA	NA	49·5	47·6–51·5	59·0	56·9–61·2
EUROCARE-4 mean	14·8	13·4–16·4	32·2	29·0–35·7	47·3	46·8–47·8	55·8	55·3–56·2
US SEER-13 registries	13·9	12·6–15·2	36·0	33·1–39·1	66·3	66·0–66·6	62·9	62·6–63·2

RS=relative survival. NA=not available (due to missing data in one or more age classes impeding the age standardisation). SEER=Surveillance, Epidemiology, and End Results. *Data from France was represented by the digestive cancer registry of Côte d'Or. In some instances, *SEER*Stat fails to compute a CI for specific age classes that have few patients. Reported figures are age-adjusted, but in these calculations CIs are not available.

Table 8: **Age-adjusted 5-year relative survival of acute and chronic myeloid leukaemia and all malignancies (men and women) for period analysis 2000–02**

survival differences between Europe and the USA were not statistically significant, except for non-Hodgkin lymphoma. 5-year survival in the USA for all cancers combined was 66·3% (66·0–66·6) in men and 62·9% (62·6–63·2) in women; both of these percentages were significantly higher than those for Europe—ie, 47·3% (46·8–47·8) for men and 55·8% (55·3–56·2) for women, both p values <0·001). However, by excluding prostate cancer, this difference for men decreases by about half—ie, to 46·9% (46·6–47·3) for the USA and 38·1% (37·9–38·2) for Europe.

Figure 2 shows 5-year and 10-year survival profiles in Europe over the periods 1991–2002 and 1997–2002, respectively, for only the cancer sites that showed significantly improved 5-year survival out of the 47 different cancer types that we analysed (results not shown) and also for rare malignancies expected to benefit from recent advances in treatment (eg, chronic myeloid leukaemia and testicular cancer). The 5-year relative survival profile was longer than the 10-year profile because each point of the first profile required data of patients who were diagnosed at least up to 5 years previously (eg, the first point 1991–93 was based on data on patients diagnosed back to the years 1987–89), whereas the 10-year profile would need data at least up to 10 years previously for each data point of patients diagnosed (eg, the first point of 1991–93 would be based on patients diagnosed back to the years 1982–84). The length of each profile, therefore, depended on the availability of historical data from the EUROCARE-4 database. For example, for the period of 1997–99, figure 2 shows 5-year survival (continuous line) for patients with cancer diagnosed up to 5 years before, and for 10-year survival (dashed line), figure 2 shows the survival of patients with cancer diagnosed up to 10 years before; both estimates were obtained by the period method.

We noted major and sustained improvements in survival for colorectal, breast, prostate, and thyroid cancers and

for Hodgkin's disease, non-Hodgkin lymphoma, chronic myeloid leukaemia, and for all cancers in both sexes.

The profiles of 5-year and 10-year survival were similar, although 10-year survival was lower. The 10-year survival was very close to or overlapped the 5-year survival for melanoma and corpus uteri, testicular, and thyroid cancer, for which death generally occurred within 5 years of diagnosis. For cancers of the stomach, colon and rectum, soft tissues, Hodgkin's disease, and all cancers combined (for both sexes), 10-year survival was similar to 5-year survival (difference of less than 5 percentage points), indicating the tendency for death to occur mainly within 5 years of diagnosis for these cancers, although some risk persists beyond this period. Conversely, for breast cancer, prostate cancer, non-Hodgkin lymphoma, and chronic myeloid leukaemia, 10-year survival was much lower than 5-year survival; for these cancers, the excess risk of death persists for many years. The distance between 5-year and 10-year relative survival for breast and prostate cancer existed also for cohorts of patients diagnosed during the period 1983–85, before the implementation of screening programmes.[25]

Figure 3 shows the trend in age-adjusted 5-year survival in five European regions for cancers for which screening is effective or for which diagnostic procedures and treatment might differ by country. Patients in eastern European had the highest improvement in survival for major cancer sites during 1991–2002 (colorectal cancer from 30·3% [28·3–32·5] to 44·7% [42·8–46·7]; breast cancer from 60% [57·2–63·0] to 73·9% [71·7–76·2]; for prostate cancer from 39·5% [35·0–44·6] to 68·0% [64·2–72·1]. Although survival in eastern Europe was lower than in the other European areas, the increases in survival over time were greater, especially for cancers of the colon and rectum (annual percent increase of survival over the period 1991–2002 of 4·7% [1·6–7·9] for eastern European countries and 1·1% [0·5–1·6] for the European mean), breast (annual percent increase of survival over the period 1991–2002 of 2·5% [0·5–4·6] for eastern

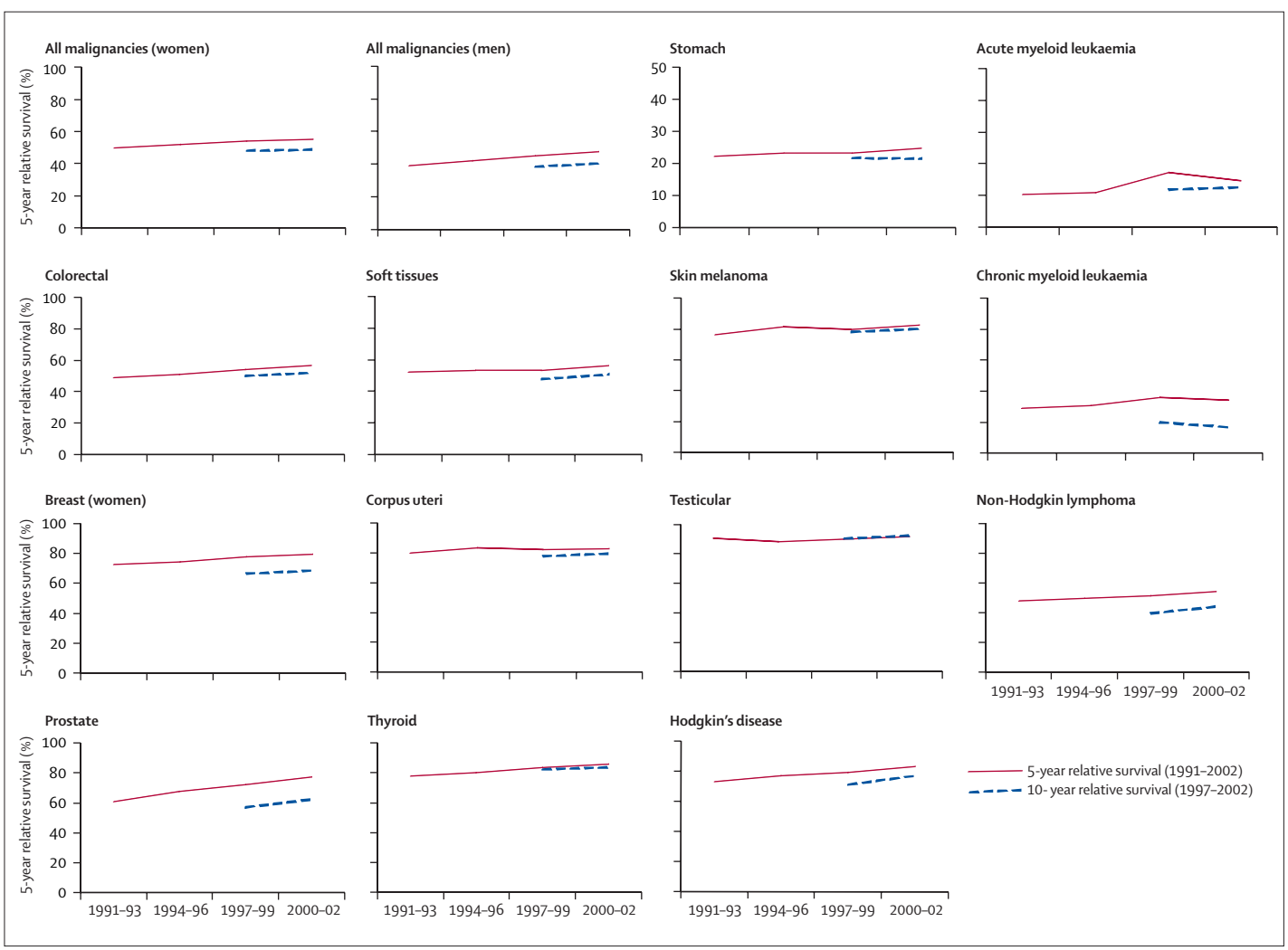

Figure 2: **5-year and 10-year period survival profiles (%) of EUROCARE-4 data by cancer site**
Survival are weighted by geographical area and age-adjusted.

European countries and 1·6% [1·4–1·9] for the European mean), and prostate (annual percent increase of survival over the period 1991–2002 of 5·9% [2·4–9·6] for eastern European countries and 2·6% [1·5–3·8] for the European mean). For lung cancer, 5-year survival increased for all areas except central Europe, which showed the highest survival 13·4% (12·8–14·0). In eastern Europe, lung-cancer survival increased until 1999, reaching 9·8% (8·7–11·0) and then slightly decreased. For cervical cancer, 5-year survival remained stable in the UK and Ireland, and central Europe, and slightly increased in eastern, northern, and southern European countries.

Discussion

Overall survival has improved for all cancers and for the major cancer sites. Survival for patients treated in 2000–02 was highest generally for countries in northern Europe and lowest in countries in eastern Europe—although the eastern European countries had the largest improvements.

The use of period analysis allowed us to estimate survival within a few years of diagnosis and to acquire recent estimates (ie, for 2000–02) for Europe. Consequently, survival and time trends can be interpreted in the context of more recent standards of diagnosis and treatment with respect to those considered when using traditional cohort-survival analysis.

When comparing survival within Europe and between Europe and the USA, some potential sources of bias need to be considered. In particular, differences in the completeness or quality of the data (or both) from the cancer registries might have affected our results. High-quality and comparable data are prerequisites for comparative international studies on cancer survival. In our study, the comparability of data was assured by the use of a detailed standard protocol for sending and coding the data and by a centralised procedure for detecting errors and unusual combinations of site and histology.[26] The quality-control indicators were satisfactory: very few data had to be excluded because of invalid records (0·1%) or loss to follow-up (0·2%). These indicators were even better for patients diagnosed in the most recent period (2000–02), and the results of the JoinPoint analysis indicated that the potential incompleteness of incidence data for this period was not selective with respect to the patient's life status, and therefore, was unlikely to have affected our estimates. In terms of the potential bias caused by the exclusion of records based exclusively on the death certificate, although the proportion of records overall was very low (<2%), the proportion was higher for individual registries (eg, Austria and Wales). However, previous studies have shown that the exclusion of these records does not affect greatly the results for cohort[27] or period analysis.[28]

In countries without national coverage of patients with cancer, our data cannot be deemed as representative of the entire population, as previously reported for survival estimates based on EUROCARE data.[29] For example, in Italy, coverage is higher in the north—where the population is wealthier and where survival is higher—than in the south, where coverage is low. Furthermore, our analysis included only about half of the registries contributing to EUROCARE-4 (ie, those able to provide 2000–02 incidence and follow-up data), and only 30 registries were included in the time-profile analysis. Nonetheless, the countries included in our study represent a fairly large proportion of Europe, and this set of registries constitutes the largest available dataset providing recent cancer survival data for Europe. Another major limitation of the EUROCARE data is the absence of information on clinical stage, which precludes comparisons of stage-matched patients.

From the results of our analysis, it is encouraging that overall cancer survival in Europe continued to increase in the most recent period. Recent increases in survival were also noted for certain common cancers (colon and rectum, breast, and prostate cancer), less common cancers (Hodgkin's disease, non-Hodgkin lymphoma, and thyroid cancer). For brevity, we decided not to report profiles for other cancer sites with no clear tendency and small variation between countries.

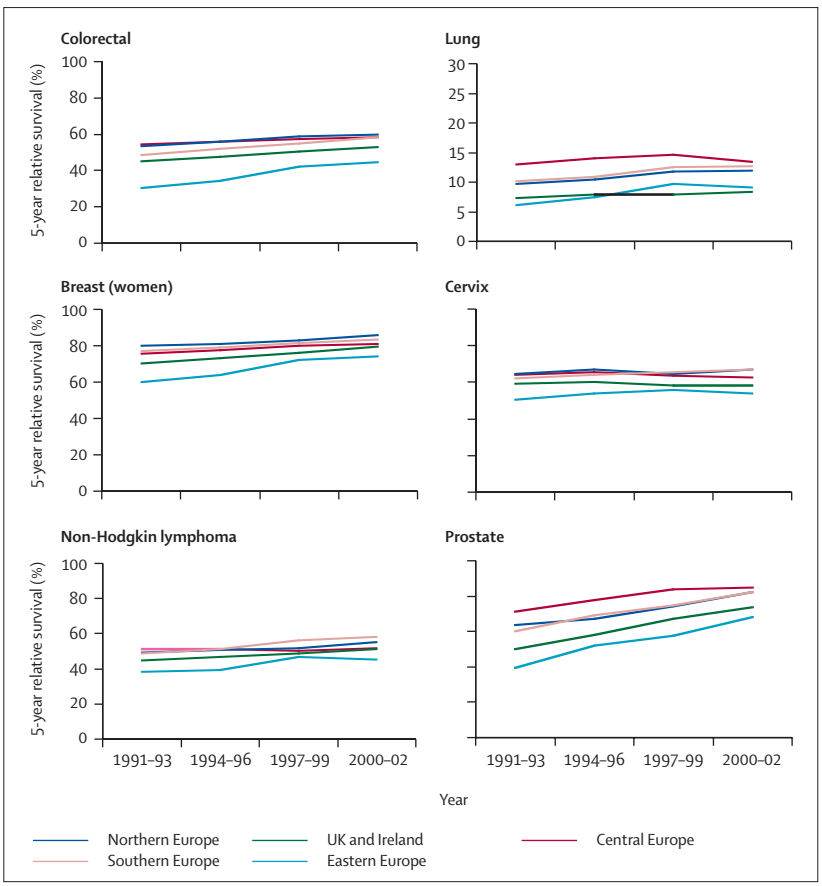

Figure 3: **5-year period survival profiles (%) from 1991 to 2002, by geographical area and cancer site**
Survival are age-adjusted.

Survival was highest in the northern Europe, where the increases were smaller than in other regions. Major increases occurred in eastern European countries, with a consequent decrease of the gap between eastern European survival compared with those of other European areas. Eastern European countries, which had poorer survival at the earlier time points of the study, benefited more from improvements in survival than did the other areas over the entire period of 1991–2002.

Survival increases might be attributed to the development of screening programmes and increased access to innovative treatment, although, for breast cancer, the prevalence of adjuvant chemotherapy for node-positive breast cancer in the late 1990s still varied greatly in European populations, ranging from 37% to 77%.[30]

Survival for cancer of the colon and rectum increased for all five geographical areas, especially for eastern European coutries. This might have, in part, been due to the increased dissemination of cancer-site specific protocols[31] and the more widespread use of mesorectal excision to decrease local recurrences in rectal cancer.[32] Bowel cancer screening programmes were not common in the study period and are thus unlikely to have had a major effect on survival.

For prostate cancer, increasing use of prostate-specific antigen assessment might be the reason for the marked increase in survival; however, differences in the marker's use in European countries are also responsible for large differences in survival, and in incidence. The slight decrease in mortality for prostate cancer evident in several European countries might, at least in part, be due to improved treatments,[33] specifically, the more widespread use of adjuvant hormonal treatment for locally advanced disease.[34]

With regard to the comparison between EUROCARE and US SEER data, the differences in survival were greatest in 2000–02 for the major cancer sites: colon and rectum (56·2% [95% CI 55·3–57·2] *vs* 65·5% [64·9–66·1]), breast (79·0% [78·1–80·0] *vs* 90·1% [89·6–90·5]), and prostate cancer (77·5% [76·5–78·6] *vs* 99·3% [98·9–99·8]), which probably represents differences in the timeliness of diagnosis. In the USA, 70% of women aged 50–70 years have reported that they have undergone a mammogram in the previous 2 years;[35] one-third of people reported that they had undergone sigmoidoscopy or colonoscopy in the previous 5 years;[36] and over 80% of men aged 65 years or older reported that they had undergone prostate-specific antigen, of whom 40% had been tested in the previous year.[37] That we found a 5-year relative survival for prostate cancer as high as 99·3% in the USA suggests that the increase in survival is largely an artefact from the introduction of screening of prostate-specific antigen—although, we cannot establish the effect that this artefact will have on mortality.

With the exception of non-Hodgkin lymphoma, the survival of patients with haematological malignancies was comparable in the US SEER and EUROCARE populations. These malignancies are usually referred to specialist centres for treatment, in accordance with evidence-based guidelines, and they are frequently included in international clinical trials.

In Europe, the 5-year relative survival for all cancers combined was 47·3% (46·8–47·8) for men and 55·8% (55·3–56·2) for women, which are much lower than the 66·3% (66·0–66·6) for men and 62·9% (62·6–63·2) for women in the USA. However, when excluding prostate cancer, the survival decreased to 38·1% (37·9–38·2) in Europe and 46·9% (46·6–47·3) in the USA, so that, in men, over half of the difference in survival between Europe and the USA can be attributed to prostate cancer. For women, the 5-year survival for all cancers combined in the USA (62·9% [62·6–63·2]) was comparable with that in some of the wealthiest European countries (from 59·7% [59·4–60·1] in Italy, up to 61·7% [61·2–62·1] in Sweden); the slightly higher survival in the USA was largely due to better survival for colorectal and breast cancer.

The differences in survival are due to a variety of reasons, including factors related to cancer services (eg, organisation, training and skills of health-care professionals, application of evidence-based guidelines, and investment in diagnostic and treatment facilities), and clinical factors (eg, tumour stage and biology). Survival represents the end result of the complex interplay of these factors, whose individual contribution to survival cannot be distinguished easily, although studies in the USA[38] and the UK[39] have shown that improvements in treatment and screening probably had a major effect in decreasing breast cancer mortality.

In conclusion, the present analysis of the most recent cancer survival data available in Europe suggests that the wide variations in cancer survival in Europe, which have persisted over many years,[40] might be on the verge of decreasing. Part of the explanation might be related to the wealth of individual countries, the evolving organisation of healthcare systems, and increasing access to modern diagnostic and treatment facilities.

Because of population aging, the development of new technologies, and the demands of increasingly informed patients, health-care costs will continue to increase and difficult decisions will need to be made regarding the allocation of health-care resources. Furthermore, priorities in resource allocation will differ between different countries, as seen, for example, for investment in radiotherapy (eg, much fewer machines per million population in Poland compared with France or the Netherlands).[41] Currently, in the European Union (EU), the organisation of cancer services is the sole responsibility of member states. Sharing the dividends of successful national cancer plans between European policymakers and, in the long-term, developing a pan-European cancer plan could assist in the adoption of modern diagnostic and treatment facilities and the establishment of evidence-based clinical practice in all European countries.

Contributors

AV, GG, AM designed the study. SF did the statistical analysis. HB contributed to the study design and analysis. AV, SF, HB, GG, AM, LM, and IK wrote the report. The EUROCARE Working Group provided survival data.

Conflicts of interest

The authors declared no conflicts of interest.

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