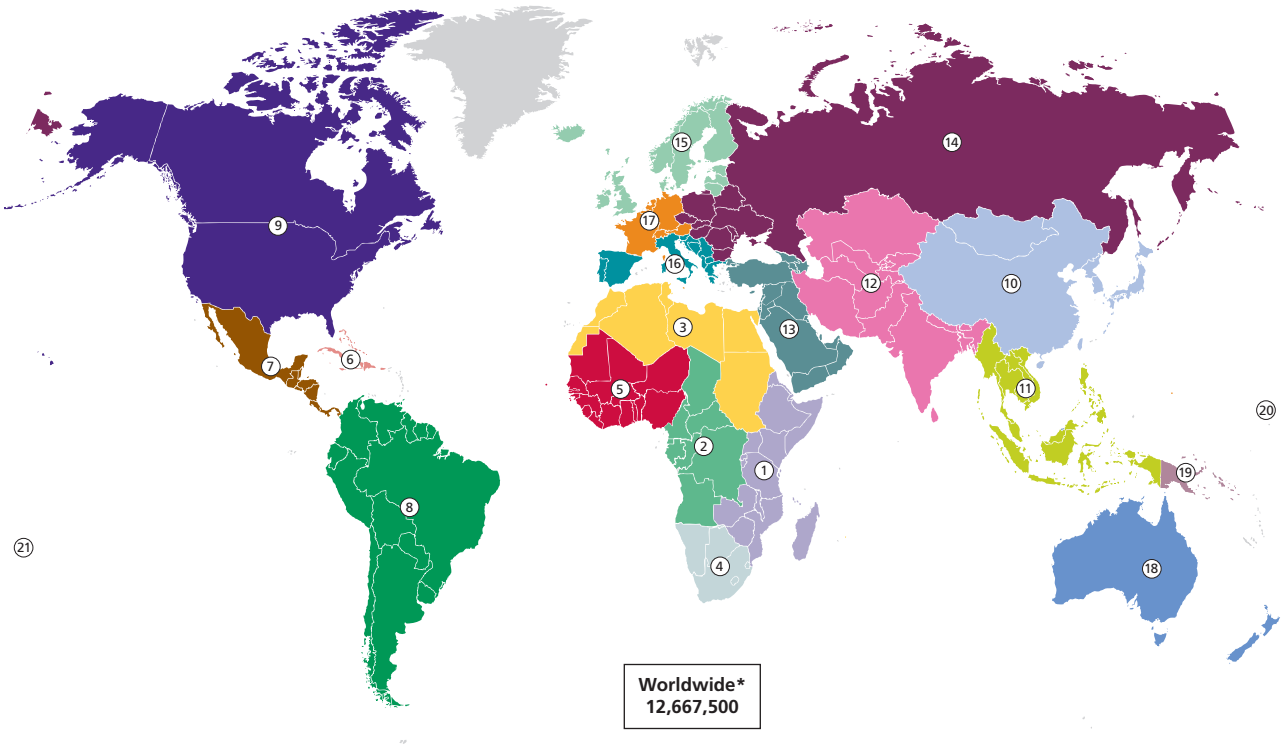
Global Cancer Facts & Figures

2nd Edition

Estimated Number of New Cancer Cases by World Area, 2008*



1 Eastern Africa (221,100)
2 Middle Africa (66,900)
3 Northern Africa (164,400)
4 Southern Africa (79,200)
5 Western Africa (184,100)
6 Caribbean (79,300)
7 Central America (176,600)
8 South America (650,100)
9 Northern America (1,603,900)
10 Eastern Asia (3,720,700)
11 South-Eastern Asia (725,600)
12 South-Central Asia (1,423,100)
13 Western Asia (223,300)
14 Central and Eastern Europe (985,200)
15 Northern Europe (480,200)
16 Southern Europe (713,900)
17 Western Europe (1,034,300)
18 Australia/New Zealand (127,000)
19 Melanesia (7,000)
20 Micronesia (700)
21 Polynesia (1,100)

*Region estimates do not sum to the worldwide estimate due to calculation method.
Source: GLOBOCAN 2008.

Special Section:
Cancer in Africa
see page 37

American Cancer Society®

Contents

This publication would not have been possible without the contributions of the International Agency for Research on Cancer and its work in producing GLOBOCAN 2008 (http://globocan.iarc.fr) alongside the work of cancer registrars worldwide.

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This publication attempts to summarize current scientific information about cancer. Except when specified, it does not represent the official policy of the American Cancer Society.

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Cancer: Basic Facts

What Is Cancer?

Cancer is a group of diseases characterized by uncontrolled growth and spread of abnormal cells. If the spread is not controlled, it can result in death. Cancer is caused by both external factors (tobacco, chemicals, radiation, and infectious organisms) and internal factors (inherited mutations, hormones, immune conditions, and mutations that occur from metabolism). These causal factors may act together or in sequence to initiate or promote carcinogenesis. The development of most cancers requires multiple steps that occur over many years. Certain types of cancer can be prevented by eliminating exposure to tobacco and other factors that initiate or accelerate this process. Other potential malignancies can be detected before cells become cancerous or at an early stage, when the disease is most treatable. Cancer is treated with surgery, radiation, chemotherapy, hormones, and immunotherapy. Worldwide, one in eight deaths is due to cancer; cancer causes more deaths than AIDS, tuberculosis, and malaria combined. When countries are grouped according to economic development, cancer is the leading cause of death in developed countries and the second leading cause of death in developing countries (following heart diseases) (Table 1). According to recent World Health Organization (WHO) projections, cancer will have replaced ischemic heart disease as the overall leading cause of death worldwide in 2010.[1]

How Many New Cancer Cases and Deaths Occured in 2008 Worldwide?

According to estimates from the International Agency for Research on Cancer (IARC), there were 12.7 million new cancer cases in 2008 worldwide, of which 5.6 million occured in economically developed countries and 7.1 million in economically developing countries (Figure 1). The corresponding estimates for total cancer deaths in 2008 were 7.6 million (about 21,000 cancer deaths a day), 2.8 million in economically developed countries and 4.8 million in economically developing countries. By 2030, the global burden is expected to grow to 21.4 million new cancer cases and 13.2 million cancer deaths simply due to the growth and aging of the population, as well as reductions in childhood mortality and deaths from infectious diseases in developing countries.[2]

The estimated future burden could be much larger than given above due to the adoption of western lifestyles, such as smoking, poor diet, physical inactivity, and reproductive factors, in economically developing countries. Cancers related to these factors, such as lung, breast, and colorectal cancers, are increasing in economically transitioning countries. Rates of cancers common in Western countries will continue to rise in developing countries if preventive measures are not widely applied. Table 2 provides the estimated numbers of total new cancer cases and deaths in 2008 by United Nations (UN) area. In economically developed countries, the three most commonly diagnosed cancers were prostate, lung and bronchus, and colorectal among men, and breast, colorectal,

Table 1. Leading Causes of Death Worldwide and in Developing and Developed Countries, 2004 (thousands)

	Worldwide			Developing			Developed		
	Rank	Deaths	%	Rank	Deaths	%	Rank	Deaths	%
Heart diseases	1	8,923	15.1	1	7,342	14.5	2	1,563	19.3
Malignant neoplasms	2	7,424	12.6	2	5,255	10.4	1	2,154	26.6
Cerebrovascular diseases	3	5,712	9.7	3	4,949	9.8	3	757	9.4
Lower respiratory infections	4	4,177	7.1	4	3,910	7.7	4	305	3.8
Perinatal conditions*	5	3,180	5.4	5	3,141	6.2		35	0.4
Chronic obstructive pulmonary disease	6	3,025	5.1	6	2,737	5.4	5	285	3.5
Diarrhoeal diseases	7	2,163	3.7	7	2,148	4.2		14	0.2
HIV/AIDS	8	2,040	3.5	8	2,018	4.0		20	0.2
Tuberculosis	9	1,464	2.5	9	1,448	2.9		15	0.2
Road traffic accidents	10	1,275	2.2	10	1,158	2.3		114	1.4
Diabetes mellitus	11	1,141	1.9		914	1.8	7	221	2.7
Malaria	12	889	1.5		888	1.8		0	0.0
Suicide	13	844	1.4		707	1.4	9	118	1.5
Cirrohsis of the liver	14	772	1.3		655	1.3	10	116	1.4
Nephritis and nephrosis	15	739	1.3		611	1.2	8	126	1.6
All causes		58,772	100.0		50,582	100.0		8,095	100.0

The number zero in a cell indicates a non-zero estimate of less than 500.

* Includes "causes arising in the perinatal period" as defined in the International Classification of Diseases, principally low birthweight, prematurity, birth asphyxia, and birth trauma, and does not include all causes of deaths occurring in the perinatal period.

Source: World Health Organization, The global burden of disease: 2004 update.

and lung among women (Figure 1). In economically developing countries, the three most commonly diagnosed cancers were lung, stomach, and liver in men, and breast, cervix uteri, and lung in women. In both economically developed and developing countries, the three most common cancer sites were also the three leading causes of cancer death (Figure 1).

Is There Geographic Variation in Cancer Occurrence?

Factors that contribute to regional differences in the types or burden of cancer include regional variations in the prevalence of major risk factors, availability and use of medical practices such as cancer screening, availability and quality of treatment, and age structure. In 2008, two of the four leading cancers in men (stomach and liver) and women (cervix and stomach) in developing countries were related to infection. Stomach cancer continued to be the most common infection-related cancer worldwide, followed closely by liver and cervix (Figure 1). Approximately 15% of all incident cancers worldwide are attributable to infections.[3] This percentage is about three times higher in developing countries (26%) than in developed countries (8%) (Figure 2).

The frequency of the most common cancer diagnoses and deaths also varies by geographic areas (Table 3). For example, among women breast cancer was the most common cause of cancer death in 10 out of the 21 world areas, while cervical and lung cancers were the leading causes of cancer death in the remaining areas. Further variations in the most frequently diagnosed cancers are observed by examining individual countries worldwide. In 2008, the most common cancer site among males in most economically developed countries was prostate, with the exception of Japan where stomach cancer was the most common. Lung cancer predominated as the top cancer site in most of Eastern Europe and Asia. The greatest variation among males was observed in Africa, where the most common cancers included prostate, lung, liver, esophagus, bladder, Kaposi sarcoma, and Non-Hodgkin lymphoma. Among females worldwide the most common cancer sites were either breast or cervical cancer, with the exception of China (lung), South Korea (thyroid), and Mongolia and Vietnam (liver) (Figure 3). The geographic variations in a number of specific cancer sites are presented in the Selected Cancers section of this document (page 11).

Can Cancer Be Prevented?

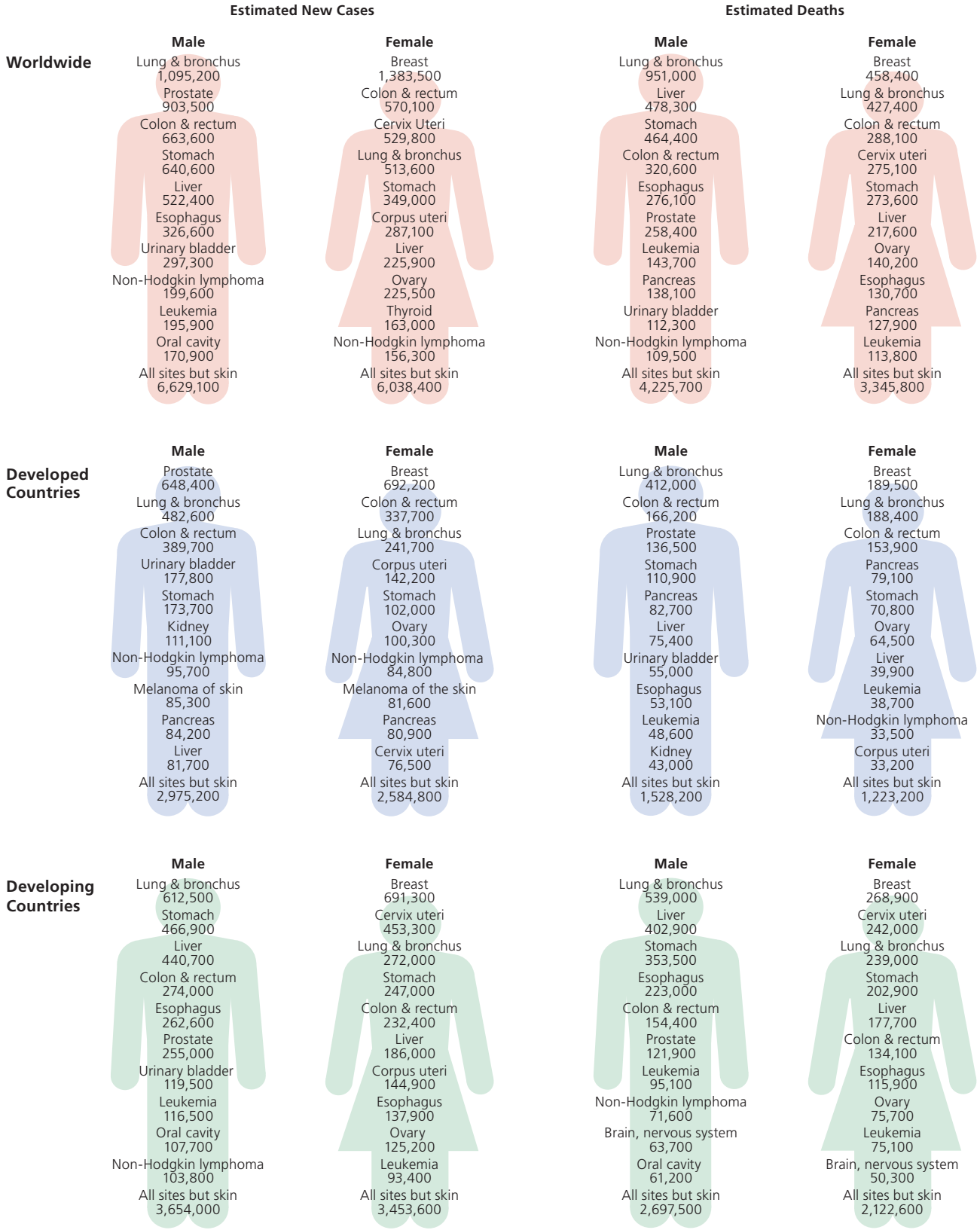
It is estimated that more than half of all cancer cases and deaths worldwide are potentially preventable (Figure 2). Cancers related to

Table 2. Estimated Number of New Cancer Cases and Deaths by World Area, 2008*

	Cases			Deaths		
	Male	Female	Overall	Male	Female	Overall
Eastern Africa	100,800	120,200	221,100	85,400	88,300	173,700
Middle Africa	29,500	37,400	66,900	25,600	27,600	53,200
Northern Africa	81,500	82,900	164,400	65,400	55,400	120,800
Southern Africa	40,600	38,600	79,200	29,300	25,500	54,800
Western Africa	72,500	111,600	184,100	61,300	78,000	139,300
Eastern Asia	2,135,300	1,585,400	3,720,700	1,511,800	928,600	2,440,400
South-Central Asia	651,100	772,000	1,423,100	496,800	483,200	979,900
South-Eastern Asia	336,700	388,800	725,600	258,600	242,400	501,000
Western Asia	118,500	104,800	223,300	86,700	64,400	151,200
Caribbean	42,800	36,500	79,300	26,300	21,500	47,800
Central America	84,000	92,600	176,600	52,500	55,800	108,300
Northern America	831,800	772,100	1,603,900	332,500	305,900	638,300
South America	318,000	332,100	650,100	200,600	185,300	385,900
Central and Eastern Europe	494,600	490,600	985,200	351,700	283,000	634,800
Northern Europe	248,400	231,800	480,200	126,400	116,300	242,700
Southern Europe	398,800	315,000	713,900	225,000	155,500	380,500
Western Europe	569,600	464,700	1,034,300	258,900	204,900	463,800
Australia/New Zealand	70,300	56,700	127,000	27,600	21,400	49,100
Melanesia	3,300	3,700	7,000	2,600	2,500	5,100
Micronesia	300	400	700	200	200	400
Polynesia	600	600	1,100	300	200	600

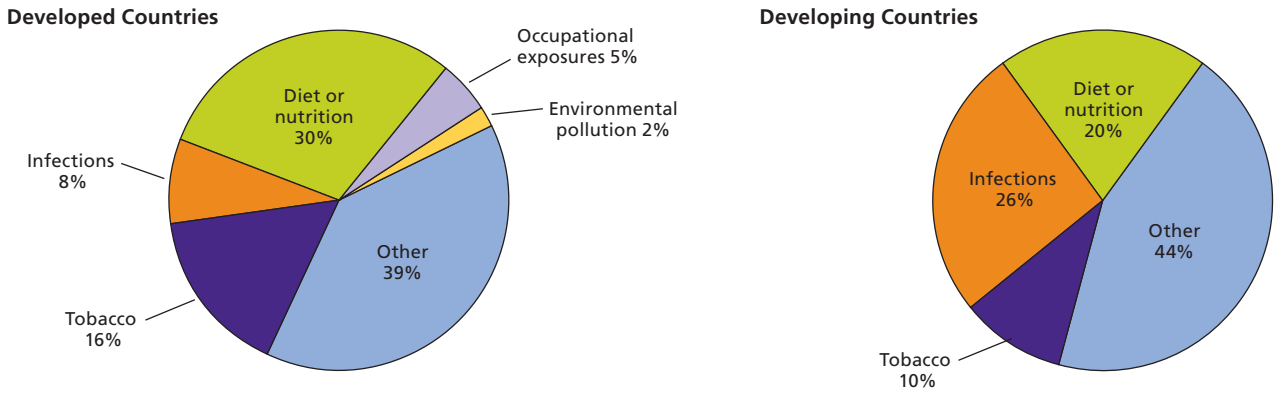
* Excludes nonmelanoma skin cancer.
Source: GLOBOCAN 2008.

Figure 1. Estimated New Cancer Cases and Deaths Worldwide for Leading Cancer Sites by Level of Economic Development, 2008



Source: Globocan 2008.

Figure 2. Proportion of Cancer Causes by Major Risk Factors and Level of Economic Development



Source: Cancer Atlas, 2006.

tobacco use, heavy use of alcohol, and obesity are most effectively prevented through a combination of education and social policies that encourage healthy behaviors and discourage unhealthy practices. Certain cancers that are related to infectious agents, such as hepatitis B virus (HBV), human immunodeficiency virus (HIV), human papillomavirus (HPV), and *helicobacter pylori* (*H. pylori*), could be prevented through known interventions, including vaccines, antibiotics, improved sanitation, or education. Some cancers (colorectal and cervix) can be avoided by detection and removal of precancerous lesions through regular screening examinations by a health care professional. Early detection of cancer is important because it provides a greater chance that treatment will be successful. Cancers that can be detected at an early stage through screening include breast, cervix, colorectum, prostate, oral cavity, and skin.[4] However, screening has been proven to be effective in reducing the mortality for only breast, cervical, and colorectal cancers. Screening and treatment services for most of these cancers are not available in developing countries because of limited resources.

Who Is at Risk of Developing Cancer?

Anyone can develop cancer. However, the risk of being diagnosed with cancer increases substantially with age. In economically developed countries, 78% of all newly diagnosed cancer cases occur at age 55 and older, compared to 58% in developing countries. The difference is largely due to variations in age structure of the populations. The populations of developing countries are younger and have a smaller proportion of older individuals in whom cancer most frequently occurs. Table 4 shows the estimated age-standardized incidence and mortality rates (per 100,000) for various types of cancers by sex and level of economic development in 2008. The incidence rate for all cancers combined was higher in more developed countries compared to less developed countries in both men (300.1 vs. 160.3, respectively) and women (225.5 vs. 138.0). In contrast, the mortality rate for all cancers combined was generally similar between more developed and less developed countries, particularly among women (87.3 vs. 85.4, respectively). These differences relate to variations in both the type of major cancers and the availability of early detection and treatment services between more and less developed countries.

What Is Meant by Genetic Factors?

All cancers involve the malfunction of genes that control cell growth, division, and death. However, most of the genetic abnormalities that affect cancer risk are not hereditary (inherited from parents), but instead result from damage to genes (mutations) that occur throughout a person's lifetime. Damage to genes may be due to internal factors, such as hormones or the metabolism of nutrients within cells, or external factors, such as tobacco, chemicals, and sunlight. These nonhereditary mutations are called somatic mutations. It is estimated that about 5% of all cancers are strongly hereditary. Most cancers evolve through multiple changes resulting from a combination of hereditary and environmental factors.

What Percentage of People Will Survive Cancer?

Cancer survival is usually measured as the proportion of cancer patients who are still alive five years after diagnosis relative to the 5-year survival of people in the general population who are of the same age and sex. Cancer survival rates in a population are affected by a number of factors, most importantly, the types of cancer that occur, the stages at which cancers are diagnosed, and whether treatment is available (Table 5). For cancers that are affected by screening and/or treatment, such as female breast, colorectal and certain childhood cancers, there are large survival differences between economically developed and developing countries. For example, five-year survival rates for breast cancer in the United States are approximately 84%, compared to 39% in Algeria.[5] In contrast, for cancer sites without early detection or

Table 3. The Two Most Common Types of New Cancer Cases and Deaths by World Area, 2008

Cancer Cases

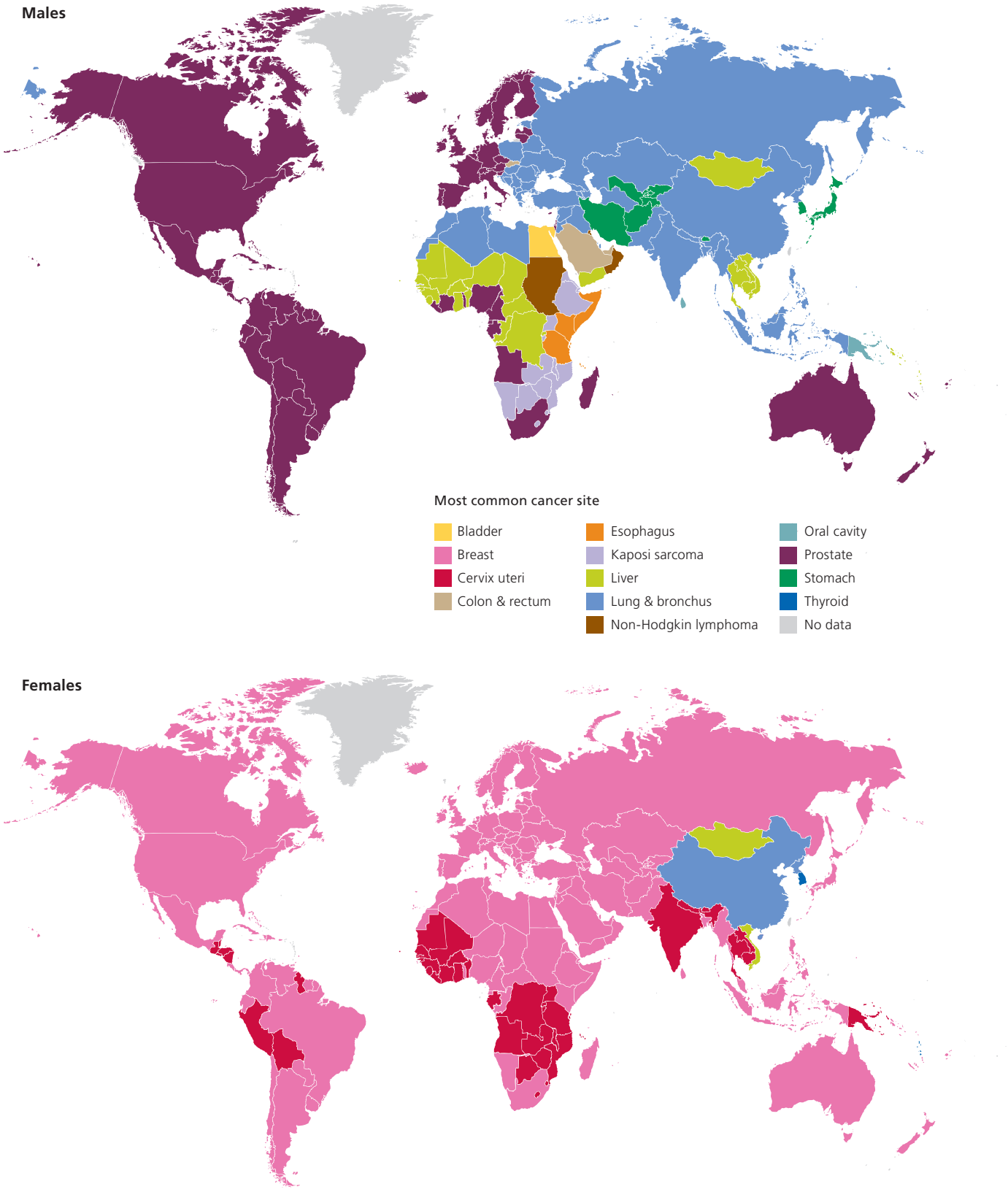
	Males				Females			
	First		Second		First		Second	
Eastern Africa	Kaposi sarcoma	15.8%	Esophagus	10.4%	Cervix uteri	26.2%	Breast	14.9%
Middle Africa	Liver	23.6%	Prostate	14.1%	Breast	22.1%	Cervix uteri	22.0%
Northern Africa	Lung & bronchus	12.7%	Bladder	12.5%	Breast	33.8%	Cervix uteri	6.4%
Southern Africa	Prostate	19.2%	Lung & bronchus	11.5%	Breast	23.4%	Cervix uteri	16.9%
Western Africa	Liver	19.2%	Prostate	18.3%	Breast	26.4%	Cervix uteri	25.9%
Caribbean	Prostate	37.3%	Lung & bronchus	13.0%	Breast	24.6%	Cervix uteri	13.0%
Central America	Prostate	24.4%	Stomach	9.1%	Breast	18.9%	Cervix uteri	16.9%
South America	Prostate	26.4%	Lung & bronchus	10.6%	Breast	26.6%	Cervix uteri	14.4%
North America	Prostate	25.7%	Lung & bronchus	15.1%	Breast	26.6%	Lung & bronchus	14.3%
Eastern Asia	Lung & bronchus	20.4%	Stomach	19.1%	Breast	15.2%	Lung & bronchus	13.2%
South-Eastern Asia	Lung & bronchus	19.8%	Liver	15.1%	Breast	22.4%	Cervix uteri	11.4%
South-Central Asia	Lung & bronchus	12.3%	Oral cavity	9.4%	Cervix uteri	22.5%	Breast	22.4%
Western Asia	Lung & bronchus	19.0%	Colon & rectum	8.4%	Breast	27.2%	Colon & rectum	8.2%
Central and Eastern Europe	Lung & bronchus	22.2%	Colon & rectum	13.0%	Breast	23.4%	Colon & rectum	13.3%
Northern Europe	Prostate	27.3%	Lung & bronchus	14.3%	Breast	30.0%	Colon & rectum	12.1%
Southern Europe	Prostate	20.0%	Lung & bronchus	17.0%	Breast	29.0%	Colon & rectum	14.2%
Western Europe	Prostate	29.8%	Lung & bronchus	13.4%	Breast	32.1%	Colon & rectum	13.8%
Australia/New Zealand	Prostate	29.8%	Colon & rectum	13.4%	Breast	28.4%	Colon & rectum	14.0%
Melanesia	Oral cavity	16.1%	Liver	10.3%	Cervix uteri	19.5%	Breast	17.1%
Micronesia	Lung & bronchus	29.9%	Prostate	15.9%	Breast	35.7%	Colon & rectum	11.6%
Polynesia	Prostate & Lung	20.1%	Colon & rectum	6.4%	Breast	29.6%	Thyroid	12.2%

Cancer Deaths

	Males				Females			
	First		Second		First		Second	
Eastern Africa	Kaposi sarcoma	16.0%	Esophagus	11.8%	Cervix uteri	24.5%	Breast	11.3%
Middle Africa	Liver	26.6%	Prostate	13.3%	Cervix uteri	20.7%	Breast	16.9%
Northern Africa	Lung & bronchus	14.7%	Bladder	10.1%	Breast	26.3%	Colon & rectum	5.6%
Southern Africa	Lung & bronchus	14.8%	Esophagus	13.1%	Breast	17.5%	Cervix uteri	13.6%
Western Africa	Liver	22.2%	Prostate	17.5%	Cervix uteri	24.9%	Breast	21.0%
Caribbean	Prostate	24.9%	Lung & bronchus	19.6%	Breast	15.8%	Lung & bronchus	12.7%
Central America	Prostate	15.5%	Lung & bronchus	13.8%	Cervix uteri	13.7%	Breast	11.6%
South America	Lung & bronchus	15.6%	Prostate	14.6%	Breast	14.6%	Cervix uteri	11.8%
North America	Lung & bronchus	30.4%	Prostate	9.8%	Lung & bronchus	25.9%	Breast	14.9%
Eastern Asia	Lung & bronchus	24.7%	Liver	20.3%	Lung & bronchus	19.1%	Stomach	15.5%
South-Eastern Asia	Lung & bronchus	22.4%	Liver	18.2%	Breast	15.2%	Lung & bronchus	11.5%
South-Central Asia	Lung & bronchus	14.6%	Oral cavity	8.1%	Cervix uteri	19.8%	Breast	17.1%
Western Asia	Lung & bronchus	23.7%	Stomach	9.3%	Breast	19.0%	Colon & rectum	8.1%
Central and Eastern Europe	Lung & bronchus	28.3%	Colon & rectum	11.5%	Breast	16.8%	Colon & rectum	14.6%
Northern Europe	Lung & bronchus	23.6%	Prostate	14.0%	Lung & bronchus	18.6%	Breast	15.8%
Southern Europe	Lung & bronchus	27.1%	Colon & rectum	11.6%	Breast	16.5%	Colon & rectum	13.1%
Western Europe	Lung & bronchus	25.6%	Colon & rectum	11.5%	Breast	18.2%	Colon & rectum	13.3%
Australia/New Zealand	Lung & bronchus	20.1%	Prostate	14.6%	Lung & bronchus	16.4%	Breast	15.7%
Melanesia	Liver	12.7%	Oral cavity	9.1%	Cervix uteri	18.7%	Breast	13.6%
Micronesia	Lung & bronchus	30.2%	Colon & rectum	11.7%	Breast & lung	17.8%	Colon & rectum	11.2%
Polynesia	Lung & bronchus	30.0%	Prostate	10.0%	Breast	16.7%	Lung & bronchus	15.4%

Source: GLOBOCAN 2008.

Figure 3. Most Common Cancer Sites Worldwide by Sex, 2008



Source: GLOBOCAN 2008.

Table 4. Estimated Age-standardized Incidence and Mortality Rates (per 100,000) by Sex, Cancer Site, and Level of Economic Development, 2008

	Males				Females			
	Developed countries		Developing countries		Developed countries		Developing countries	
Site	Incidence	Mortality	Incidence	Mortality	Incidence	Mortality	Incidence	Mortality
Bladder	16.6	4.6	5.4	2.6	3.6	1.0	1.4	0.7
Brain & other nervous system	6.0	3.9	3.2	2.6	4.4	2.6	2.8	2.0
Breast	–	–	–	–	66.4	15.3	27.3	10.8
Cervix uteri	–	–	–	–	9.0	3.2	17.8	9.8
Colon & rectum	37.6	15.1	12.1	6.9	24.2	9.7	9.4	5.4
Corpus uteri	–	–	–	–	12.9	2.4	5.9	1.7
Esophagus	6.5	5.3	11.8	10.1	1.2	1.0	5.7	4.7
Hodgkin lymphoma	2.2	0.4	0.9	0.6	1.9	0.3	0.5	0.3
Kidney	11.8	4.1	2.5	1.3	5.8	1.7	1.4	0.8
Larynx	5.5	2.4	3.5	2.1	0.6	0.2	0.6	0.4
Leukemia	9.1	4.8	4.5	3.7	6.0	2.9	3.6	2.9
Liver	8.1	7.2	18.9	17.4	2.7	2.5	7.6	7.2
Lung & bronchus	47.4	39.4	27.8	24.6	18.6	13.6	11.1	9.7
Melanoma of skin	9.5	1.8	0.7	0.3	8.6	1.1	0.6	0.3
Multiple myeloma	3.3	1.9	0.9	0.8	2.2	1.3	0.7	0.6
Nasopharynx	0.6	0.3	2.1	1.4	0.2	0.1	1.0	0.6
Non-Hodgkin lymphoma	10.3	3.6	4.2	3.0	7.0	2.2	2.8	1.9
Oral cavity	6.9	2.3	4.6	2.7	2.4	0.6	2.6	1.5
Other pharynx	4.4	2.2	3.0	2.5	0.8	0.3	0.8	0.6
Ovary	–	–	–	–	9.4	5.1	5.0	3.1
Pancreas	8.2	7.9	2.7	2.5	5.4	5.1	2.1	2.0
Prostate	62.0	10.6	12.0	5.6	–	–	–	–
Stomach	16.7	10.4	21.1	16.0	7.3	4.7	10.0	8.1
Testis	4.6	0.3	0.8	0.3	–	–	–	–
Thyroid	2.9	0.3	1.0	0.3	9.1	0.4	3.4	0.7
All sites*	300.1	143.9	160.3	119.3	225.5	87.3	138.0	85.4

*Excludes nonmelanoma skin cancer.
Source: GLOBOCAN 2008.

effective treatment (poor prognosis), such as esophagus, liver, lung, and pancreatic cancer, survival rates vary little between developing and developed countries. In addition to differences in screening and treatment, international differences in cancer survival rates are also affected by differences in detection practice, awareness, and data quality.

How Is Cancer Staged?

Staging describes the extent or spread of the disease at the time of diagnosis. It is essential in determining the choice of therapy and in assessing prognosis. Stage is based on the primary tumor's size and location and whether it has spread to other areas of the body. A number of different staging systems are used to classify tumors. The TNM staging system assesses tumors in three ways: size and extent of the primary tumor (T), absence or presence of regional lymph node involvement (N), and absence or presence of distant metastases (M).[6] Once the T, N, and M are determined, a stage of I, II, III, or IV is assigned, with stage I being early stage and stage IV being advanced. Summary staging (in situ, local, regional, and distant) is the most simplistic way to categorize how far a cancer has spread from its point of origin. It is useful for historical descriptive and statistical analysis of tumor registry data. If cancer cells are present only in the layer of cells where they originated and have not penetrated the basement membrane of the tissue, the stage is in situ; otherwise, it is invasive. Stage is categorized as local if cancer cells are confined to the organ of origin, regional if the cells have spread beyond their original (primary) site to nearby lymph nodes or tissues, and distant if they have spread from the primary site to distant organs or distant lymph nodes. However, as the molecular properties of cancer have become better understood, prognostic models have been developed for some cancer sites that incorporate biological markers and genetic features in addition to summary stage and tumor characteristics.

Table 5. Five-year Relative Survival Rates*(%) for Selected Cancers among Individuals† Aged 15 and Older in Select Countries

	United States (1999-2006)	England (1995-1999)	Demark (1995-1999)	Austria (1995-1999)	Poland (1995-1999)	Belgium (1995-1999)	Germany (1995-1999)
Brain	26.1	17.6	18.1	20.8	19.8	22.7	22.6
Breast (female)	89.0	77.3	77.5	80.0	73.7	77.3	78.3
Colorectal	65.0	50.5	49.3	58.1	38.8	57.4	57.5
Esophagus	17.0	9.9	5.2	10.6	7.6	19.0	19.2
Hodgkin lymphoma	84.2	78.6	79.6	79.6	78.4	83.5	—
Kidney	68.4	45.6	45.1	68.1	53.8	58.8	64.9
Larynx	61.3	63.9	59.1	63.6	47.9	58.7	58.5
Leukemia	50.1	42.3	45.1	32.7	32.6	42.1	46.7
Liver	13.8	7.7	—	9.1	7.9	11.5	8.1
Lung, bronchus, and trachea	15.8	8.4	7.9	14.4	9.2	16.5	13.2
Melanoma of the skin	91.4	84.6	85.1	82.7	63.0	77.9	83.4
Multiple myeloma	38.2	30.6	28.4	30.1	23.1	46.7	28.8
Non-Hodgkin lymphoma	67.1	50.7	49.4	50.6	40.2	56.5	56.6
Oral cavity	60.8	53.6	45.9	40.3	36.7	41.5	60.7
Ovary	45.2	30.2	32.3	44.9	31.0	40.5	36.9
Pancreas	5.6	4.4	2.9	6.8	5.2	9.6	5.7
Prostate	99.1	69.7	47.7	86.7	60.5	83.3	81.6
Stomach	25.9	16.1	14.4	30.3	14.4	31.5	27.5
Testis	95.4	89.7	90.2	88.2	—	92.7	—
Thyroid	97.3	77.6	76.0	84.9	82.3	72.9	84.3
Urinary bladder	79.3	72.4	68.9	77.8	61.2	69.6	78.2
Uterine cervix	70.2	59.1	64.0	63.7	51.5	65.1	60.5
Uterine corpus	83.8	75.2	82.5	78.4	72.7	76.9	76.8
All sites	65.9	46.2	—	56.1	38.6	54.2	52.3

	Spain (1995-1999)	Switzerland (1995-1999)	Slovenia (1995-1999)	China (1990-2001)	India (1990-2001)	South Korea (1990-2001)	Thailand (1990-2001)	Uganda (1990-2001)
Brain	17.1	21.2	15.6	—	—	—	—	—
Breast (female)	80.3	82.0	71.9	82.0	52.0	79.0	63.0	46.0
Colorectal	53.6	59.9	44.2	44.0	28.0	60.0	35.0	8.0
Esophagus	9.7	12.8	7.0	—	—	—	—	—
Hodgkin lymphoma	80.1	83.1	82.5	—	—	—	—	—
Kidney	58.9	56.5	53.1	—	—	—	—	—
Larynx	63.8	61.5	64.8	68.0	28.0	62.0	36.0	—
Leukemia	44.6	50.2	41.3	—	—	—	—	—
Liver	11.5	11.0	3.4	—	—	—	—	—
Lung, bronchus, and trachea	10.7	13.9	8.8	21.0	7.0	20.0	9.0	0.0
Melanoma of the skin	83.7	89.5	79.6	—	—	—	—	—
Multiple myeloma	34.0	35.9	33.2	—	—	—	—	—
Non-Hodgkin lymphoma	51.9	55.6	55.7	—	—	—	—	—
Oral cavity	50.6	43.7	41.4	67.0	37.0	52.0	36.0	—
Ovary	36.9	38.6	33.4	56.0	25.0	59.0	47.0	9.0
Pancreas	5.3	4.4	2.2	—	—	—	—	—
Prostate	75.4	82.3	58.2	—	—	—	—	—
Stomach	27.8	27.2	20.7	39.0	6.0	49.0	12.0	0.0
Testis	94.9	91.0	76.2	—	—	—	—	—
Thyroid	82.0	85.6	88.5	—	—	—	—	—
Urinary bladder	73.7	64.0	56.5	78.0	39.0	76.0	48.0	—
Uterine cervix	62.7	68.2	63.5	67.0	46.0	79.0	61.0	13.0
Uterine corpus	73.1	78.7	77.0	—	—	—	—	—
All sites	49.3	55.0	41.5	—	—	—	—	—

* Survival rates are age standardized. Variations in survival rates across countries reflect differences in detection practice, availability of treatment, and data quality.
† Survival rates for Asia and Africa are for persons age 0-74.
— Data not available.

Sources: United States – Surveillance, Epidemiology, and End Results (SEER) Program (www.seer.cancer.gov) SEER*Stat Database: Incidence - SEER 17 Regs Research Data + Hurricane Katrina Impacted Louisiana Cases, Nov 2009 Sub (1973-2007 varying) - Linked To County Attributes - Total U.S., 1969-2007 Counties, National Cancer Institute, DCCPS, Surveillance Research Program, Cancer Statistics Branch, released April 2010, based on the November 2009 submission. **Europe –** Sant M et al.[53] **Asia & Africa –** Sankaranarayanan R. et al.[44]

Information on stage at diagnosis is not available for most parts of the world. Table 6 illustrates the wide variation in stage at diagnosis for cancer of the uterine cervix among patients in cancer hospitals in different cities around the world. Only about 17% of women diagnosed with this cancer in Cape Town, South Africa and Zagreb, Croatia had early stage disease (stage I), compared to more than 60% in Amsterdam, Netherlands and Carlton, Australia.

What Are the Costs of Cancer?

In addition to the human toll of cancer, the financial cost of cancer is substantial. The direct costs include payments and resources used for treatment, as well as the costs of care and rehabilitation related to the illness. Indirect costs include the loss of economic output due to days missed from work (morbidity costs) and premature death (mortality costs). There are also hidden costs of cancer, such as health insurance premiums and nonmedical expenses (transportation, child or elder care, housekeeping assistance, wigs, etc.).[7] Recent research has shown that cancer has the most devastating economic impact of any cause of death in the world.[8] Data limitations do not allow estimating the worldwide economic costs of cancer. However, portions of the total costs of cancer have been estimated to be as high as $895 billion (US) worldwide.[8-9] The costs of cancer are staggering, and with the growth and aging of the population, prevention efforts are important to help reduce new cancer cases, human suffering, and economic costs.

Interventions for Cancer Prevention and Control

Each year on February 4, the International Union Against Cancer (UICC) leads a World Cancer Day in order to raise awareness of cancer prevention. In response to the urgency of the rising incidence of cancer, World Health Organization (WHO) member states approved a resolution on cancer prevention and control in 2005 at the 58th World Health Assembly in Geneva.[10] In addition, at the World Cancer Congress in 2006 in Washington D.C., the global cancer community united behind a call for urgent action to deal with the growing worldwide cancer burden by launching the first World Cancer Declaration, which outlines the steps needed to begin to reverse the global cancer crisis by 2020.[11] A balanced approach to cancer control includes prevention, early detection, and effective treatment.[12] Successful national cancer control policies and programs raise awareness of cancer, reduce exposure to cancer risk factors, provide information and support for the adoption of healthy lifestyles, and increase the proportion of cancers detected early. The WHO emphasizes that, when developing national strategies for controlling cancer, countries should consider the following four broad approaches based on their economic development.[4]

Table 6. Stage Distribution (%) for Cervical Cancer in Selected Countries among Patients Treated in 1999-2001

	Stage I	Stage II	Stage III	Stage IV
Argentina (Buenos Aires)	46.5	39.5	10.0	4.0
Australia (Carlton)	61.5	14.3	15.4	6.6
Brazil (Sao Paolo)	52.6	26.2	19.4	1.8
Canada (Montreal)	55.0	26.1	8.1	9.9
China (Guangzhou)	36.4	42.5	17.9	0.9
Thailand (Bangkok)	32.6	30.7	32.8	2.4
Croatia (Zagreb)	17.0	38.0	35.3	9.7
Poland (Warsaw)	22.0	36.1	36.8	3.8
Peru (Arequipa)	25.2	30.4	29.6	14.8
Netherlands (Amsterdam)	60.4	21.2	14.0	4.4
South Africa (Cape Town)	16.6	25.0	43.0	15.5
United States (Nashville)	57.0	20.6	17.8	2.8

Percentages do not sum to 100 because there are cases for which stage is unknown.

Source: Quinn MA, Benedet JL, Odicino F et al. Carcinoma of the Cervix Uteri. 26th Annual Report on the Results of Treatment in Gynecological Cancer. *Int Gynecol Obst*.2006;95(Suppl 1):S43-S103.

Primary prevention. The goal of primary prevention is to reduce or eliminate exposure to cancer-causing factors, which include modifiable factors related to tobacco use, nutrition, physical inactivity, occupational exposures, and chronic infections. Primary prevention offers the greatest public health potential and the most cost-effective, long-term method of cancer control. Approaches to primary prevention include immunization against, or treatment of, infectious agents that cause certain cancers; application of effective tobacco control measures; reduction of excessive alcohol consumption; maintenance of healthy body weight and physically active lifestyles; dietary intervention; avoidance of excess sun exposure; reduction in occupational exposure to carcinogens; and pharmacological intervention.

The Framework Convention on Tobacco Control (FCTC), the first health treaty negotiated under the auspices of the WHO, was promulgated in May 2003 in response to the global tobacco pandemic with the objective of substantially reducing the worldwide prevalence of tobacco use and exposure to tobacco smoke. The FCTC provides a framework for national legislation and enforcement of tobacco control measures. As of October 2010, 168 out of 195 eligible countries had ratified the treaty. FCTC provisions establish international standards for tobacco taxation; tobacco advertising and sponsorship; regulation of tobacco products; tobacco product disclosure; packaging and labeling; education, communication, training, and public awareness; cessation measures; measures to eliminate illicit trade; sales to minors; support for economically viable alternatives; liability issues; and scientific and technical cooperation and exchange of information.[13]

In order to combat chronic diseases, such as cancer, related to unhealthy diets and physical inactivity, the WHO adopted the Global Strategy on Diet and Physical Activity in 2004. The four main objectives of the strategy are: 1) Reduce risk factors for chronic diseases that stem from unhealthy diet and physical inactivity through public health actions. 2) Increase awareness and understanding of the influences of diet and physical activity on health and the positive impact of preventive interventions. 3) Develop, strengthen, and implement global, regional, national policies and action plans to improve diets and increase physical activity that are sustainable, comprehensive, and actively engage all sectors. 4) Monitor science and promote research on diet and physical activity.[14]

Early detection and secondary prevention. The main objective of early detection or secondary prevention through screening is to detect precancerous changes or early stage cancers when they can be treated most effectively. Early detection is only valuable if it leads to timely diagnostic follow-up and effective treatment. Strategies for early detection through screening include: 1) opportunistic screening requested sporadically by a physician or an individual or 2) organized screening in which a defined population is contacted and invited to be screened at regular intervals. In practice, many cancer screening programs have elements of each of these approaches.[15] Cancers that have proven early detection methods include cervix, colon and rectum, and breast. However, wide implementation of screening for these cancers has not been fully achieved even in economically developed countries. The Institute of Medicine of the National Academies recommends that low-resource countries that cannot afford the infrastructure required for organized screening programs should focus on increasing awareness of signs and symptoms of cancer in the general population leading to earlier diagnosis and treatment.[16] In developing countries, cervical cancer is one of the most important health problems for women. The WHO provides a variety of resources to assist countries with comprehensive cervical cancer control program implementation.[17] If Pap test screening for cervical cancer is considered in developing countries, it should focus primarily on women between the ages of 35 and 50 years since these women are generally at highest risk of developing the disease or precancerous lesions.[18] Once-in-a-lifetime screening between the ages of 35 and 40 can reduce lifetime cervical cancer risk by 25% to 35%.[19] New low-tech methods of screening for cervical cancer with direct visualization, acetic acid, and oftentimes immediate treatment, may be cost-effective in developing countries.[20]

Diagnosis and treatment. Cancer diagnosis, including careful clinical and pathological assessments, is the first step to cancer management. Once a diagnosis is confirmed, it is necessary to determine cancer stage, where the main goals are to aid in the choice of therapy, to determine prognosis, and to standardize the design of research treatment protocols. The primary modalities of cancer treatment are surgery, chemotherapy, and radiotherapy; these may be used alone or in combination. There is increasing emphasis worldwide on the development of specialized cancer centers that apply evidence-based multimodal therapies and provide rehabilitation and palliative care. The International Atomic Energy Agency has created a Programme of Action for Cancer Therapy that helps developing countries fight cancer by integrating radiotherapy into sustainable comprehensive cancer control programs.[21]

Palliative care. In most parts of the world, the majority of cancer patients are diagnosed with advanced-stage disease. For these patients, the only realistic treatment option is pain relief and palliative care. The most basic approach to palliative care for terminally ill cancer patients, especially in low-resource settings, involves using inexpensive oral pain medications ranging from aspirin to opiates, depending on individual patient needs.

Unfortunately, sufficient supplies of opioid drugs for use in palliative care are often not available in developing countries because of regulatory or pricing obstacles, lack of knowledge, or false beliefs. The WHO has developed guidelines for cancer pain management based on the three-step analgesic ladder. These steps comprise a sequential approach according to the individual pain intensity, which begins with non-opioid analgesics and progresses to opioids for moderate pain and then for severe pain. In many countries, national drug laws have been evaluated and found to interfere with cancer pain relief. In many developing countries, cancer pain management is also limited by geographical barriers, medical infrastructure, and financial resources. In some countries, stringent regulations and negative perceptions associated with heroin trafficking further limit appropriate medical use of opioids. The WHO also elaborated on guidelines for assessing national drug policies to ensure the availability of opioids for medical and scientific use, while at the same time safeguarding against abuse and diversion.[22] The WHO has played an important role in encouraging effective pain management and monitoring the availability of opioids internationally.[23] When available and appropriate surgery, chemotherapy, and radiotherapy may also be used as part of palliative care. Radiotherapy in particular is often used for pain relief without curative intent.[24-25]

SELECTED CANCERS

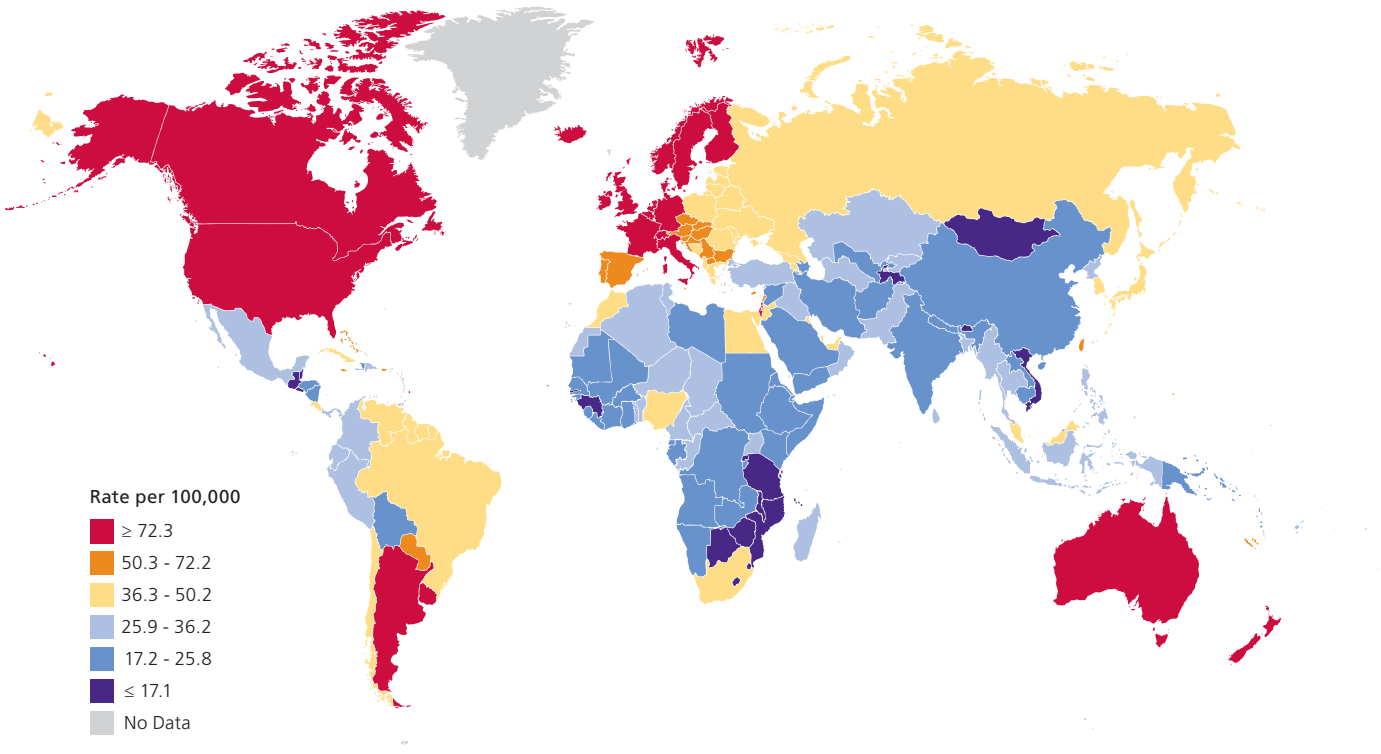
Female Breast

New cases: Breast cancer is the most frequently diagnosed cancer in women worldwide with an estimated 1.4 million new cases in 2008. About half of these cases occured in economically developing countries. Female breast cancer incidence rates varied internationally by more than 13-fold in 2008, ranging from 8.0 cases per 100,000 in Mongolia and Bhutan to 109.4 per 100,000 in Belgium (Figure 4). This may in part reflect low screening rates and incomplete reporting in developing countries. Rates were generally high in North America, Australia, and Northern and Western Europe; intermediate in Eastern Europe; and low in large parts of Africa and Asia (with the exception of Israel).

Deaths: An estimated 458,400 breast cancer deaths occurred in women in 2008. Breast cancer is the leading cause of cancer death among women worldwide.

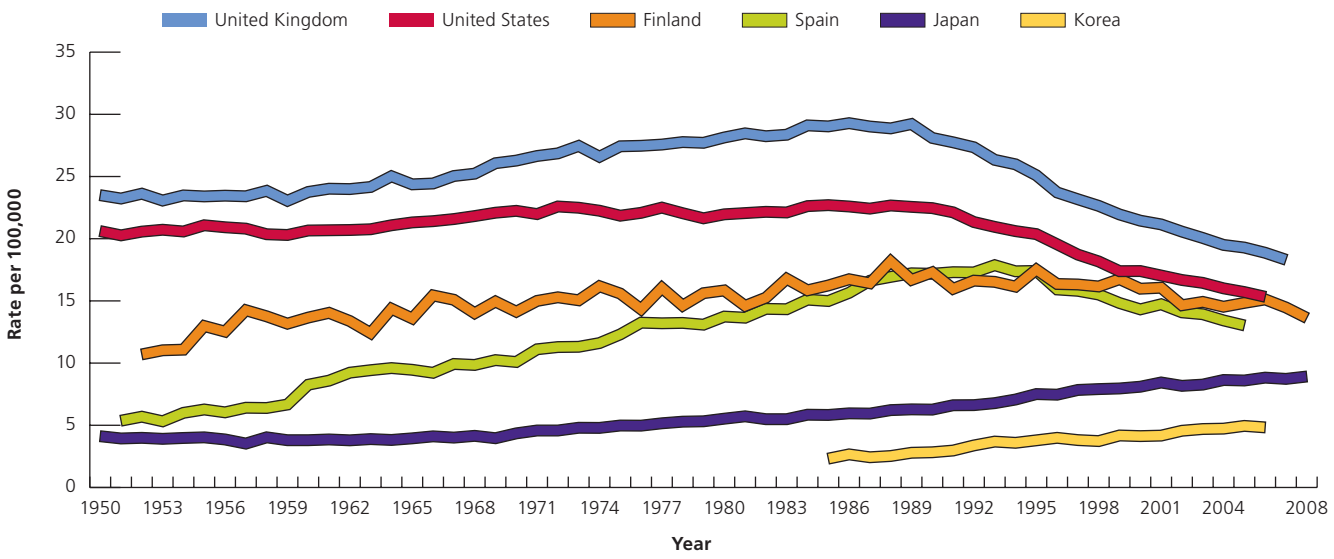
Global trends: Between 1980 and the late 1990s, breast cancer incidence rates rose approximately 30% in westernized countries because of changes in reproductive patterns and more recently because of increased screening.[26] However, incidence rates in the United States decreased between 1999 and 2006, in part due to lower use of postmenopausal combined hormone therapy.[27-29] Similar trends have also been noted in other Western countries including the United Kingdom, France, and Australia.[30-32] Breast cancer incidence rates have been rising in many African and Asian countries including Japan, where rates increased more than 140% in the Miyagi registry during the time period 1973-1977 through 1998-2002, and India, where rates increased 40% in the Chennai registry between 1983-1987 and 1998-2002.[33] Reasons for these rising trends are not completely understood but likely reflect changes in reproductive patterns, obesity, physical inactivity,[34] and some breast cancer screening activity. Although breast cancer incidence rates continued to increase through the late 1990s, breast cancer mortality over the past 25 years has been stable or decreasing in some North American and European countries (Figure 5). These reductions have been attributed to early detection through mammography and improved treatment.[26] In contrast, mortality rates continue to increase in many Asian countries such a s Japan and Korea (Figure 5) most likely due to lifestyle changes associated with westernization and delayed introduction of effective breast cancer screening programs.[35]

Figure 4. International Variation in Age-standardized Breast Cancer Incidence Rates, 2008



Source: GLOBOCAN 2008.

Figure 5. Trends in Age-standardized Female Breast Cancer Death Rates in Select Countries



Source: WHO Mortality Database.

Signs and symptoms: Early stage breast cancer typically produces no symptoms. When breast cancer has grown to a size that it can be felt, the most common physical sign is a painless mass. Less common signs and symptoms include breast pain and persistent changes to the breast, such as thickening, swelling, skin irritation or distortion, and nipple abnormalities such as spontaneous discharge, erosion, inversion, or tenderness. All women should become familiar with both the appearance and feel of their breasts so they can promptly report any changes to a doctor or nurse.[36]

Risk factors: Aside from being female, age is the most important factor affecting breast cancer risk. Risk is also increased by inherited mutations in breast cancer susceptibility genes BRCA1 and BRCA2, a personal or family history of breast cancer, high breast tissue density (a mammographic measure of the amount of glandular tissue relative to fatty tissue in the breast), biopsy confirmed hyperplasia of breast tissue (especially atypical hyperplasia), and high-dose radiation to the chest as a result of medical procedures.[37-40] The primary factors that contribute to the striking international variation in incidence rates include differences in reproductive and hormonal factors. Reproductive factors that increase risk include a long menstrual history (menstrual periods that start earlier and/or end later in life), never having children, recent use of oral contraceptives, and having one's first child after age 30.[41] Some potentially modifiable factors that increase risk include being overweight or obese after menopause, use of menopausal hormone therapy (MHT) (especially combined estrogen and progestin therapy), physical inactivity, and consumption of one or more alcoholic beverages per day. Being overweight also adversely affects survival after a diagnosis of breast cancer for postmenopausal women. Breast feeding, moderate or vigorous physical activity, and maintaining a healthy body weight are all associated with a lower risk of breast cancer.

Prevention and early detection: The best available strategy to reduce the risk of developing breast cancer is to reduce known risk factors as much as possible by maintaining a healthy body weight, increasing physical activity, and minimizing alcohol intake. Methods for early detection of breast cancer include screening by mammography and clinical breast examination. Mammography is especially valuable as an early detection tool because it can identify breast cancer at a stage when treatment may be more effective. Numerous studies have shown that early detection saves lives and increases treatment options. However, implementation of population-based, organized mammography screening programs may be cost prohibitive in many developing countries and is only recommended for countries with good health infrastructure that can afford long-term screening programs.[42] Therefore, the recommended early detection strategies for low- and middle-income countries are awareness of early signs and symptoms and screening by clinical breast examination.[43]

Treatment: Taking into account tumor size, stage, other clinical characteristics, and patient preference, treatment may involve lumpectomy (surgical removal of the tumor with clear margins) or mastectomy (surgical removal of the breast) with removal of some of the axillary (underarm) lymph nodes to obtain accurate information on stage of disease; radiation therapy; chemotherapy (before or after surgery); hormone therapy; or targeted biologic

therapy. Two or more methods are often used in combination. Numerous studies have shown that, unless cancer has spread to the skin, chest wall, or distant organs, long-term survival rates after lumpectomy plus radiation therapy are similar to survival rates after modified radical mastectomy. Effective breast cancer treatment for women in low- and middle-income countries may be limited by the small numbers of trained medical personnel, insufficient modern equipment including radiotherapy machines, and the high cost of cancer drugs.[43]

Survival: The five-year survival rate from breast cancer among women age 15 and older is 89% in the United States, 82% in Switzerland, and 80% in Spain (Table 5). Breast cancer survival rates in developing countries are generally lower than in Europe and North America, with rates as low as 38.8% in Algeria (Setif), 36.6% in Brazil (Campinas), and 12% in Gambia.[5, 44] The stage at diagnosis is the most important prognostic variable. For instance, the overall five-year relative survival among US women diagnosed with breast cancer at early stage is 98%, compared to 84% and 23% when the disease is spread to regional lymph nodes or distant organs, respectively.[45]

Colon and Rectum

New cases: Colorectal cancer is the third most common cancer in men and the second in women. Worldwide, an estimated 1.2 million cases of colorectal cancer occured in 2008. The highest incidence rates were in North America, Australia, New Zealand, Europe, and Japan (Figures 6a and 6b). Rates were low in Africa and South Central Asia. Rates were substantially higher in men than in women.

Deaths: About 608,700 deaths from colorectal cancer occured in 2008 worldwide, accounting for 8% of all cancer deaths.

Global trends: The incidence of colorectal cancer is increasing in certain countries where risk was historically low (Japan).[46] In high-risk/high-income countries, trends are either gradually increasing (Finland, Norway), stabilizing (France, Australia), or declining (United States) with time. The greatest increases in the incidence of colorectal cancer are in Asia (Japan, Kuwait, Israel) and Eastern Europe (Czech Republic, Slovakia, Slovenia). In fact, rates among males in the Czech Republic, Slovakia, and Japan have not only exceeded the peak rates observed in long-standing developed countries such as the United States, Canada, and Australia but they continue to increase.[46] In contrast to the stabilizing rates observed in most Western and Northern European countries, relatively large increases have been observed in Spain, which may be related to the increasing prevalence of obesity in recent years in that country.[47] The decrease in colorectal cancer incidence in the United States partially reflects the increase in detection and removal of precancerous lesions;[29] the increase in several Asian and Eastern European countries may reflect changes in risk factors for colorectal cancer that are associated with westernization such as elevated obesity and smoking prevalence.[48] In contrast to incidence trends, decreasing colorectal cancer mortality rates have been observed in a large number of countries worldwide and are most likely attributed to colorectal cancer screening and/or improved treatments. However, increases in mortality rates are still occurring in countries that have more limited resources, including Mexico and Brazil in South America and Romania and Russia in Eastern Europe.[48]

Signs and symptoms: Early stage colorectal cancer is often asymptomatic. Advanced disease may cause rectal bleeding, blood in the stool, a change in bowel habits, and cramping pain in the lower abdomen. In some cases, blood loss from the cancer leads to anemia (low red blood cells), causing symptoms such as weakness and excessive fatigue.

Risk factors: The risk of colorectal cancer increases with age. In developed countries, more than 90% of cases are diagnosed in individuals older than 50. Risk is also increased by certain inherited genetic mutations (i.e., Lynch syndrome [hereditary non-polyposis colorectal cancer] and familial adenomatous polyposis [FAP]), a personal or family history of colorectal cancer and/or polyps, or a personal history of chronic inflammatory bowel disease. However, lifestyle factors are also important determinants of colorectal cancer risk. Modifiable factors associated with increased risk of colorectal cancer are obesity, physical inactivity, a diet high in red or processed meat, heavy alcohol consumption, and smoking. Studies indicate that men and women who are overweight are more likely to develop and die from colorectal cancer. Consumption of milk and calcium appears to decrease risk. Some studies suggest that regular use of nonsteroidal anti-inflammatory drugs (such as aspirin) and hormones, such as progestin, may reduce colorectal cancer risk. However, these drugs are not recommended for the prevention of cancer because they can have other adverse health effects.

Prevention and early detection: Screening can prevent colorectal cancer through the detection and removal of precancerous lesions. Screening can also detect colorectal cancer at an early stage. The current recommendation for colorectal cancer screening in most countries is to begin screening at age 50 for men and women who are at average risk for developing colorectal cancer. Persons at higher risk should begin screening at a younger age and may need to be tested more frequently.

There are several accepted colorectal cancer screening methods, including fecal occult blood test (FOBT), flexible sigmoidoscopy, double-contrast enema, and colonoscopy. While colonoscopy is a highly sensitive test, it requires a skilled examiner, involves greater cost, and is less convenient and has more risk for the patient.[50] As such, screening using colonoscopy is not feasible in low-resource countries; therefore, FOBT, which is inexpensive and easy to perform, is a more practical screening option in many areas of the world.[48] Country-specific colorectal cancer screening programs, recommendations, and guidelines vary greatly worldwide. While some countries have implemented

Figure 6a. International Variation in Age-standardized Colorectal Cancer Incidence Rates among Males, 2008

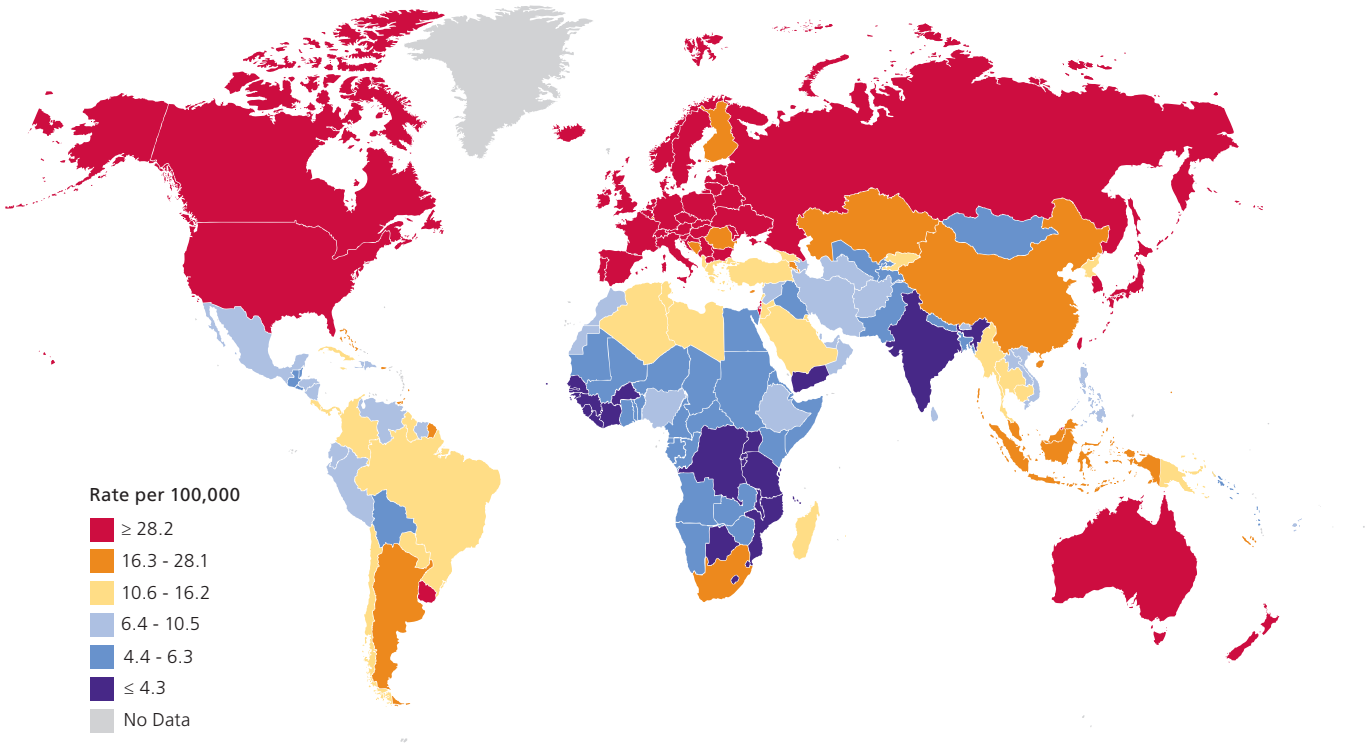
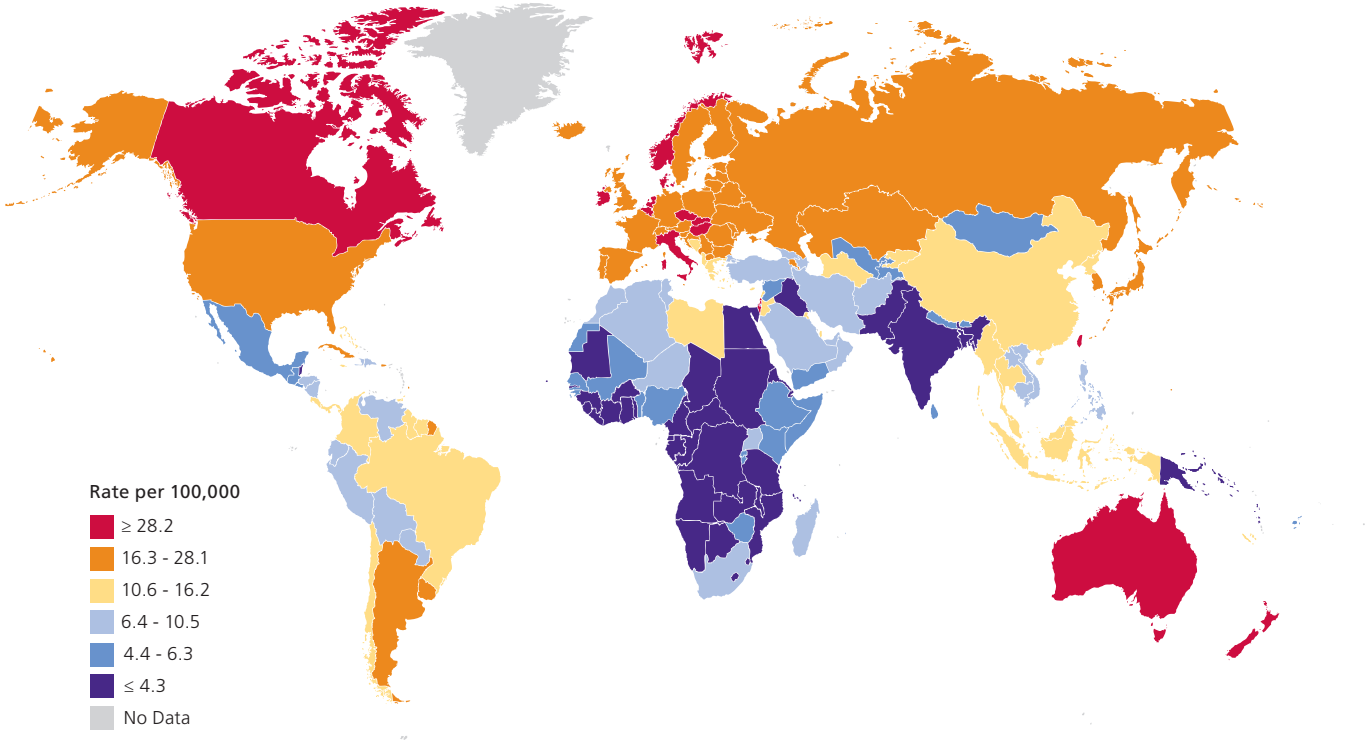


Figure 6b. International Variation in Age-standardized Colorectal Cancer Incidence Rates among Females, 2008



Source: GLOBOCAN 2008.

national screening programs (Czech Republic, Germany, Israel, Japan, Poland, and the United Kingdom), the majority of national colorectal cancer screening initiatives consist of recommendations and/or guidelines with opportunistic screening available.[48, 51] However, ongoing regional research studies and/or pilot studies are in place in many countries (United States, Canada, Belgium, Denmark, France, Italy, Norway, Spain, Switzerland, Australia, Taiwan) with the intent to evaluate the potential for implementing colorectal cancer screening programs.[48] Additionally, studies are conducted to evaluate alternatives to FOBT such as a recent randomized trial in the United Kingdom that reported one-time flexible sigmoidoscopy screening between 55 and 64 years of age reduced colorectal cancer incidence by 33% and mortality by 43%.[52] Colorectal cancer screening initiatives are scarce in Africa, Asia, and South America.

Other preventive measures for colorectal cancer include maintaining a healthy body weight, being physically active, minimizing consumption of red meat and alcohol, and not smoking.[49]

Treatment: Surgery is the most common treatment for colorectal cancer. For cancers that have not spread, surgical removal may be curative. A permanent colostomy (creation of an abdominal opening for elimination of body wastes) is very rarely needed for colon cancer and is infrequently required for rectal cancer. For rectal cancer, chemotherapy alone, or in combination with radiation, is often given before surgery, after surgery, or both. For colon cancer, chemotherapy is most often used after surgery for cancers that have spread to lymph nodes and may also be used for cancers that have invaded the bowel wall.

Survival: Five-year relative survival rates for colorectal cancer vary worldwide. In the United States the overall five-year survival rate for persons with colorectal cancer is 65%.[45] When colorectal cancers are detected at an early stage, the five-year survival rate increases to 90%; however, only 39% of colorectal cancers are diagnosed at this stage, mainly due to underuse of screening. In Europe survival rates range from 38.8% in Poland to 59.9% in Switzerland (Table 5) with the highest rates observed in Western and Northern European countries and the lowest rates observed in Eastern Europe.[53] High five-year relative survival rates are also observed among men diagnosed during 1990-94 in Japan (61.1%), and Australia (56.7%),[5] while survival rates for men diagnosed with colorectal cancer during 1982-1992 in four developing countries – China, India, the Philippines, and Thailand – ranged from 28% to 42%.[54] The lowest reported five-year survival rate is 4% in Gambia.[44]

Lung and Bronchus

New cases: An estimated 1.6 million new cases occurred in 2008, accounting for about 13% of total cancer diagnoses. In men, the highest lung cancer incidence rates were in North America, Europe, Eastern Asia, Argentina, and Uruguay and the lowest rates were in sub-Saharan Africa (Figure 7a). Among women, the highest lung cancer rates were in North America, Northern Europe, Australia, New Zealand, and China (Figure 7b). Despite a lower prevalence of smoking, lung cancer rates in Chinese women (21.3 cases per 100,000 women) were higher than rates among women in some European countries.[55] This is thought to reflect indoor air pollution from unventilated coal-fueled stoves and cooking fumes.[56]

Deaths: Worldwide, lung cancer is the leading cause of cancer death in men and the second leading cause of cancer death in women, with an estimated 951,000 deaths in men and 427,400 deaths in women in 2008.

Global trends: International variations in lung cancer rates and trends largely reflect differences in the stage and degree of the tobacco epidemic.[57-58, 59-60] In several Western countries, where the tobacco epidemic peaked by the middle of the past century, such as the United States, the United Kingdom, and Finland, lung cancer rates have been decreasing in men and plateauing in women[61-62] (Figure 8). In contrast, in countries where the epidemic has been established more recently and smoking has just peaked or continues to increase, such as China, Korea, and several countries in Africa, lung cancer rates are increasing and are likely to continue to increase at least for the next few decades, barring interventions to accelerate smoking cessation and reduce initiation.[57, 63]

Signs and symptoms: Symptoms may include persistent cough, sputum streaked with blood, chest pain, voice change, and recurrent pneumonia or bronchitis.

Risk factors: Cigarette smoking is the most important risk factor for lung cancer, accounting for about 80% of lung cancer cases in men and 50% in women worldwide.[7] Risk increases with quantity and duration of cigarette consumption. Cigar and pipe smoking also increase risk. Other risk factors include secondhand smoke, occupational or environmental exposures to radon and asbestos (particularly among smokers), certain metals (chromium, cadmium, arsenic), some organic chemicals, radiation, air pollution, coal smoke, and indoor emissions from burning other fuels. Genetic susceptibility contributes to risk, especially in those who develop the disease at a younger age.[64-65]

Prevention and early detection: Lung cancer is one of the most preventable cancers. Most lung cancers could be prevented by reducing smoking initiation among adolescents and increasing smoking cessation among adults. This requires a comprehensive tobacco control program that includes raising the price of tobacco products through excise taxes, banning smoking in public places, restricting tobacco advertising and promotion, counter-advertising, and providing treatment and counseling for tobacco dependence. In the United States, comprehensive tobacco control programs in many states have markedly decreased smoking rates and accelerated the reduction in lung cancer occurrence, particularly in California. In the developing

Figure 7a. International Variation in Age-standardized Lung Cancer Incidence Rates among Males, 2008

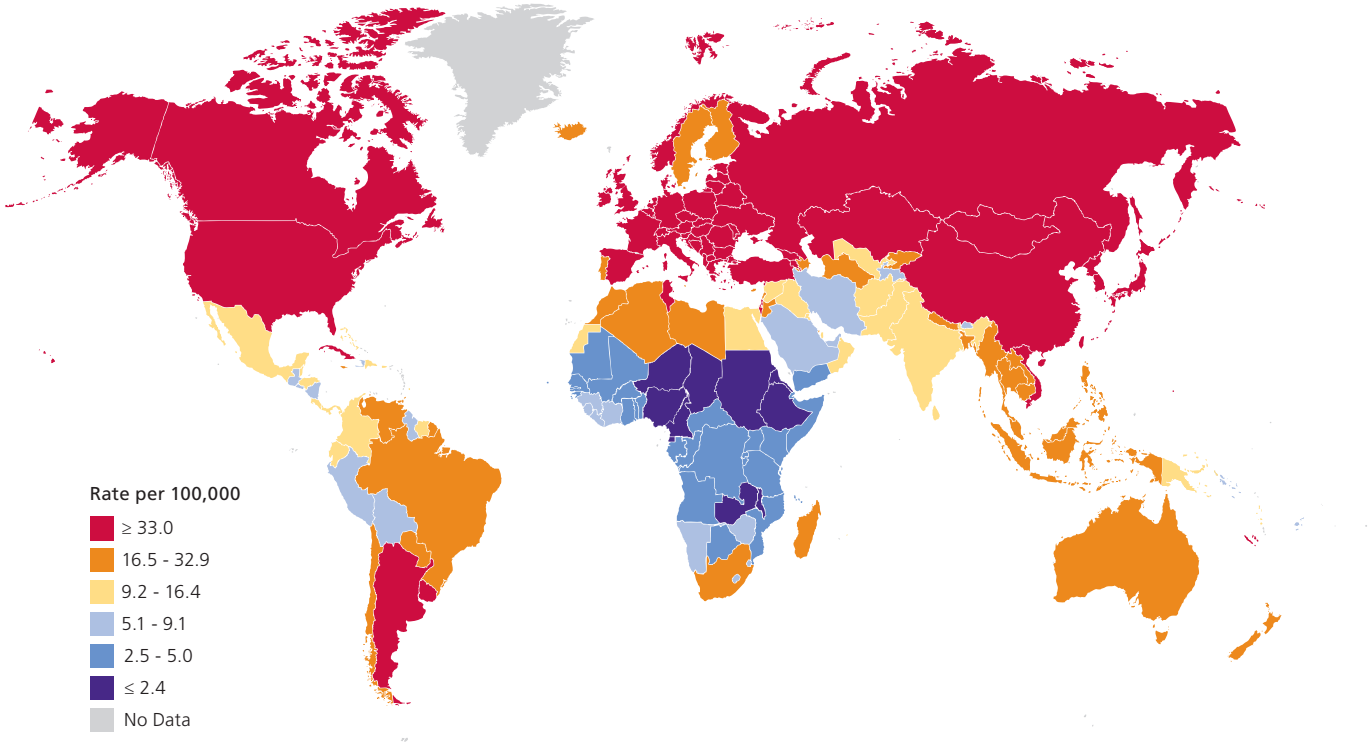
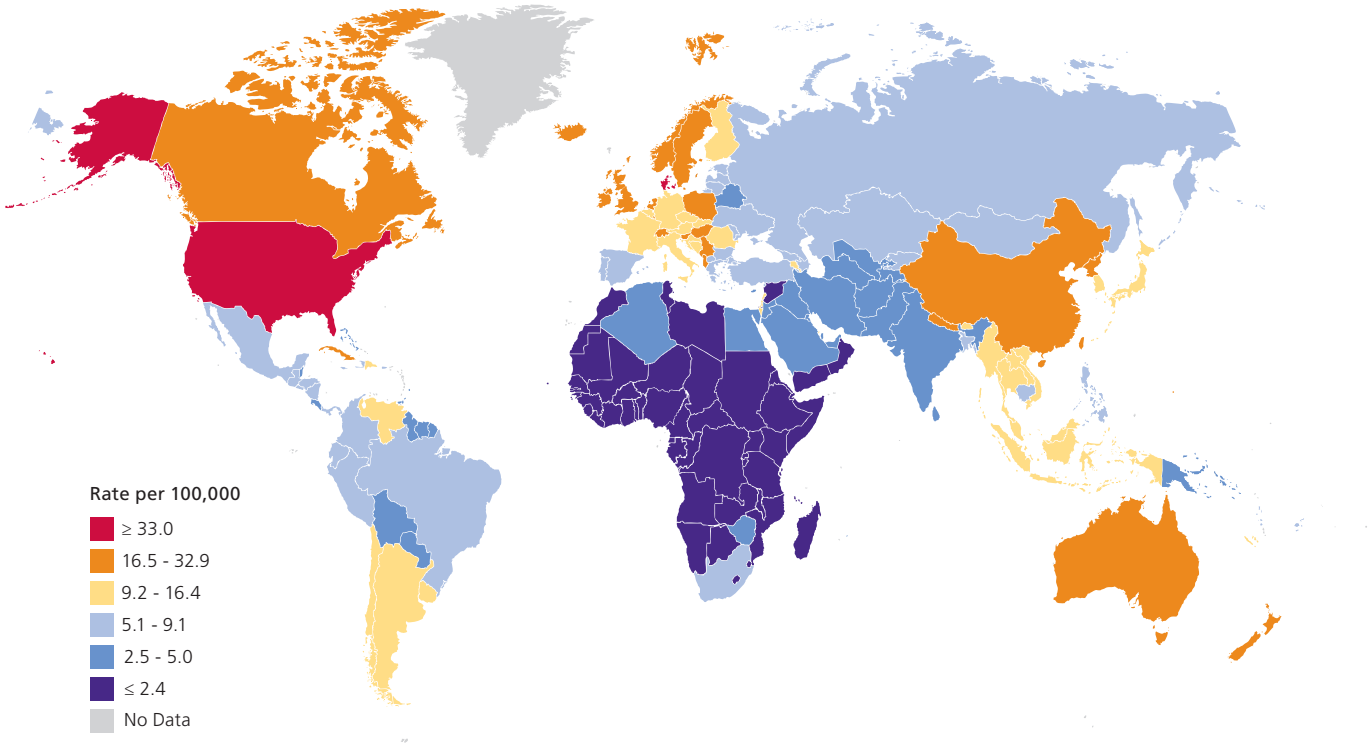
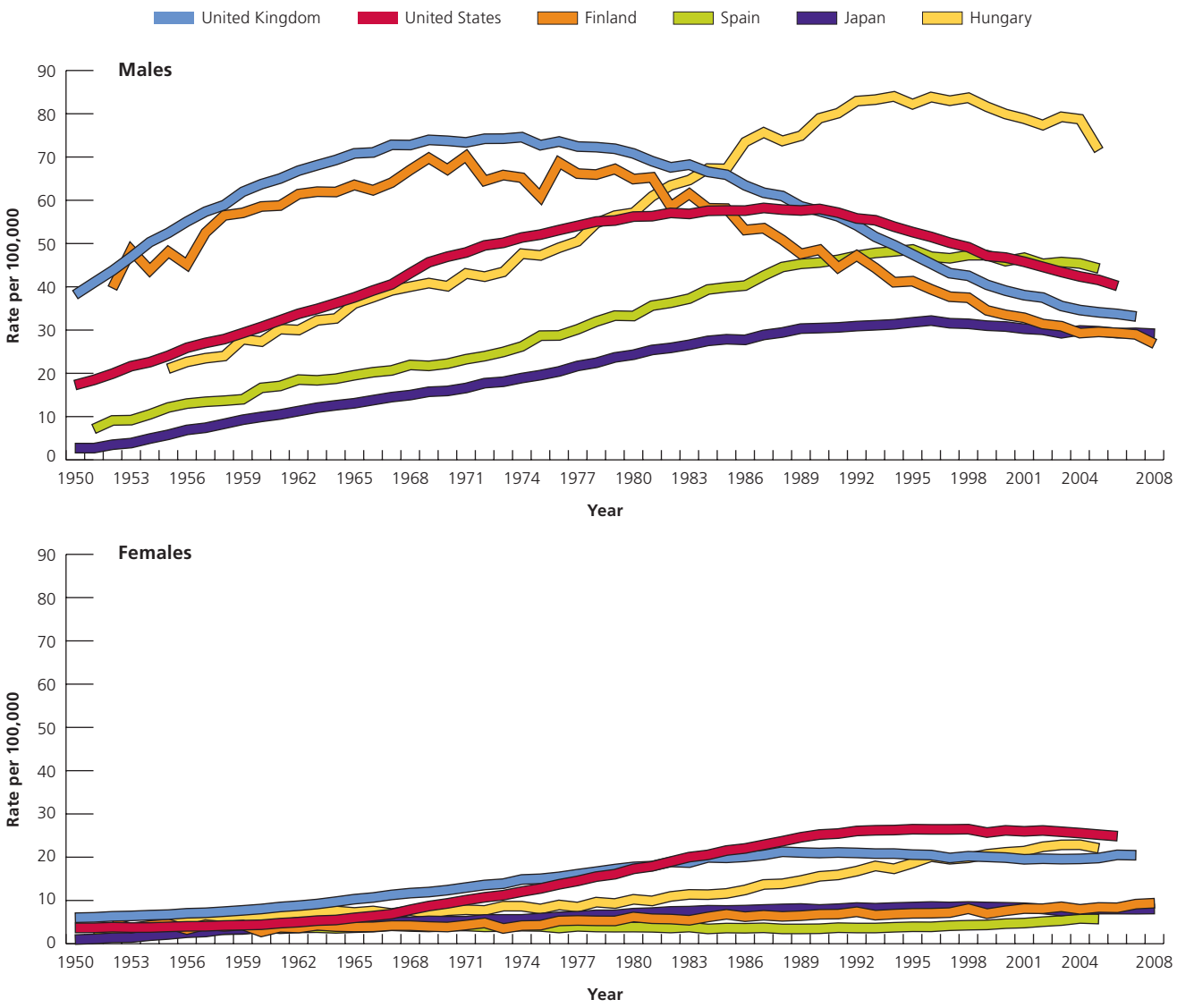


Figure 7b. International Variation in Age-standardized Lung Cancer Incidence Rates among Females, 2008



Source: GLOBOCAN 2008.

Figure 8. Trends in Age-standardized Lung Cancer Death Rates by Sex in Select Countries



Source: WHO Mortality Database.

world, there is a striking difference in smoking prevalence between men (50%) and women (9%).[66] As women have not yet begun to smoke in large numbers in developing countries, preventing increases in smoking prevalence among women could have a major impact on future lung cancer rates and would provide an opportunity to avoid the mistakes made in developed countries where lung cancer rates skyrocketed as a result of the tobacco epidemic.

Screening for early lung cancer detection has not yet been proven to reduce mortality. Chest x-ray, analysis of cells in sputum, and fiber-optic examination of the bronchial passages have shown limited effectiveness in reducing lung cancer mortality. Newer tests, such as low-dose spiral computed tomography (CT) scans and molecular markers in sputum, have produced promising results in detecting lung cancers at earlier, more operable stages, and preliminary results from a randomized clinical trial have shown reduced lung cancer deaths in high-risk patients.[67] However, there are considerable risks associated with lung biopsy and surgery, and the net benefit of screening in the general population has not been established.

Treatment: Treatment options are determined by the type of lung cancer (small cell, non-small cell) and stage at diagnosis. Treatments include surgery, radiation therapy, chemotherapy, and targeted therapies. For localized cancers, surgery is usually the treatment of choice. Recent studies indicate that survival with early stage non-small cell lung cancer is improved by chemotherapy following surgery. Because the disease has usually spread by the time it is discovered, radiation therapy and

chemotherapy are often used, sometimes in combination with surgery. Chemotherapy alone or combined with radiation is the usual treatment of choice for small cell lung cancer; on this regimen, a large percentage of patients experience remission, though the cancer often returns.

Survival: Despite some improvements in surgical techniques and combined therapies over the past several decades, lung cancer is one of the most lethal cancers. The five-year relative survival rate for all stages combined is about 16% in the United States. The five-year survival rate is 53% for cases detected when the disease is still localized, but only 15% of lung cancers are diagnosed at this early stage.[45] In Europe, five-year survival rates are generally similar to those in the United States, ranging from 7.9% (Denmark) to 16.5% (Belgium) (Table 5).

Prostate

New cases: Prostate cancer is the second most frequently diagnosed cancer in men, with 903,500 new cases estimated to have occured in 2008. Nearly three-quarters of these cases were diagnosed in economically developed countries. Incidence rates of prostate cancer vary by more than 70-fold worldwide. The highest rates are recorded primarily in the developed countries of Europe, North America, and Oceania, largely because prostate specific antigen (PSA) testing is widely used and detects clinically important tumors, as well as other slow-growing cancers that might otherwise have escaped diagnosis. The lowest rates are in many parts of Asia (Figure 9).

Deaths: With an estimated 258,400 deaths in 2008, prostate cancer was the sixth leading cause of cancer death in men worldwide. Men of African descent in the Caribbean region have the highest prostate cancer mortality in the world, with age-standardized rates more than four times higher than those in the US and more than 15 times higher than those in the Middle East and Eastern Asia. The reason for the high prostate cancer risk among some populations of African descent is still poorly understood, though it may in part reflect differences in genetic susceptibility.

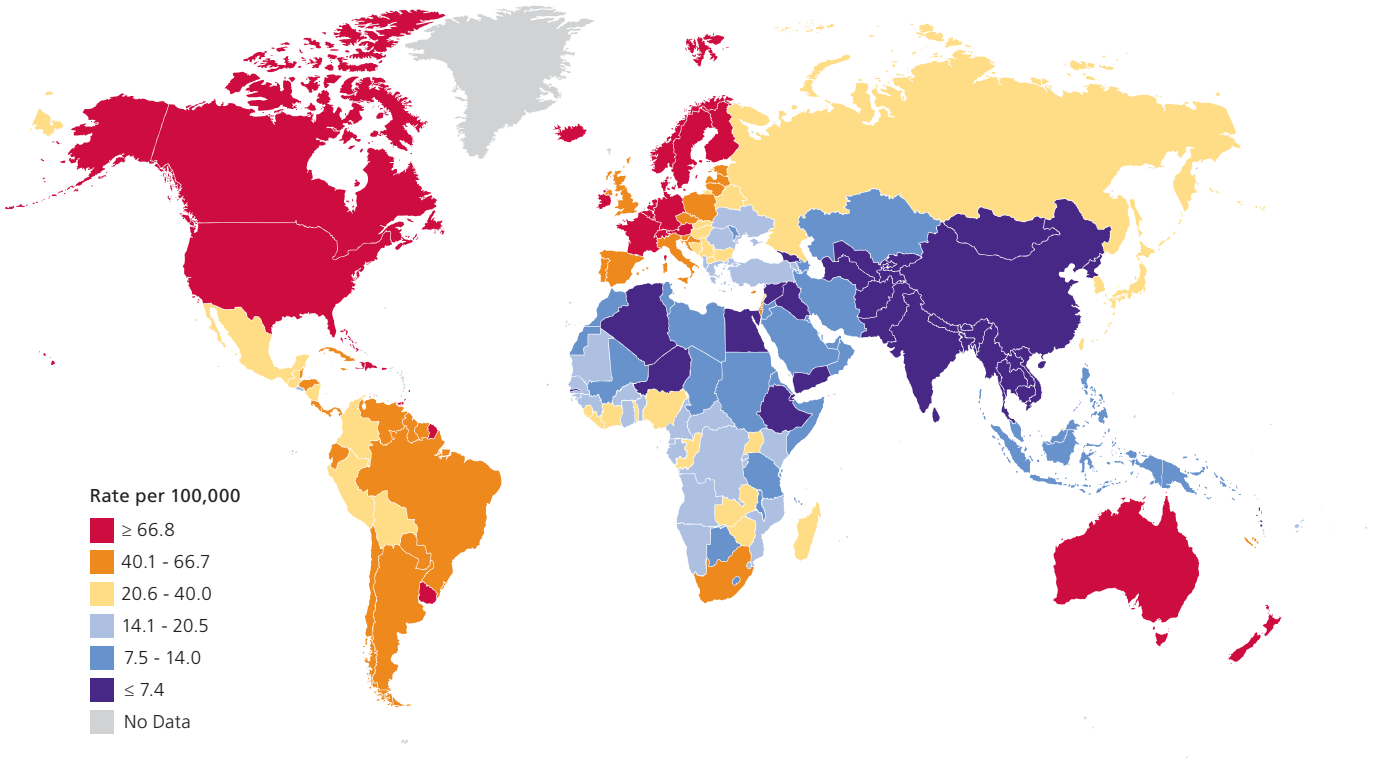
Global trends: Temporal trends in prostate cancer death rates are easier to interpret than trends in incidence rates because they are less affected by changes in PSA screening rates. Incidence trends follow a consistent pattern in countries with higher uptake of PSA, such as Australia, Canada, and the United States, with a rapid rise in incidence in prostate cancer in the early 1990s soon after the introduction of PSA testing followed by a sharp decline. In other high-income countries with low prevalence of PSA testing, such as Japan and the United Kingdom, the dramatic peak in incidence is not observed, though rates continue to increase slightly. Death rates for prostate cancer have been decreasing in many developed countries, including Australia, Canada, Finland, France, Israel, Italy, The Netherlands, Norway, Portugal, Sweden, the United Kingdom, and the United States.[68] In contrast, mortality rates are rising in some Asian and Eastern European countries, such as Japan, Singapore, and Poland. While the decrease in prostate cancer death rates in Western European and North American countries has been attributed mainly to improved treatment, the increase in Asian and Eastern European countries has been thought to reflect westernization, including increased consumption of animal fat, obesity, and physical inactivity.[69]

Signs and symptoms: Early prostate cancer usually has no symptoms. With more advanced disease, individuals may experience weak or interrupted urine flow; inability to urinate or difficulty starting or stopping the urine flow; the need to urinate frequently, especially at night; blood in the urine; or pain or burning with urination. Continual pain in the lower back, pelvis, or upper thighs may be an indication of spread of the disease to the bones. Many of these symptoms, however, are similar to those caused by benign conditions.

Risk factors: The only well-established risk factors for prostate cancer are older age, race (black), and family history of the disease. About 62% of all prostate cancer cases in the United States are diagnosed in men 65 and older. Recent genetic studies suggest that strong familial predisposition may be responsible for 5% to 10% of prostate cancers. Some studies suggest that a diet high in processed meat may also be a risk factor. There is some evidence that the risk of dying from prostate cancer is increased by obesity.

Prevention and early detection: Although modifiable risk factors for prostate cancer are not understood well enough to make definitive recommendations for preventive measures, factors that may reduce risk include maintaining a healthy body weight, getting regular physical activity, and consuming a diet low in animal fat and high in fruits and vegetables. Evidence about the value of testing for early prostate cancer detection is insufficient to recommend for or against screening with PSA for men at average risk.[70] However, PSA is widely used in North America, Australia, and parts of Europe.[71] The American Cancer Society recommends that men who are at average risk of prostate cancer, do not have any major medical problems, and have a life expectancy of at least 10 years receive information about the benefits and limitations of testing for early prostate cancer detection beginning at age 50 and have an opportunity to make an informed decision about testing.[72] Results of two large clinical trials designed to determine the efficacy of PSA testing were recently published. A European study found a lower risk of death from prostate cancer among men receiving PSA screening[73], while a US study did not.[74] Further analyses of these studies are under way.

Figure 9. International Variation in Age-standardized Prostate Cancer Incidence Rates, 2008



Source: GLOBOCAN 2008.

Treatment: Treatment options vary depending on age, stage, and grade of the cancer, as well as other medical conditions. Surgery (open, laparoscopic, or robotic-assisted), external beam radiation, or radioactive seed implants (brachytherapy) may be used to treat early stage disease. Hormonal therapy, chemotherapy, and radiation (or combinations of these treatments) are used for metastatic disease and as a supplemental or additional therapy for early stage disease. Hormone treatment may control prostate cancer for long periods by shrinking the size or limiting the growth of the cancer, thus relieving pain and other symptoms. Careful observation ("watchful waiting" or "active surveillance") rather than immediate treatment may be appropriate for some men with less aggressive tumors, especially older men with limited life expectancy and/or other health considerations.

Survival: Over the past 25 years, a dramatic improvement in survival has been observed, partly attributable to earlier diagnosis of asymptomatic cancers (some of which would never have become clinically evident) and improvements in treatment. The five-year relative survival rate for patients diagnosed with prostate cancer in the United States approaches 100%[45] and in Europe ranges from 48% (Denmark) to 87% (Austria) (Table 5). In sub-Saharan African and Southeast Asia, the five-year survival rate is less than 40% in most countries.[75]

Stomach

New cases: Stomach cancer was the fourth most common malignancy in the world in 2008, with an estimated 989,600 new cases. Approximately 72% of new cases occured in developing countries. Generally, stomach cancer rates are about twice as high in men as in women. Stomach cancer incidence rates vary widely across countries, ranging from less than 1 case (per 100,000) in areas such as Botswana to about 62 in Korea for men and from less than 1 in Botswana to about 26 in Guatemala for women (Figures 10a and 10b). In general, the highest incidence rates are in Asia (particularly in Korea, Japan, and China) and many parts of South America, and the lowest rates are in North America and most parts of Africa with the exception of Mali and Western Sahara.

Deaths: Stomach cancer is the third leading cause of cancer death in men and the fifth leading cause in women. About 738,000 people worldwide died from stomach cancer in 2008.

Global trends: A steady decline in stomach cancer rates has been observed in most developed countries of North America and Europe over the past 50 years, with rates dropping by more than 80%. Similar decreasing trends have been noted in more recent years in areas with historically high stomach cancer

Figure 10a. International Variation in Age-standardized Stomach Cancer Incidence Rates among Males, 2008

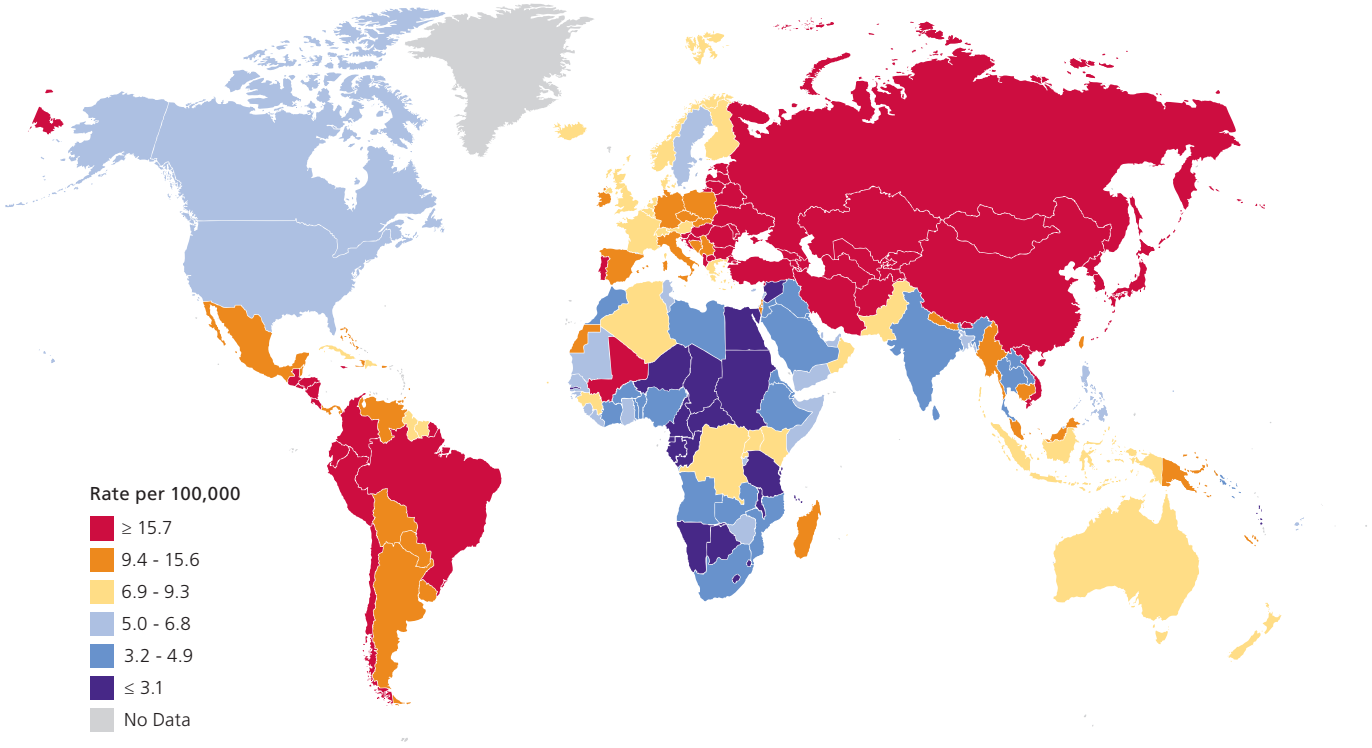
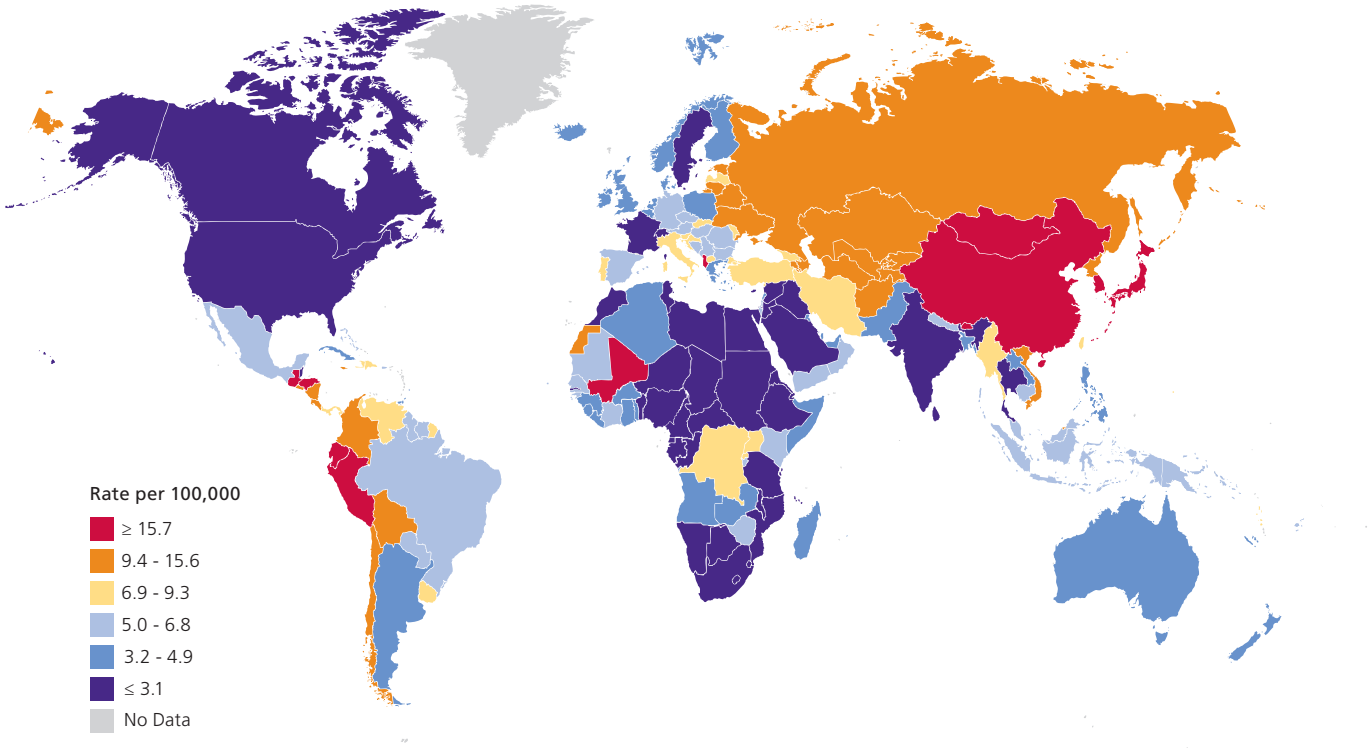


Figure 10b. International Variation in Age-standardized Stomach Cancer Incidence Rates among Females, 2008



Source: GLOBOCAN 2008.

incidence rates, including several countries in Asia (Japan, China, Korea), Latin America (Colombia, Ecuador) and Europe (Ukraine).[76] Factors that have contributed to these remarkable decreases are thought to include increased availability of fresh fruits and vegetables, decreased reliance on salted and preserved foods, reduction in chronic *H. pylori* infection due to sanitation and antibiotics,[3] and increased screening (Japan only).[77] However, a recent study predicted that decreasing stomach cancer rates in China could be discontinued by the tobacco epidemic without interventions that effectively promote smoking cessation.[78]

Signs and symptoms: Stomach cancer has very few symptoms in the early stages, but may include indigestion, a bloated sensation after eating, and heartburn. As it progresses, symptoms may include nausea, abdominal pain or discomfort in the upper abdomen, diarrhea or constipation, bloody stools, vomiting blood, loss of appetite, weight loss, anemia, and feelings of fullness or pressure in the stomach.

Risk factors: More than 50% of new stomach cancer cases can be attributed to *H. pylori* infection.[3] *H. pylori* is a bacterium that colonizes in the stomach. It is not known with absolute certainty how *H. pylori* is transmitted, but the most likely route of spread is from person to person through fecal-oral or oral-oral routes. Possible environmental sources include water contaminated with human waste. Dietary risk factors for stomach cancer include eating diets rich in smoked foods, salted meat or fish, and pickled vegetables. On the other hand, eating fresh fruits and vegetables appears to lower the risk. Smoking also increases risk of stomach cancer, particularly for cancers of the upper portion of the stomach closest to the esophagus. Smokers have a 50% to 60% increased risk for stomach cancer compared to nonsmokers.[79]

Prevention and early detection: The primary prevention strategy for stomach cancer is to reduce known dietary risks by avoiding the intake of foods preserved by salting, pickling, or smoking and increasing consumption of fresh fruits and vegetables. Avoiding *H. pylori* infection by improvement of hygienic conditions may also reduce risk. Antibiotics are sometimes utilized to treat persons with known *H. pylori* infection; however, their effectiveness is suboptimal, and extensive use of antibiotics leads to concerns for the development of antibiotic-resistant strains of *H. pylori*. Stomach cancers are believed to develop slowly over many years, usually beginning with asymptomatic precancerous changes in the lining of the stomach. National stomach cancer screening programs are only available in Japan and Korea, where the disease burden is the highest. This intervention is thought to have contributed to the decrease in stomach cancer death rates in Japan.[77] General population screening is not recommended in low-incidence countries such as the United States where the disease is rare.

Treatment: Cancer of the stomach is difficult to cure unless it is found in an early stage. Unfortunately, because early stomach cancer causes few symptoms, the disease is usually advanced at diagnosis. The main treatments for stomach cancer are surgery, chemotherapy, and radiation therapy. Often the best approach uses two or more of these treatment methods. If a cure is not possible, treatment is aimed at relieving symptoms.

Survival: In the United States, the five-year relative survival rate for stomach cancer is 26%. Survival rates improve to 63% if cancer is detected at early stages of the disease. However, less than 25% of stomach cancers are diagnosed at an early stage in the United States.[45] In contrast, the disease is diagnosed frequently at early stages in Japan due to early detection services. In Osaka, Japan, the five-year relative survival has increased from 32.0% to 50.3% among men and from 26.7% to 47.6% among women between 1975 and 1999.[80] In Europe, the five-year relative survival rate is about 25%, ranging from 14.4% in Poland and Denmark to 30.3% in Austria.[53] In developing countries low survival rates are reported in Thailand (12%), India (6%), and Gambia (3%) (Table 5).[44]

Liver

New cases: Liver cancer is the fifth most common cancer in men and the seventh in women. An estimated 748,300 new liver cancer cases occured in the world during 2008. Nearly 85% of these cases occur in developing countries, with China alone accounting for more than 50% of the total. Rates are more than twice as high in men as in women. Liver cancer rates are the highest in West and Central Africa and in East and Southeast Asia (Figures 11a and 11b). In contrast, incidence rates are generally lowest in developed countries, with the exception of Japan. Among primary liver cancers occurring worldwide, hepatocellular carcinoma (HCC) represents the major histologic type and likely accounts for 70% to 85% of cases.[81] One type of liver cancer (cholangiocarcinoma) that is rare in most parts of the world has high incidence rates in Thailand and other parts of Asia due to the high prevalence of liver fluke infection.

Deaths: Liver cancer is the second leading cause of cancer death in men and the sixth leading cause among women. About 695,500 people worldwide died from liver cancer in 2008.

Global trends: Liver cancer incidence is increasing in areas with historically low rates, including parts of Oceania, Central Europe, and North America.[82,83] In the United States, age-adjusted incidence rates of HCC tripled between 1975 and 2005, rising from 1.6 per 100,000 to 4.9 per 100,000.[82] This increase is thought to be attributed to increases in hepatitis C virus (HCV) infection through injection drug use or possibly obesity.[84] In contrast, liver cancer rates are decreasing in some historically high-risk areas, including China and Singapore, most likely due to reduction in hepatitis B virus (HBV) infection through improved hygiene and sanitation conditions. A decline in liver cancer incidence rates among children and adolescents in Taiwan has occurred as a result of a universal HBV childhood vaccination program that was initiated in 1984.[85] However, HBV vaccination programs

Figure 11a. International Variation in Age-standardized Liver Cancer Incidence Rates among Males, 2008

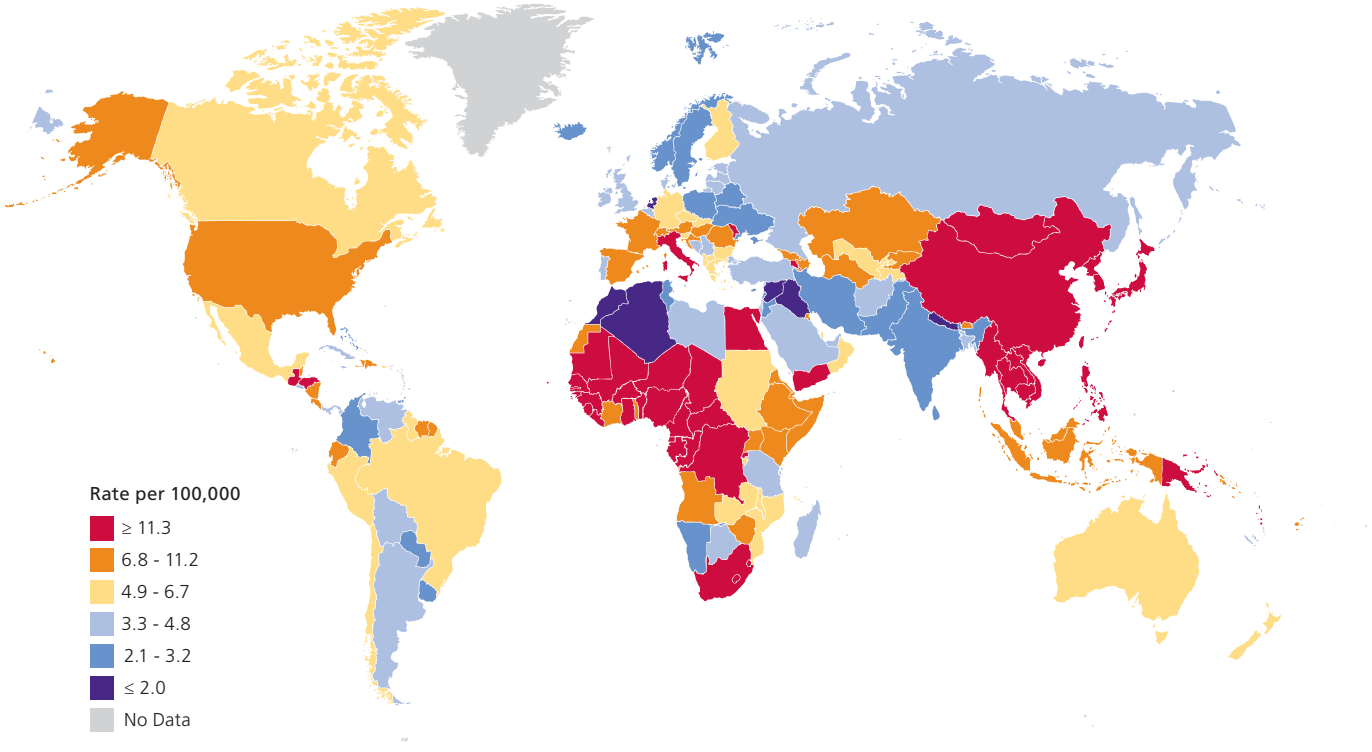
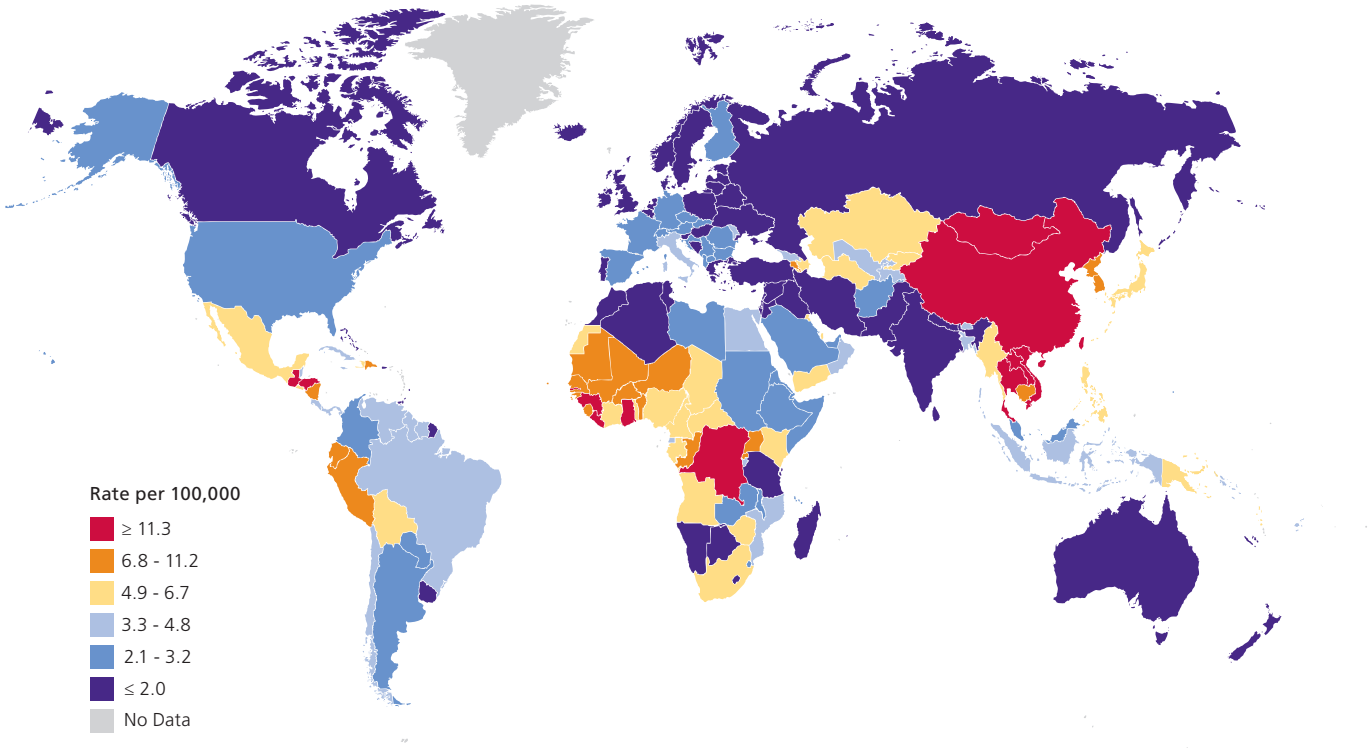
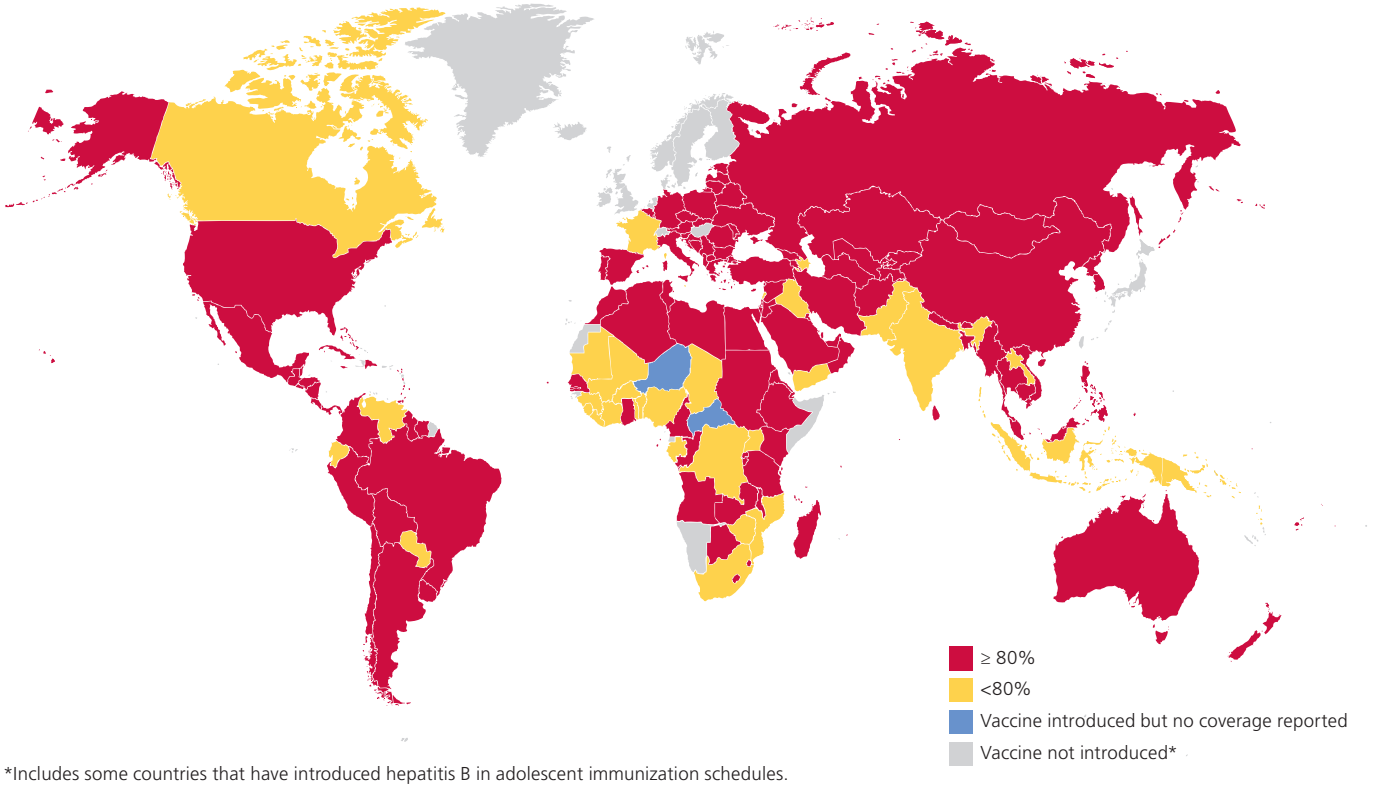


Figure 11b. International Variation in Age-standardized Liver Cancer Incidence Rates among Females, 2008



Source: GLOBOCAN 2008.

Figure 12. Proportion of Infants Covered by National Infant Hepatitis B Immunization Programs, 2008



*Includes some countries that have introduced hepatitis B in adolescent immunization schedules.

Source: WHO/UNICEF coverage estimates, 1980-2008, July 2009.

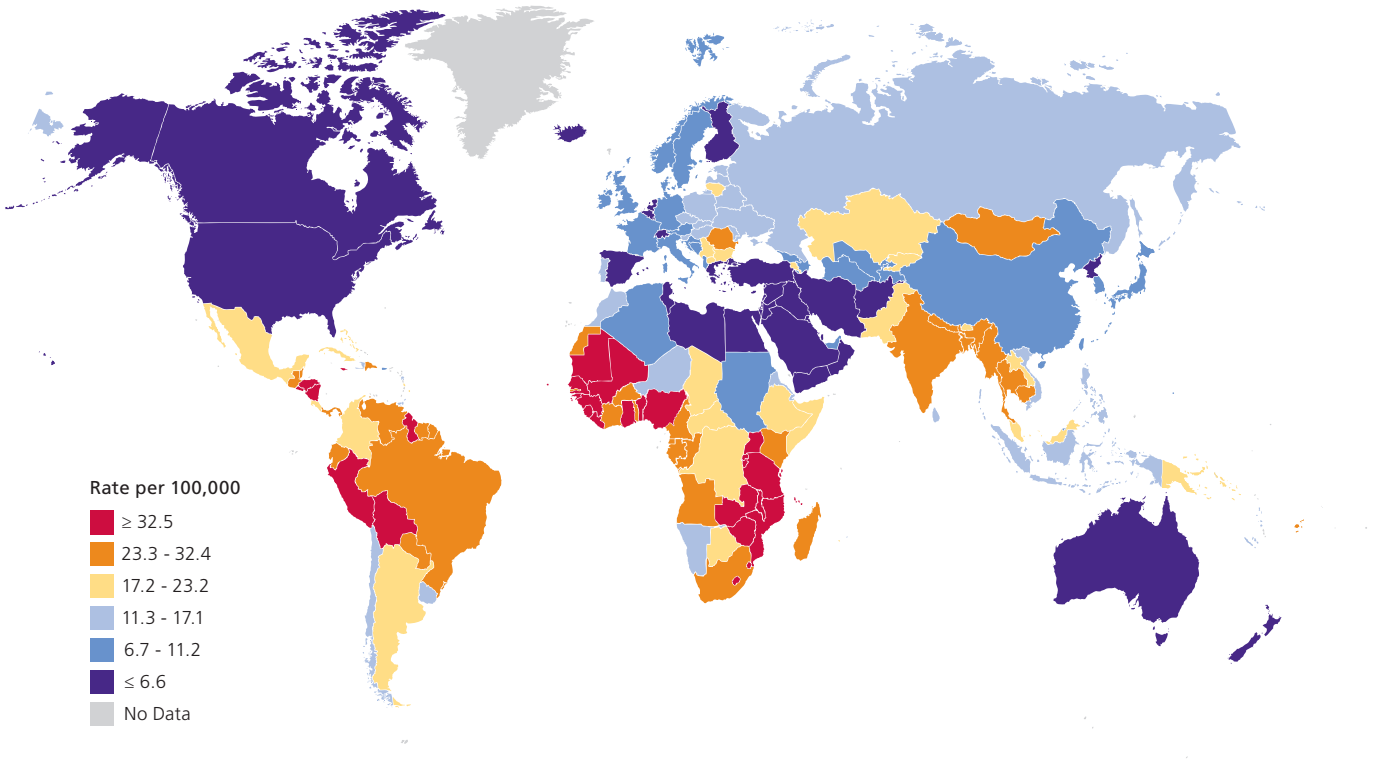
are less likely to be major contributors to the decreasing liver cancer rates among adults in most parts of Asia because of their relatively recent implementation.

Signs and symptoms: Most people do not experience symptoms in the early stages of liver cancer. Symptoms may include abdominal pain and/or swelling, weight loss, weakness, lack of appetite, sense of fullness after a small meal, or yellow-green color to the skin and eyes (jaundice). Enlargement of the liver is the most common physical sign, occurring in 50% to 90% of patients.

Risk factors: Liver cancer is strongly associated with chronic infection of HBV or HCV. Both HBV and HCV are transmitted by intimate person-to-person contact or direct contact with infectious blood or blood-derived body fluids. This can occur through contaminated injections, sexual intercourse with an infected partner, birth to an infected mother, or contact with contaminated surfaces. In developing countries, 59% of liver cancers are attributable to HBV and 33% are attributable to HCV. In developed countries, 23% of liver cancers are attributable to HBV, while 20% are attributed to HCV.[3] Other risk factors for liver cancer, particularly in economically developing countries, include consumption of food contaminated with aflatoxin B (a toxin produced by a fungus that infests grains, peanuts, soybeans, and corn that have been stored in warm, moist conditions) and parasitic infections (schistosomiasis and liver flukes). In the United States and other Western countries, alcohol-related cirrhosis and possibly non-alcoholic fatty liver disease associated with obesity account for the majority of liver cancer cases.[84] Treatment of cirrhosis (a disease state that precedes liver cancer in the majority of cases) with interferon may reduce the risk of progression to cancer and is the subject of ongoing research.

Prevention and early detection: Preventive strategies for liver cancer include prevention of hepatitis B and C infection, as well as avoidance of excessive alcohol consumption and implementation of policies to reduce aflatoxin contamination of the food supply. A vaccine that protects against HBV has been available since 1982. The WHO recommends that all countries include hepatitis B vaccine in routine infant immunization programs. As of 2008, a total of 177 countries (91%) had introduced hepatitis B vaccine into their national infant immunization schedules (Figure 12).[86] However, it was reported that in 2006 only 27% of infants worldwide received the first dose within 24 hours of birth, as recommended by the WHO, highlighting the need for wider implementation of this key hepatitis B prevention strategy.[87] In contrast to HBV, no vaccine is available against HCV. Therefore,

Figure 13. International Variation in Age-standardized Cervical Cancer Incidence Rates, 2008



Source: GLOBOCAN 2008.

hepatitis C prevention strategies include screening of blood, organ, tissue, and semen donors for antibodies to HCV and instituting adequate infection control practices during all medical, surgical, and dental procedures. In addition, measures to prevent injections with contaminated needles such as needle exchange programs have been shown to reduce exposure to the virus among injection drug users. However, these preventive measures have not been implemented in many developing countries due to resource constraints. Effective preventive strategies also include limiting alcohol because cirrhosis due to heavy alcohol consumption increases the risk for liver cancer. Another approach to reduce liver cancer in some areas of the world is to reduce consumption of foods contaminated with aflatoxins. Crop substitution and improved grain storage practices have been used to reduce contamination with aflatoxin in areas such as sub-Saharan Africa.

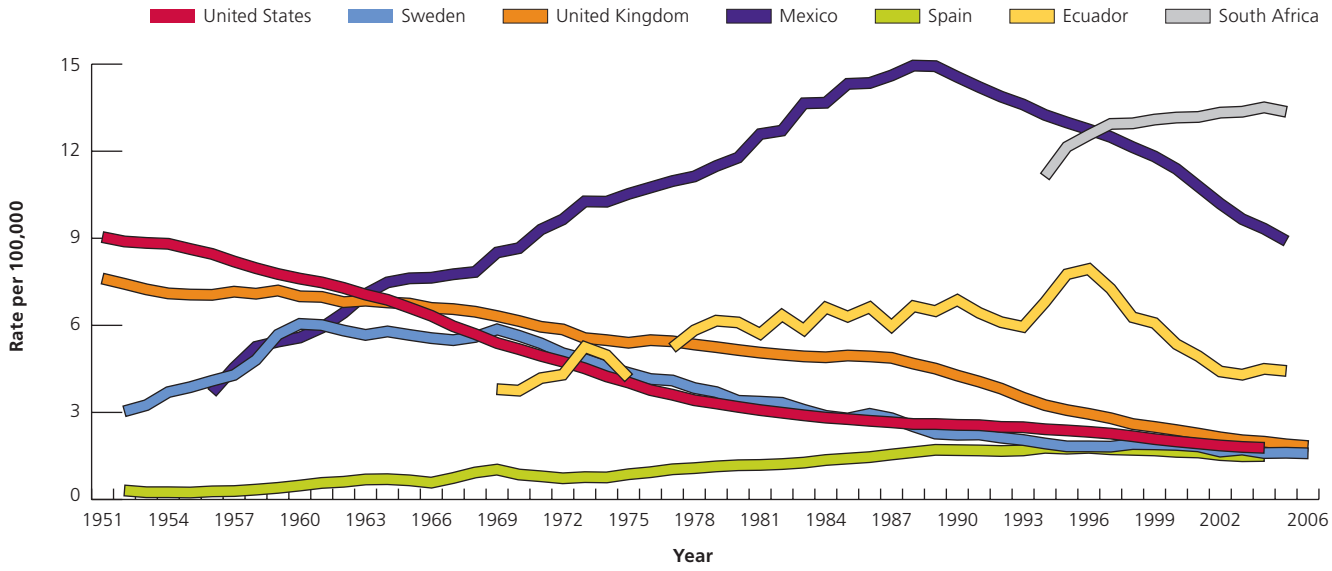
Treatment: In countries with developed health care systems, early stage liver cancer in patients with sufficient healthy liver tissue can sometimes be successfully treated with surgery or, less often, liver transplantation. Fewer surgical options exist for patients diagnosed at an advanced stage of disease, often because the portion of the liver not affected by cancer is damaged as well. Patients whose tumors cannot be surgically removed may choose ablation (tumor destruction) or embolization, a procedure that cuts off blood flow to the tumor. For people with advanced liver cancer, sorafenib (Nexavar) may be helpful.

Survival: Liver cancer is one of the most fatal cancers, with five-year relative survival rates less than 15% even in developed countries. In Europe the five-year relative survival rate is 9.1% and ranges from 3.4% in Slovenia to 11.5% in Spain and Belgium.[53] In the United States, the five-year relative survival rate is 13.8%. About 26% of patients survive five years after diagnosis when the cancer is found at early stage, compared to only 3% when it is found after spreading to other distant organs.[45]

Cervix Uteri

New cases: Cervical cancer was the third most commonly diagnosed cancer in women in 2008, with an estimated 529,800 new cases worldwide, more than 85% of which were in developing countries. The highest incidence rates were in Central and South America, the Caribbean, sub-Saharan Africa, and Southern Asia. Rates were lowest in the Middle East, North America, Australia, China, and parts of Western Europe (Figure 13). The disproportionate burden of cervical cancer in developing countries and elsewhere in medically underserved populations is mainly due to lack of screening.

Figure 14. Trends in Age-standardized Cervical Cancer Death Rates* in Select Countries



* Rates have been smoothed using 3-year average. Note: Break in trend indicates missing data.

Source: WHO Mortality Database.

Deaths: Cervical cancer was the fourth leading cause of cancer death in women worldwide in 2008, with an estimated 275,100 deaths. Nearly 90% of cervical cancer deaths occured in developing parts of the world: 53,300 deaths in Africa, 31,700 in Latin America, and 159,800 in Asia. India, the second most populous country in the world, accounted for 26% (72,800) of cervical cancer deaths.

Global trends: The large regional variation in cervical cancer rates primarily reflects the availability of screening with the Papanicaloau (Pap) test (organized or opportunistic), which allows the detection and removal of precancerous lesions.[88-91] Geographic differences in HPV prevalence, the primary cause of cervical cancer, may also play a role.[92] In several Western countries, where screening programs have long been established, cervical cancer rates have decreased by as much as 65% over the past four decades (Figure 14). For example, in Finland, cervical cancer incidence rates decreased from 21.1 per 100,000 in 1966 to 7.3 per 100,000 in 2007.[93] Rates have also decreased in high-risk areas, including China, Korea, and India, in part due to improved screening activities and socioeconomic conditions,[90, 94-97] although the decreases in proportionate terms were much smaller compared to those in Western countries.

In contrast to the favorable trends at all ages combined, cervical cancer rates have been increasing among younger generations in several countries, including Finland, the United Kingdom, Denmark, and China.[88, 96, 98] This unfavorable trend is thought to reflect increases in HPV prevalence from changing sexual behaviors.[88, 96, 98] The exceptionally low overall cervical cancer rates in the Middle East and other parts of the developing world are thought to reflect low prevalence of HPV infections due to societal disapproval of extramarital sexual activity.[99]

Signs and symptoms: Symptoms usually do not appear until abnormal cervical cells become cancerous and invade nearby tissue. When this happens, the most common symptom is abnormal vaginal bleeding. Bleeding may start and stop between regular menstrual periods, or it may occur after sexual intercourse, douching, or a pelvic exam. Menstrual bleeding may last longer and be heavier than usual. Bleeding after menopause or increased vaginal discharge may also be symptoms of cervical cancer.

Risk factors: The primary cause of cervical cancer is infection with certain types of HPV. About 15 HPV types are associated with a more than 200-fold increased risk of cervical cancer.[100] Among these, HPV 16 and 18 are most common among cervical cancer patients (associated with 50.5% and 13.1% of cervical cancers, respectively). The cumulative lifetime probability of acquiring a cervical infection with at least one type of HPV is extremely high for sexually active women. However, most HPV infections disappear spontaneously within two to four years, and only a small percentage progress to cervical cancer. Persistence of the infection and progression to cancer may be influenced by many factors, such as immunosuppression, high parity (number of childbirths), high number of lifetime sexual partners, and cigarette smoking. Long-term use of oral contraceptives is also associated with increased risk of cervical cancer.

Prevention and early detection: The Pap test is a simple procedure in which a small sample of cells is collected from the cervix and examined under a microscope. The test detects both precancerous lesions and early stage cancer. However, many

low-resource countries do not have the technical and public health infrastructure to support Pap testing for cervical cancer (Table 7). Therefore, increasing access to and improving quality of screening programs in the high-risk age group of 35-50 years has been identified as a key component of effective programs for the early detection of cervical cancer in low-resource settings. The most efficient and cost-effective screening techniques in low-resource countries include visual inspection using either acetic acid or Lugol's iodine and DNA testing for HPV in cervical cell samples.[101] A recent clinical trial in rural India, a low-resource area, found that a single round of HPV DNA testing significantly reduced the number of new cervical cancer cases and deaths.[102]

Two vaccines that protect against about 70% of viruses that cause cervical cancer are the new promise for preventing cervical cancer worldwide. However, in economically developing countries, the major barrier to widespread use is the high cost of the vaccine. Logistics such as vaccine acceptability and delivery may also limit population-wide HPV vaccination programs in low- and medium-resource countries worldwide.[103] It is extremely important that all women continue to receive screening services. Current vaccines are only being given to adolescent girls, and even those who have been vaccinated should begin screening at the recommended age since the vaccines do not provide protection for 30% of chronic HPV infections that cause cervical cancer.

Treatment: Pre-invasive lesions may be treated by electrocoagulation (the destruction of tissue through intense heat by electric current), cryotherapy (the destruction of cells by extreme cold), laser ablation, or local surgery. Invasive cervical cancers generally are treated by surgery, radiation, or both, as well as chemotherapy in some cases.[104]

Survival: When detected at an early stage, invasive cervical cancer is one of the most successfully treated cancers: in the United States, the five-year relative survival rate is 91%. If detected at late stage, the rate drops to 17%.[45] For all stages combined, the five-year relative survival rate is about 70% in the United States,[45] 52% (Poland) to 67% (Malta) in Europe,[53] 46 % in India, 37% in the Philippines, 22% in Gambia, and 13% in Uganda.[44]

Table 7. Percentage of Women Who Have Ever Been Screened for Cervical Cancer, Selected Developing Countries

	Year of Survey	Age	Total
Central America			
Ecuador	2004	15-49	49.6
El Salvador	2008	15-49	87.2
Guatemala	2002	15-49	36.2
Honduras	2001	15-49	60.9
Paraguay	2004	15-44	70.0
Eastern Europe/ EuroAsia			
Albania	2002	15-44	3.0
Romania	1999	15-44	17.0
Azerbaijan	2001	15-44	2.0
Georgia	1999	15-44	4.0
Moldova	1999	15-44	43.0

Source: www.cdc.gov/reproductivehealth/surveys/index.htm [accessed January 8, 2010].

Esophagus

New cases: An estimated 482,300 new cases occured in 2008 worldwide. Esophageal cancer incidence rates vary internationally by more than 50-fold. The highest rates are found in Asia, including China and Central Asia, and in East and South Africa. The lowest rates are found in Western Africa and Southeast Asia in both men and women and in parts of Europe and South America in women (Figures 15a and 15b). Esophageal cancer is three to four times more common among men than women. Cancer of the esophagus usually occurs as either squamous cell carcinoma in the middle or upper third of the esophagus, or as adenocarcinoma in the lower third or junction of the esophagus and stomach. In the highest-risk area, stretching from Northern Iran through the Central Asian republics to North-Central China, often referred to as the "esophageal cancer belt", 90% of cases are squamous cell carcinomas.

Deaths: About 406,800 people died from esophageal cancer in 2008, with more than 80% of these deaths occurring in developing countries.

Global trends: Geographic variations in the incidence rates of esophageal cancer are larger than for any other cancer. Similarly, temporal trends in esophageal cancer rates also vary greatly across the world. For example, while the incidence of esophageal squamous cell carcinoma has been increasing in some Asian countries such as Taiwan,[105] it has been steadily declining in the United States[106] and other economically developed nations due to reductions in alcohol and tobacco use. In contrast, the incidence of adenocarcinoma of the esophagus has been increasing rapidly in Western countries, such as the United States and England,[106-108] in recent decades most likely as a result of increases in overweight/obesity, chronic gastric reflux, and the premalignant condition Barrett esophagus. Increases in adenocarcinoma of the esophagus may also be related to the declining prevalence of *H. pylori* infection observed worldwide, as *H. pylori* is thought to have a protective effect for esophageal adenocarinoma.[109-110]

Signs and symptoms: It is unusual to have signs and symptoms of esophageal cancer in the early stages of the disease. When cancer is more advanced, the most common signs are painful or difficult swallowing and weight loss.

Figure 15a. International Variation in Age-standardized Esophageal Cancer Incidence Rates among Males, 2008

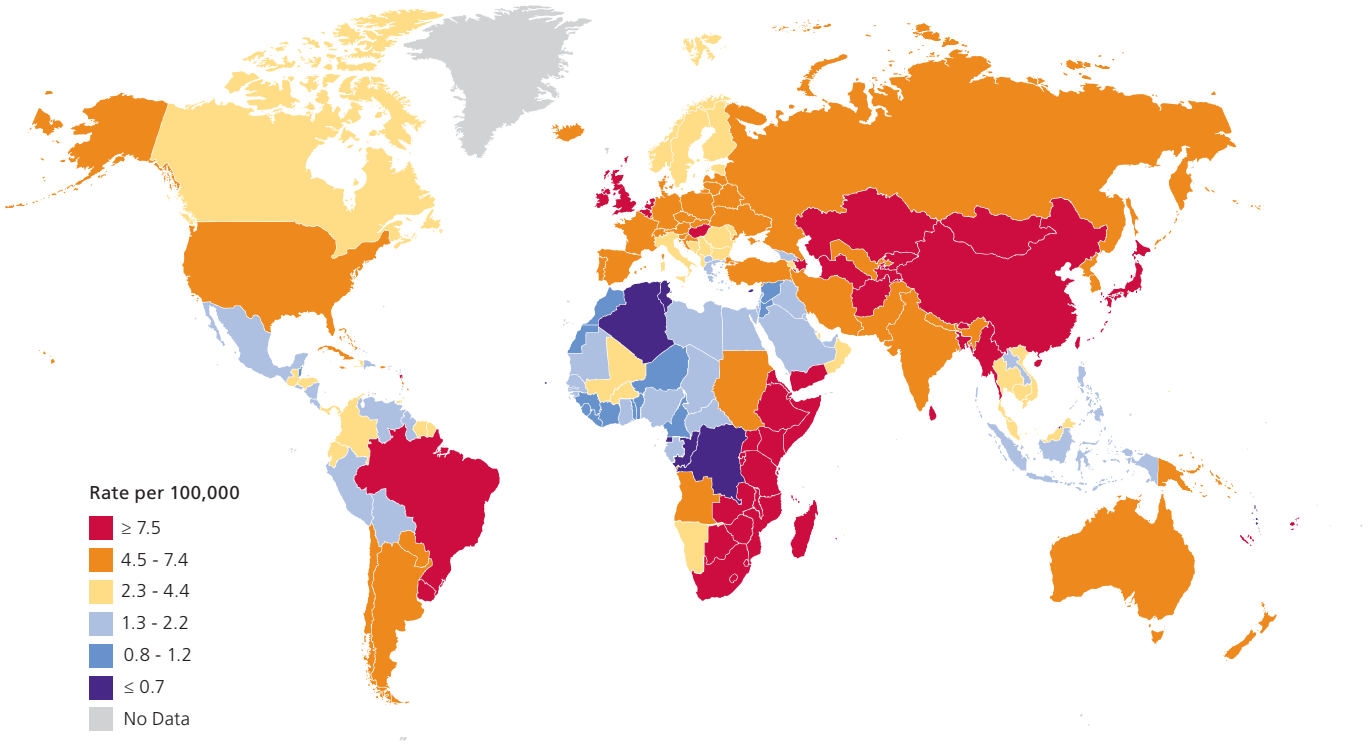
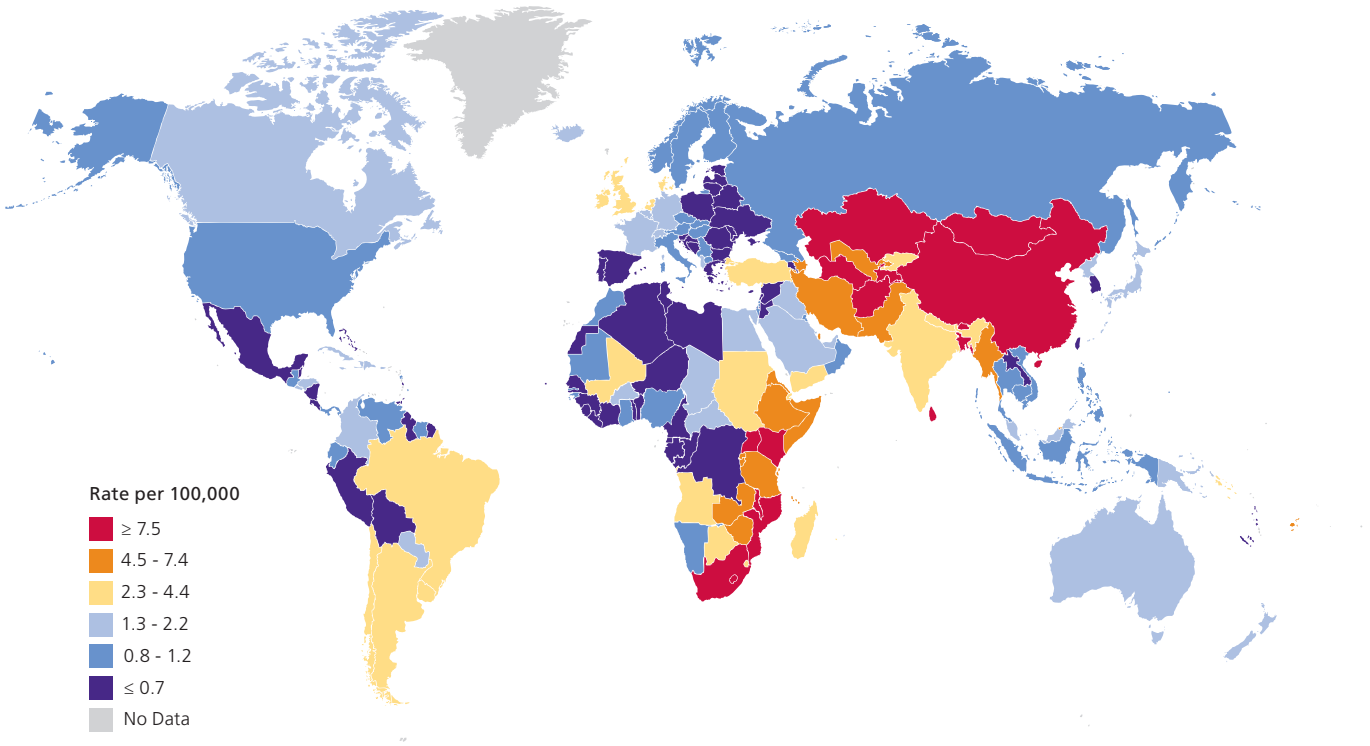
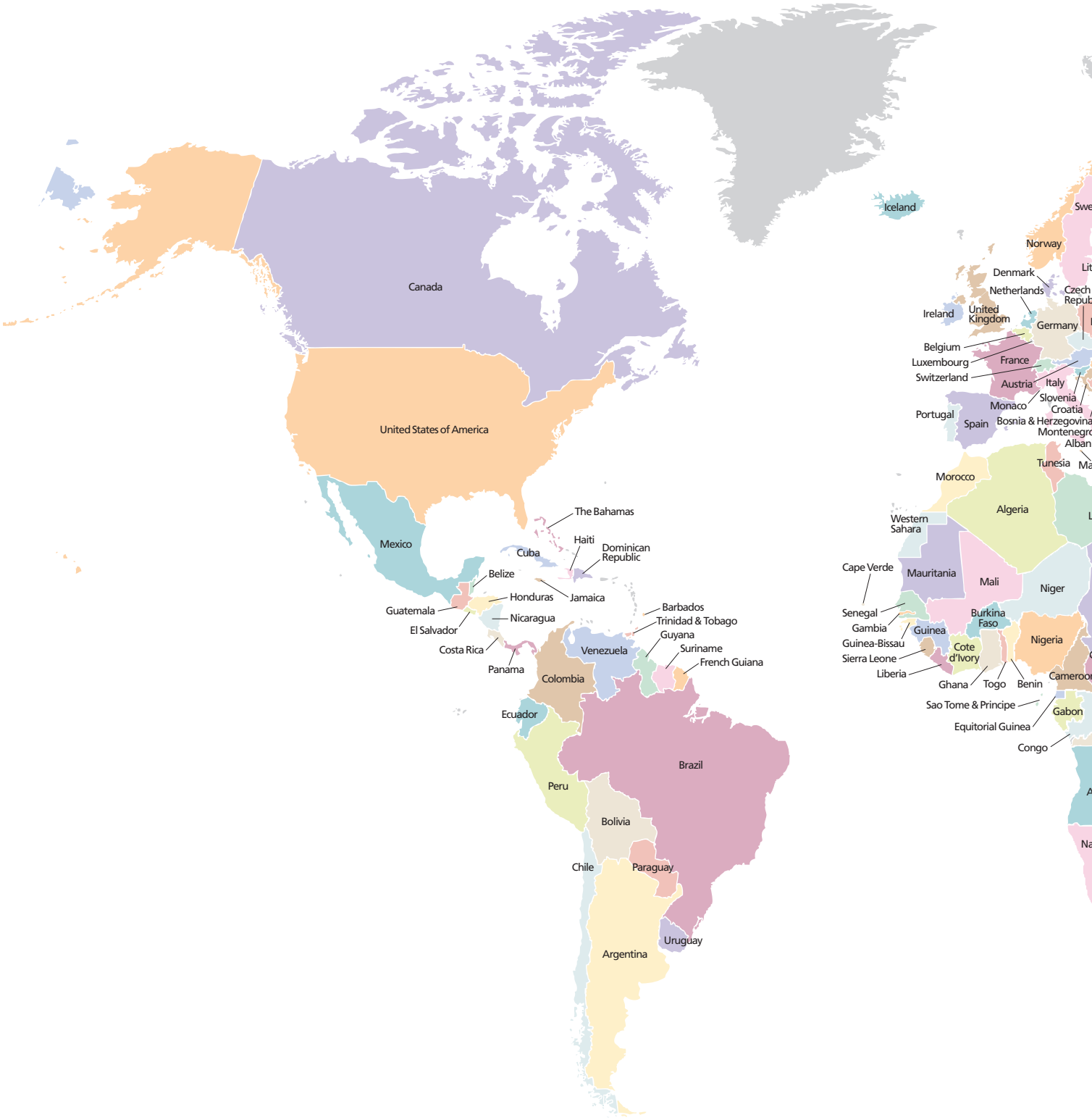


Figure 15b. International Variation in Age-standardized Esophageal Cancer Incidence Rates among Females, 2008



Source: GLOBOCAN 2008.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Morocco
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Cape Verde
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Guinea-Bissau
Sierra Leone
Liberia
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Burkina Faso
Cote d'Ivory
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Yemen
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Somalia
Ethiopia
Central African Republic
Uganda
Kenya
Congo, DRC
Rwanda
Burundi
Tanzania
Seychelles
Comoros
Malawi
Zambia
Zimbabwe
Madagascar
Mauritius
Botswana
Mozambique
Swaziland
South Africa
Lesotho

Risk factors: The greatest risk factors for squamous cell esophageal cancer are heavy drinking and smoking, accounting for almost 90% of total cases in Western countries. A diet lacking fresh fruits and vegetables also increases risk. Smoking and low fruit and vegetable consumption are also risk factors for adenocarcinoma of the esophagus; however, the main risk factors are thought to be overweight and obesity and chronic gastroesophageal reflux disease (GERD). GERD (when stomach contents enter the lower section of the esophagus) irritates the esophagus and, over time, can lead to Barrett's esophagus, a condition in which the cells lining the lower part of the esophagus have changed or been replaced with abnormal cells that could lead to cancer of the esophagus. GERD is more common in overweight men and women. In high-risk areas such as Golestan (Iran) and Linxan (China), contributing risk factors are not well understood, but are thought to include poor nutritional status, low intake of fruits and vegetables, and drinking beverages at high temperatures.[111-113]

Prevention and early detection: Reducing the use of tobacco and alcohol, maintaining a healthy body weight, and being physically active are the best ways to reduce the incidence of esophageal cancer. In addition, a healthy diet, especially one rich in fruits and vegetables may lower one's risk. Treating gastric reflux with proton pump inhibitor drugs (Prilosec, Prevacid, Nexium) or through surgery may be able to prevent Barrett's esophagus and esophageal cancer. Further risk factor studies are necessary to elucidate primary prevention measures in high-risk areas (Northern Iran and Central Asia) because the prevalence of established major risk factors for esophageal cancer (smoking and alcohol intake) is low in these regions.

Treatment: Options for treatment include surgery, chemotherapy, and radiation therapy. Palliative treatment may also be used to relieve symptoms, such as pain and trouble swallowing, but is not expected to cure the cancer.

Survival: Because esophageal cancer is usually diagnosed at a late stage, most people with esophageal cancer eventually die of this disease. In the United States, 18% of white patients and 11% of African American patients survive at least five years after diagnosis.[45] In Europe, the average five-year relative survival rate is 11%.[53]

Urinary Bladder

New cases: An estimated 386,300 new cases of bladder cancer occured in 2008, making it the ninth most common cause of cancer worldwide. The majority of bladder cancer occurs in men, and there is a 15-fold variation in incidence rates internationally. The highest incidence rates are found in Europe, Northern Africa, and the Middle East, as well as North America. The lowest rates are found in Southeast Asia and Middle Africa (Figure 16a and 16b). Some of the differences in incidence among countries are due to differences in the reporting of low-grade urinary bladder tumors; however, this does not explain all of the variation.[114]

Deaths: Bladder cancer is the 13th leading cause of cancer death among men and women worldwide. An estimated 150,200 deaths from bladder cancer occured in 2008. The highest mortality among men was in Egypt, where the estimated death rate (16.3 per 100,000) in 2008 was twice as high as the highest rates in Europe (8.3 in Spain, 8.0 in Poland) and more than four times higher than that in the United States (3.7).[2]

Global trends: Bladder cancer incidence has been declining or remaining stable in most Western countries over the past decade following a prior period of increase. However, when examining bladder cancer trends, mortality patterns are easier to interpret than incidence patterns because they are not affected by differences in reporting of low-grade tumors. In the United States, mortality rates have stabilized in males and decreased in females from 1997-2006[29], and in Europe, declines have been observed in most countries since the 1990s.[115] In Japan, bladder cancer mortality has stabilized in recent years in men and increased slightly among women.[116] The stable and/or decreasing bladder cancer mortality trends among males are due in part to reductions in smoking prevalence in Western countries along with reductions in occupational exposures known to cause bladder cancer. Bladder cancer continues to be the most common cancer among males in Egypt despite recent declines in bladder cancer incidence as the result of the reductions in schistosomal infections, the primary cause of bladder cancer in Egypt. However, smoking prevalence is increasing among males in Egypt, and the reduction in bladder cancer trends as the result of *Schistosoma* (parasite) control is being offset by tobacco-related bladder cancer.[117]

Signs and symptoms: The most common symptom is blood in the urine. Other symptoms may include increased frequency or urgency of urination and irritation during urination.

Risk factors: Smoking is the most important risk factor for bladder cancer. Smokers' risk of bladder cancer is more than twice that of nonsmokers. The risk increases with increasing duration of smoking. Smoking is estimated to cause about 34% of bladder cancer deaths among men and 13% among women worldwide.[118] Workers in the dye, rubber, or leather industries and people who live in communities with high levels of arsenic in the drinking water also have increased risk for bladder cancer. Eating more fruits and vegetables and possibly drinking more fluids may lower the risk of bladder cancer.[119] In the developing world, particularly Africa and the Middle East, chronic infection with *Schistosoma haematobium* (a parasitic worm causing urinary schistosomiasis) is associated with an increased risk of bladder cancer. Schistosomiasis, which is transmitted through contaminated water, is responsible for an estimated 50% of bladder cancer cases in some parts of Africa and about 3% of cases

Figure 16a. International Variation in Age-standardized Urinary Bladder Cancer Incidence Rates among Males, 2008

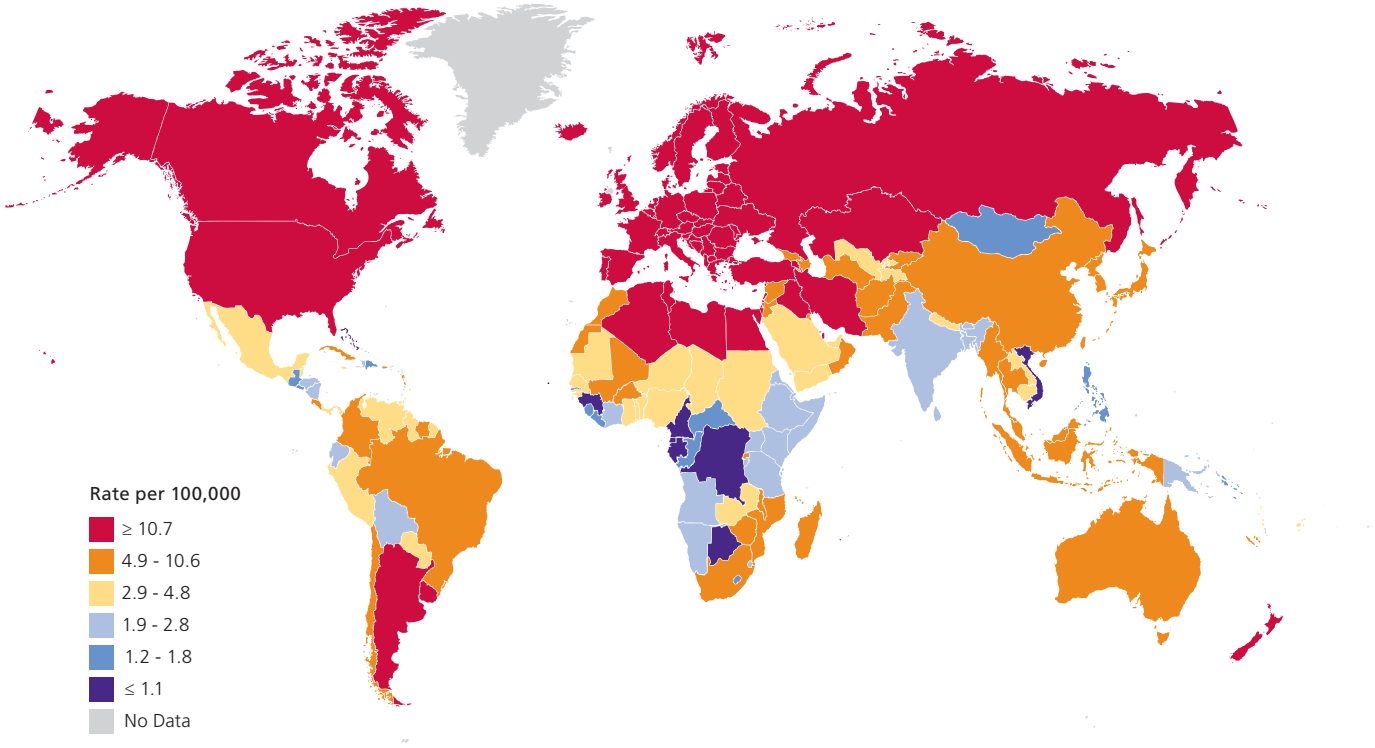
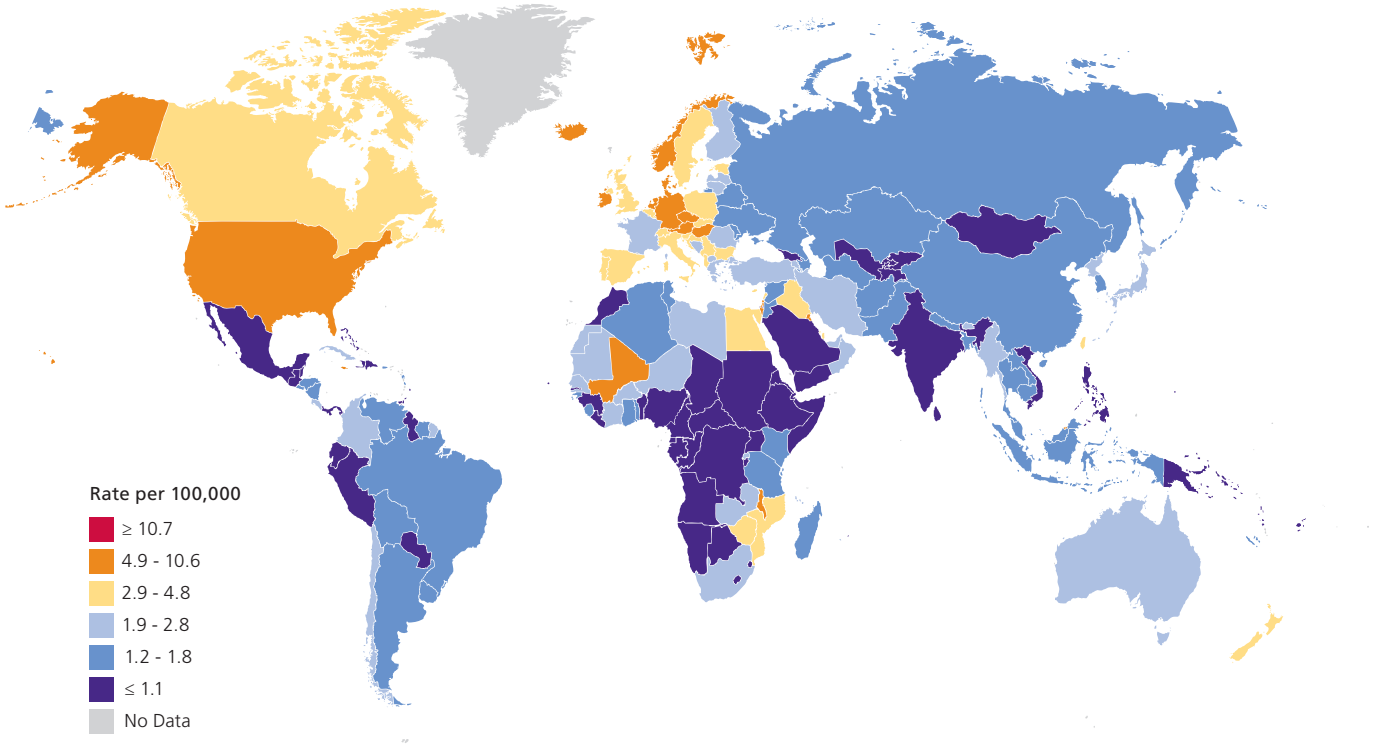


Figure 16b. International Variation in Age-standardized Urinary Bladder Cancer Incidence Rates among Females, 2008



Source: GLOBOCAN 2008.

worldwide.[3] Bladder cancers caused by schistosomiasis have a different histology (squamous cell type), compared to bladder cancers associated with other risk factors.

Prevention and early detection: Reducing smoking, increasing the intake of fruits and vegetables, and avoiding water contaminated with *Schistosoma* are the best measures for bladder cancer prevention. Symptoms of bladder cancer are nonspecific and are more often a result of other conditions, including urinary tract infection. Bladder cancer is diagnosed by microscopic examination of cells from urine or bladder tissue and examination of the bladder wall with a cystoscope, a slender tube fitted with a lens and light that can be inserted through the urethra. These tests may be used to screen people at increased risk due to occupational exposure, or for follow-up after bladder cancer treatment to detect recurrent or new tumors.

Treatment: Surgery, alone or in combination with other treatments, is used in more than 90% of cases in the United States. Superficial, localized cancers may also be treated by administering immunotherapy or chemotherapy directly into the bladder. Chemotherapy alone or with radiation before cystectomy (bladder removal) has improved treatment results. Regular follow-up care after treatment is extremely important because of the high rate of bladder cancer recurrence.

Survival: For all stages combined, the five-year relative survival rate in the United States is 79%. Half of all bladder cancer patients in the United States are diagnosed while the tumor is in situ (noninvasive, present only in the layer of cells in which the cancer developed), for which cases the five-year survival rates is 97%.[45] In Europe, the overall five-year relative survival rates average 72.4% and range from 56.5% in Slovenia to 78.2% in Germany.[53] Survival rates are low in the developing countries of Asia, such as Thailand (48%) and India (39%) (Table 5).[44]

Non-Hodgkin Lymphoma

New cases: An estimated 355,900 new cases of non-Hodgkin lymphoma (NHL) occured in 2008. NHL encompasses a wide variety of disease subtypes for which incidence patterns vary. NHL is more common in developed areas, with the highest incidence rates found in Australia, Western and Northern Europe, and North America. The lowest rates are found in Asia and Eastern Europe. In general the incidence of NHL is low in Africa with the exception of some sub-Saharan areas (particularly in East Africa) because of high incidence of Burkitt lymphoma (a subtype of NHL) among children (Figures 17a and 17b).

Deaths: An estimated 191,400 deaths from NHL occured in 2008.

Global trends: The incidence of NHL increased in most developed countries through 1990 and has leveled off in recent years.[29, 120-121] While the increases prior to 1990 may be due in part to improvements in diagnostic procedures and changes in classification, much of the trend reflects a true increase in disease occurrence.[122] In the US, some of the NHL increase throughout the 1980s, particularly among white males, is attributed to the onset of the AIDS epidemic, while the decline after 1990 likely reflects the declining incidence of HIV infection and the success of antiretroviral therapies. Non-AIDS-associated NHL subtypes continued to increase or stabilize during the same time period.[123] In developing countries such as Thailand and Uganda, the incidence of NHL is increasing, likely due in part to the AIDS epidemic.[124-125] Increases in NHL, particularly among older age groups, have also been observed in Egypt, a developing country where the AIDS epidemic is less prominent. The exact causes for the increase are not entirely clear but could be related to altered immune function associated with older age or HCV infection, which is prevalent among older Egyptian age groups.[126]

Signs and symptoms: Symptoms may include swollen lymph nodes, itching, night sweats, fatigue, unexplained weight loss, and intermittent fever.

Risk factors: In most cases, the cause is unknown, although various risk factors associated with altered immune function have been identified. NHL risk is elevated in persons with organ transplants who receive immune suppressants to prevent transplant rejection, in people with severe autoimmune conditions, and in people infected with HIV, human T-cell leukemia virus type I (HTLV-I), and probably HCV.[127] NHL is classified as an AIDS-defining illness and is 60 times more prevalent among AIDS patients compared to the general population.[128] Epstein-Barr virus causes Burkitt lymphoma and may play a role in other subtypes of NHLs. A family history of lymphoma and certain common genetic variations in immune response genes are associated with a modestly increased risk. Occupational exposures to herbicides, chlorinated organic compounds, and certain other chemicals are also associated with moderately increased risk.[127]

Prevention and Early Detection: The cause of most NHLs is unknown; therefore, for now, the best way to prevent some cases of this cancer is to prevent the known risk factors, such as a weak immune system and infection with viruses associated with NHL. At this time, there are no tests to detect NHL early. The best course of action is to pay attention to any possible symptoms of this disease.

Treatment: In areas of the world where treatment is available, chemotherapy is usually used to treat NHL. Radiation, alone or in combination with chemotherapy, is used less often. Highly specific monoclonal antibodies directed at lymphoma cells are used for initial treatment and recurrence of some types of NHL, as are antibodies linked to a radioactive atom. High-dose chemotherapy with stem cell transplantation and low-dose chemotherapy with stem cell transplantation (called non-myeloablative) are options if NHL persists or recurs after standard treatment.

Figure 17a. International Variation in Age-standardized Non-Hodgkin Lymphoma Incidence Rates among Males, 2008

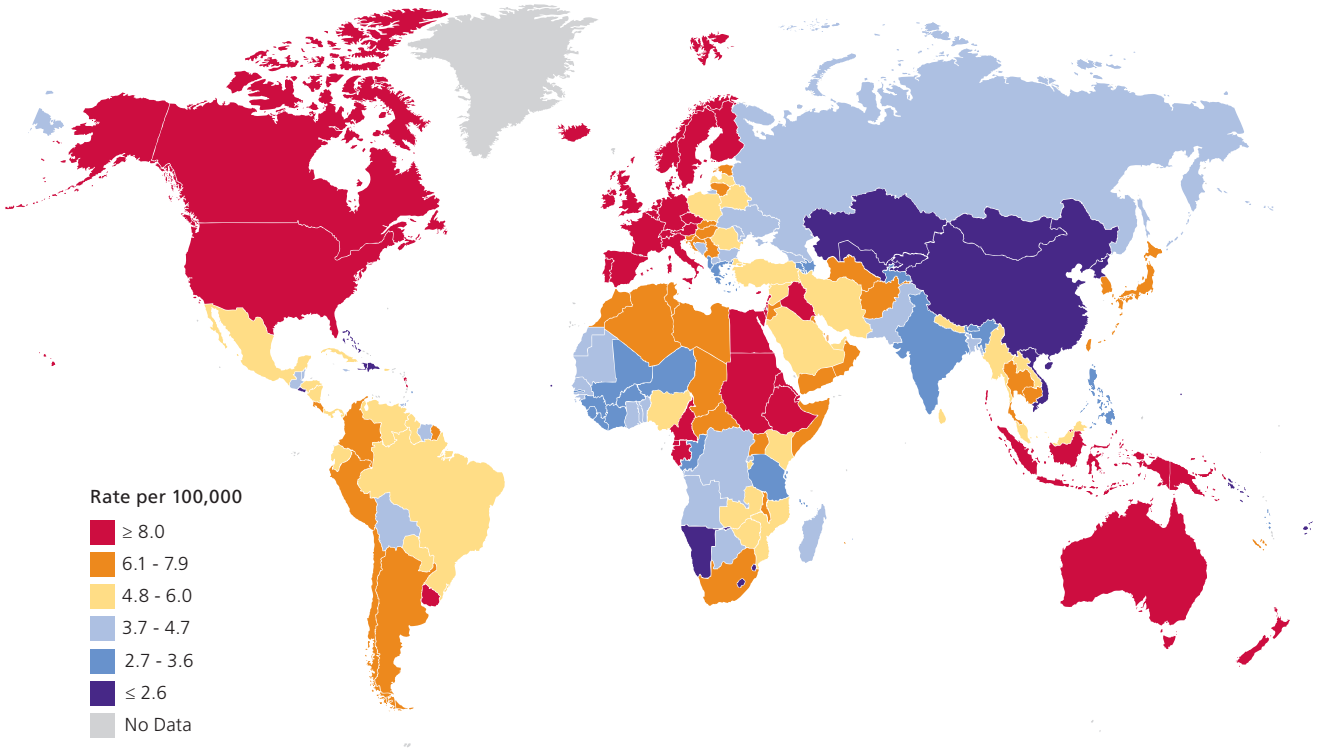
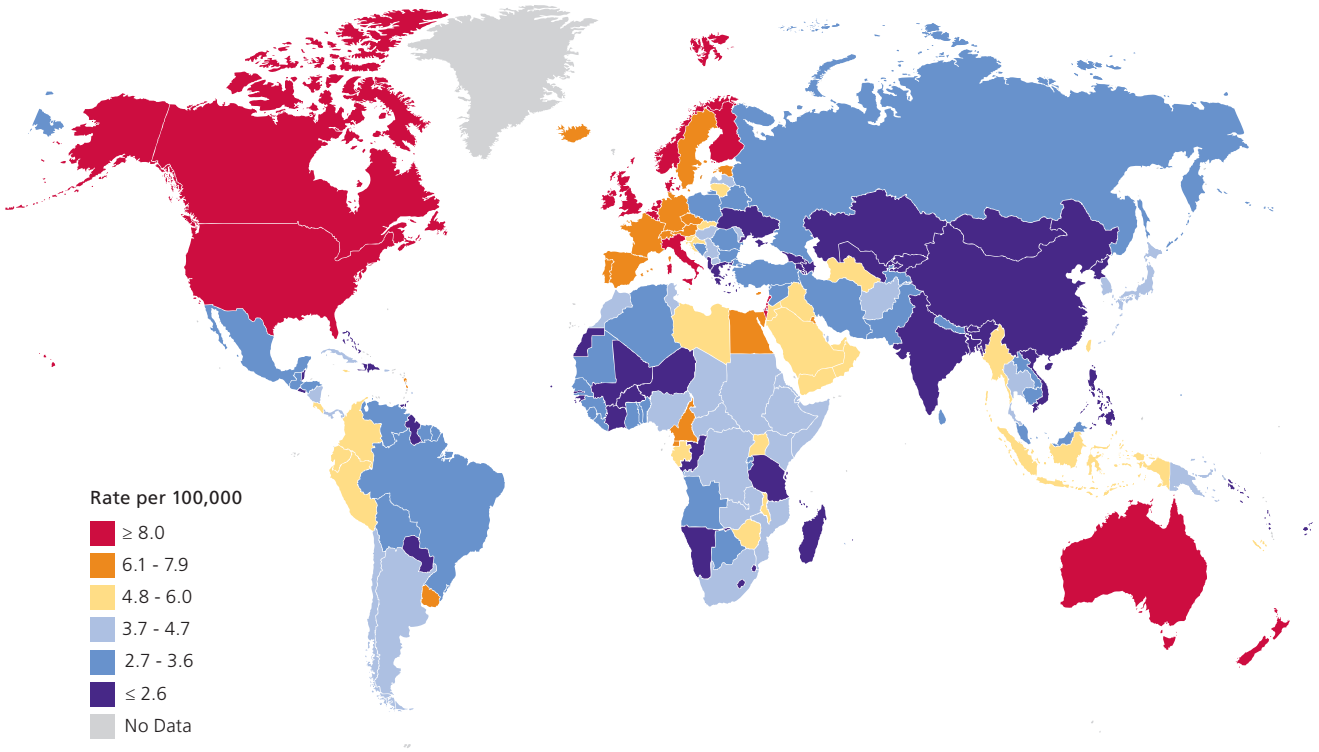


Figure 17b. International Variation in Age-standardized Non-Hodgkin Lymphoma Incidence Rates among Females, 2008



Source: GLOBOCAN 2008.

Survival: Survival varies widely by cell type and stage of the disease. In the United States, the five-year survival for all ages is 67%.[45] In Europe, the average five-year relative survival is 51.5%, ranging from 40.2% in Poland to 56.6% in Germany (Table 5).[53]

Childhood Cancer

Childhood cancer usually refers to all cancers occurring in children before 15 years of age. Although childhood cancers are rare, they are a leading cause of childhood death in developed countries such as the United States. Childhood cancer is generally not a public health priority in most developing countries. With the burden of HIV/AIDS, malaria, and other infectious diseases – even the lack of clean drinking water – treatment for cancer is often regarded as unaffordable. In developing countries, many children who have cancer are never diagnosed, are diagnosed too late, or are diagnosed where treatment is limited or not available. The International Union Against Cancer (UICC) My Child Matters initiative aims to improve the early diagnosis, treatment, care, and support of children with cancer in the developing word. Projects focus on disseminating information about cancer in children to health professionals, children's organizations, and the general public; improving early diagnosis and access to health care; and strengthening support for children with cancer and their families.[129] In addition, the International Network for Cancer Treatment and Research (INCTR) has established networks of various types around several childhood cancers: acute lymphocytic leukemia, retinoblastoma, and Burkitt lymphoma. The INCTR also has helped to establish "cooperative groups" that work together toward specific goals. These include the Leukemia Study Group of India, the Middle East Children's Cancer Group, and the Retinoblastoma Group of Mexico.

New cases: An estimated 175,300 new cancer cases occured among children aged 0-14 in 2008. Childhood cancer incidence rates are generally higher in developed than in developing countries. It is more difficult to measure the incidence of childhood cancer accurately in developing countries, where cases are often unreported due to the greater frequency of deaths from infectious diseases and malnutrition. However, the great majority of children, and 80% of children with cancer, live in developing countries.[130] Leukemia is the most common form of cancer among children in most parts of the world, except in Africa, where Kaposi sarcoma and Burkitt lymphoma are predominant (Figure 18).

Deaths: Worldwide, about 96,400 children died from cancer in 2008. Mortality rates are lowest in developed countries, despite higher incidence rates. This reflects better diagnosis and access to higher quality treatment.[131] Cancer is emerging as a major cause of childhood death in Asia, Central and South America, Northwest Africa, and the Middle East, where fewer children are now dying from preventable infectious diseases.

Global trends: Mortality rates for childhood cancer in general, and childhood leukemia in particular, have sharply declined in economically developed countries such as the United States, Canada, Japan, the United Kingdom, and New Zealand over the past 40 years.[132-133] Declines in mortality rates for childhood cancers are due largely to improvements in treatment modalities. Concern has been raised in the United States and Europe that overall incidence rates of childhood cancer have been increasing since 1970. In the United States, the childhood (0-14 years) cancer incidence rate has increased from 11.5 per 100,000 in 1975 to 14.3 per 100,000 in 2007. Although these trends in part are recognized to be the result of improved diagnosis and reporting methods, true increases in the incidence of some childhood cancers, particularly leukemia, have also been observed.[134-135] In developing countries, incidence and mortality trends for childhood cancers are much more difficult to analyze due to inadequate reporting and competing causes of death.[136]

Risk factors: The causes of most childhood cancers are unknown. Some relatively rare cancers are known to be attributable to inherited genetic conditions. Exposure to ionizing radiation is a risk factor for several types of leukemia. Worldwide, the most common examples of infection-related childhood cancers are Burkitt lymphoma, Hodgkin disease, and nasopharyngeal carcinoma (all associated with Epstein-Barr virus), liver carcinoma (HBV), and Kaposi sarcoma (HIV and human herpes virus 8). Some of these cancers, such as Burkitt lymphoma and Kaposi sarcoma, are the most common childhood cancers in some parts of developing countries, but account for a very small proportion of childhood cancer in Western countries.

Early detection: Early symptoms are usually nonspecific. Parents should ensure that children have regular medical checkups and should be alert to any unusual symptoms that persist. These include an unusual mass or swelling; unexplained paleness or loss of energy; sudden tendency to bruise; a persistent, localized pain; prolonged, unexplained fever or illness; frequent headaches, often with vomiting; sudden eye or vision changes; and excessive, rapid weight loss. According to the International Classification of Childhood Cancer, childhood cancers include:

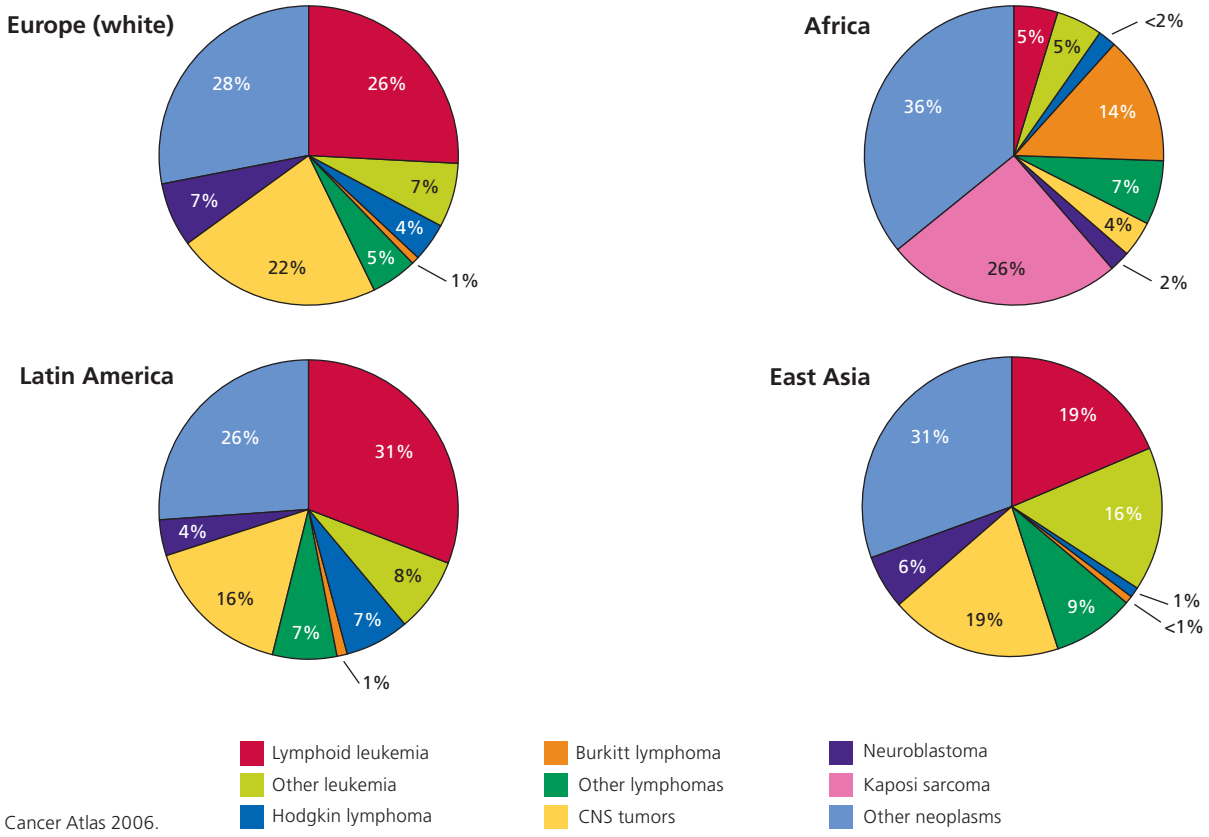
- Leukemia, a cancer of the blood-forming cells that may be recognized by bone and joint pain, weakness, bleeding, and fever
- Non-Hodgkin lymphoma (including Burkitt lymphoma) and Hodgkin lymphoma, which affect lymph nodes but may spread to bone marrow and other organs, and may cause swelling of lymph nodes in the neck, armpit, or groin; weakness; and fever
- Brain and other nervous system, which in early stages may cause headaches, nausea, vomiting, blurred or double vision, dizziness, and difficulty in walking or handling objects

- Neuroblastoma, a cancer of the sympathetic nervous system that usually appears as a swelling in the abdomen
- Retinoblastoma, an eye cancer that is typically recognized because of discoloration of the pupil of the eye and usually occurs in children younger than 4 years
- Wilms tumor (or Nephroblastoma), a kidney cancer that may be recognized by a swelling or lump in the abdomen
- Osteosarcoma, a bone cancer that most commonly appears as sporadic pain in the affected bone and may worsen at night or with activity, with eventual progression to local swelling; most often occurs in adolescents
- Ewing sarcoma, another type of cancer that usually arises in bone, appears as pain at the tumor site, and most often occurs in adolescents
- Rhabdomyosarcoma, a soft tissue sarcoma that can occur in the head and neck, genitourinary area, trunk, and extremities, and may cause pain and/or a mass or swelling
- Kaposi sarcoma, a cancer that develops from the cells that line lymph or blood vessels, is characterized by purple, red, or brown lesions on the skin and in some cases causes painful swelling, especially in the legs, groin area, or skin around the eyes

Treatment: Childhood cancers can be treated by a combination of therapies (surgery, radiation, chemotherapy) chosen based on the type and stage of the cancer. In countries with highly developed medical systems, treatment is coordinated by a team of experts including pediatric oncologists, pediatric nurses, social workers, psychologists, and others who assist children and their families. Treating childhood cancer does not have to be expensive. By developing treatment regimens that account for the capacity of a country's medical facilities and providing proper training and advice to local doctors, progress can be made on relatively limited funds. However, more than 60% of the world's children with cancer have little or no access to effective therapy. The geographic and socioeconomic inequalities in cancer treatment pose challenges that have only begun to be addressed.[137]

Survival: Survival from childhood cancer largely depends on the availability of effective treatment.[138] Significant advances have been made in diagnosis and therapy during the past four decades, and childhood cancer can largely be cured if detected early. In the United States there are an estimated 330,000 childhood cancer survivors, and this number is expected to increase in the future.[139] The overall US five-year relative survival rate for childhood cancer is around 81%.[45] Survival rates for 12 common childhood cancer types vary throughout Europe with

Figure 18. Distributions of Cancer in Children Younger than 15 Years of Age, Selected Populations



Source: Cancer Atlas 2006.

Table 8. Five-year Survival Rates (%) for Select Childhood Cancers (ages 0-14 years) in European Regions and the United States for the Most Recent Year Available

	Northern Europe (1995-1999)	UK and Ireland (1995-1999)	Central Europe (1995-1999)	Southern Europe (1995-1999)	Eastern Europe (1995-1999)	US (1995-1999)	US (1999-2006)
Lymphoid leukemia	85.2	81.4	86.8	82.5	74.8	85.1	87.1
Acute myeloid leukemia	67.7	60.1	61.1	59.8	44.4*	49.4	62.0
Hodgkin lymphoma	93.4	93.8	95.7	93.7	96.8*	94.8	94.7
Non-Hodgkin lymphoma	85.5	78.9	86.6	78.2	60.0*	80.9	83.1
Burkitt lymphoma	93.3	85.8	91.7	88.4	66.7*	88.5	89.0
All CNS tumors	61.4	56.1	63.1	57.6	57.6	71.3	71.4
Neuroblatoma	65.5	61.3	78.9	64.0	72.4	65.5	72.8
Retinoblastoma	96.8	97.4	97.9	95.0	100.0*	97.5	97.6
Nephroblastoma	89.9*	86.7	89.5	87.3	83.0	88.3	88.7
Osteosarcoma	64.9	63.4	71.5	69.5	75.0*	62.8	70.3
Ewing sarcoma	76.3	69.2	72.6	64.0	44.0*	73.7	68.2
Rhabdomyosarcoma	78.4	66.5	70.0	64.6	64.9	65.7	65.9

CNS = central nervous system.

*Based on <10 cases.

Data Sources: Europe – Gatta G, et al.[140]

US – Surveillance, Epidemiology, and End Results (SEER) Program (seer.cancer.gov) SEER*Stat Database: Incidence - SEER 17 Regs Research Data + Hurricane Katrina Impacted Louisiana Cases, Nov 2009 Sub (1973-2007 varying) - Linked To County Attributes - Total U.S., 1969-2007 Counties, National Cancer Institute, DCCPS, Surveillance Research Program, Cancer Statistics Branch, released April 2010, based on the November 2009 submission.

lower five-year survival rates observed in Eastern Europe compared to other regions.[140] Survival rates for Northern and Central Europe are similar to those in the United States (Table 8). In general, overall survival rates are much lower in the developing world. A large study conducted in Central America found that the three-year survival rate ranged from 48% to 62%, with marked variations across eight national level hospitals in seven countries.[141] In other developing countries, the estimated overall five-year survival rates for childhood cancer were as low as 40-60% in Egypt, Honduras, and Venezuela; 30% in Morocco; and 5-10% in Bangladesh, the Philippines, Senegal, Tanzania, and Vietnam.[138]

Special Section: Cancer in Africa

Introduction

Cancer is an emerging public health problem in Africa. According to the International Agency for Research on Cancer (IARC), about 681,000 new cancer cases and 512,400 cancer deaths occured in 2008 in Africa.[2] These numbers are projected to nearly double (1.28 million new cancer cases and 970,000 cancer deaths) by 2030 simply due to the aging and growth of the population,[2] with the potential to be even higher because of the adoption of behaviors associated with western lifestyles, such as smoking, unhealthy diet, and physical inactivity.[142]

Despite this growing burden, cancer continues to receive low public health priority in Africa, largely because of limited resources and other pressing public health problems, including communicable diseases such as acquired immune deficiency syndrome (AIDS)/human immunodeficiency virus (HIV) infection, malaria, and tuberculosis (Table 9). It may also be in part due to a lack of awareness about the magnitude of the current and future cancer burden among policy-makers, the general public, and international private or public health agencies interested in global health. This special section summarizes available information on cancer occurrence, risk factors, screening, and treatment in Africa in order to raise cancer awareness and promote cancer prevention and control in the region. It is intended for use by community leaders, private and public health agencies, cancer control advocates, and donors who are interested in cancer prevention and control in Africa.

Sociodemographics

Africa has an extraordinarily diverse population with respect to country of origin, religion, language, culture, economic status and other socio-demographic characteristics that affect the occurrence of cancer and its outcomes. While the sub-Saharan region is dominated by indigenous black populations, the Northern Africa region (especially Egypt, Sudan, Libya, Algeria, Tunisia, and Morocco) is dominated by Arabs. In some sub-Saharan African countries, however, whites of European origin account for a substantial proportion of the population, as much as 9% in South Africa. In addition to Islam, which is commonly practiced in Northern Africa, and Christianity, practiced in sub-Saharan Africa, there are several traditional religions in Africa. About 2,000 languages/dialectics are spoken in Africa, although Arabic is the official language in most Northern Africa countries and English or French in most sub-Saharan African countries.[143] The percentage of the population living on <$1 (US) a day in 2005

Table 9. Leading Causes of Death: Africa, sub-Saharan Africa, and Northern Africa, 2004 (thousands)

	Africa			Sub-Saharan Africa*			Northern Africa*			Worldwide		
	Rank	Deaths	%	Rank	Deaths	%	Rank	Deaths	%	Rank	Deaths	%
HIV/AIDS	1	1,678	13.3	1	1,676	14.3		2	0.2	8	2,040	3.5
Lower respiratory infections	2	1,511	12.0	2	1,456	12.5	5	55	5.9	4	4,177	7.1
Diarrhoeal diseases	3	1,063	8.4	3	1,036	8.9	7	27	2.9	7	2,163	3.7
Perinatal conditions†	4	1,061	8.4	4	1,005	8.6	4	56	6.0	5	3,180	5.4
Malaria	5	843	6.7	5	842	7.2		1	0.1	12	889	1.5
Heart diseases	6	766	6.1	6	531	4.5	1	235	25.3	1	8,923	15.1
Malignant neoplasms	7	573	4.5	7	494	4.2	2	79	8.5	2	7,424	12.6
Cerebrovascular diseases	8	505	4.0	8	434	3.7	3	71	7.7	3	5,712	9.7
Chronic obstructive pulmonary disease	9	459	3.6	8	434	3.7	9	25	2.6	6	3,025	5.1
Tuberculosis	10	435	3.4	9	429	3.7		6	0.6	9	1,464	2.5
Road traffic accidents		242	1.9		219	1.9	10	23	2.5	10	1,275	2.2
Diabetes mellitus		194	1.5		174	1.5		20	2.1	11	1,141	1.9
Nephritis and nephrosis		127	1.0		95	0.8	6	32	3.4	15	739	1.3
Cirrohsis of the liver		64	0.5		38	0.3	8	26	2.8	14	772	1.3
Suicide		58	0.5		54	0.5		4	0.4	13	844	1.4
All causes		12,609	100.0		11,683	100.0		926	100.0		58,772	100.0

*Countries are grouped according to the regional groupings used by the United Nations for reporting progress toward the Millenium Development Goals (MDG); see http://mdgs.un.org/unsd/mdg/Host.aspx?Content=Data/RegionalGroupings.

† Includes "causes arising in the perinatal period" as defined in the International Classification of Diseases, principally low birthweight, prematurity, birth asphyxia, and birth trauma, and does not include all causes of deaths occurring in the perinatal period.

Source: World Health Organization, The global burden of disease: 2004 update.

NOTE: Maternal conditions is the 10th ranked cause of death in sub-Saharan Africa.

African Regions

Northern Africa: Algeria, Egypt, Libyan Arab Jamahiriya, Morocco, Sudan, and Tunisia

Eastern Africa: Burundi, Comoros, Djibouti, Eritrea, Ethiopia, Kenya, La Reunion (France), Madagascar, Malawi, Mauritius, Mozambique, Rwanda, Somalia, Tanzania, Uganda, Zambia, and Zimbabwe

Middle Africa: Angola, Cameroon, Central African Republic, Chad, Democratic Republic of Congo, Republic of Congo, Equatorial Guinea, and Gabon

Southern Africa: Botswana, Lesotho, Namibia, South African Republic, and Swaziland

Western Africa: Benin, Burkina Faso, Cape Verde, Cote d'Ivoire, Gambia, Ghana, Guinea-Bissau, Guinea, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, and Togo

Sub-Saharan Africa refers to the combined Eastern, Middle, Southern, and Western regions.

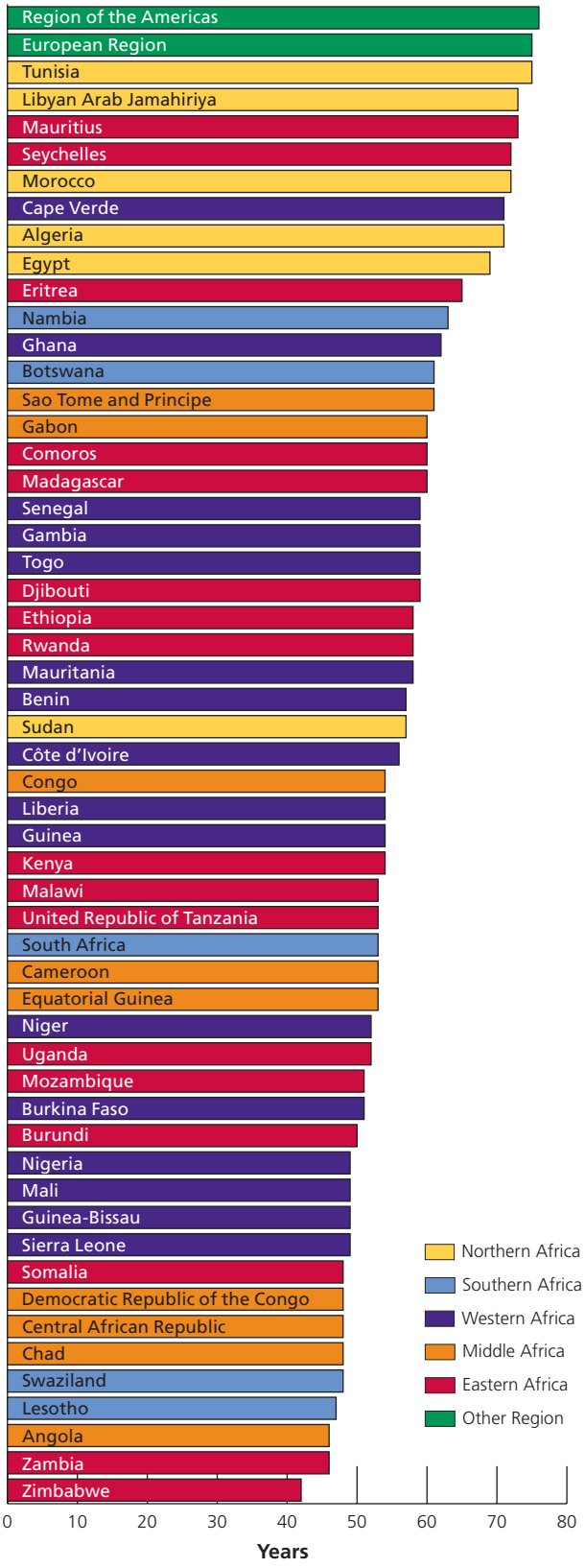
ranged from <2% in Egypt to 80% in Burundi; similarly, life expectancy ranged from 45 years in Zambia and Zimbabwe to more than 70 years in Algeria, Tunisia, and Libya (Figure 19), approaching those of the European Region and Region of the Americas.[144]

How Does the Occurrence of Cancer in Africa Differ from That in North America?

The occurrence of cancer in Africa varies remarkably from that in economically developed regions, such as North America, by type of major cancer, stage at diagnosis, survival, and incidence and mortality rates. This is largely due to differences in exposures to major risk factors, detection practices (availability of diagnostic and screening services), awareness of early signs and symptoms, and availability of treatment.

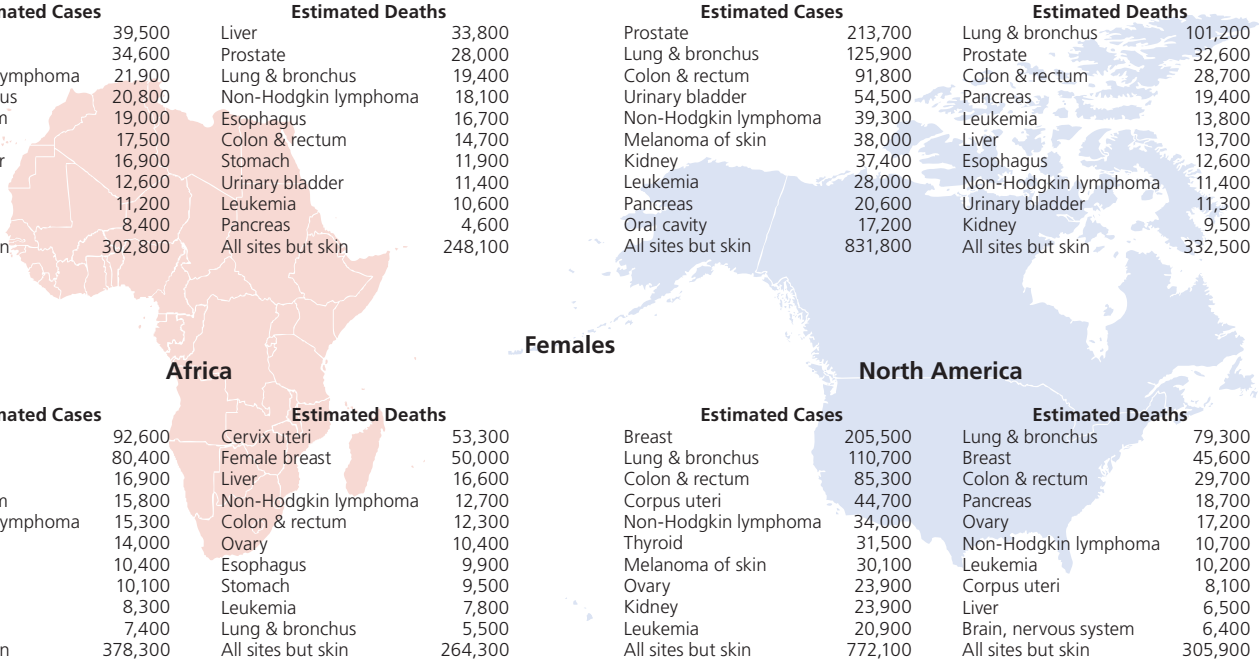
Types of major cancers: Cancers related to infectious agents (cervix, liver, Kaposi sarcoma, urinary bladder) are among the dominant forms of cancer in Africa. In 2008, cervical cancer accounted for 21% of the total newly diagnosed cancers in females and liver cancer for 11% of the total cancer cases in males. In contrast, cancers related to tobacco use (e.g., lung), reproductive behaviors (female breast), dietary patterns and obesity (e.g., colorectal), and screening or diagnostic services (prostate) are the most common cancers in North America (Figure 20). However, such cancers are also becoming more common in developing countries due to the adoption of unhealthy western lifestyles such as smoking, physical inactivity, and consumption of calorie-dense food.[145-146] For example, prostate cancer in men and breast cancer in women have now become the most commonly diagnosed cancer in some parts of Africa. (See page 40, regional differences in Africa.)

Figure 19. Life Expectancy at Birth, Both Sexes Combined, 2008



Source: World Health Statistics, 2010.

Figure 20. Estimated Numbers of New Cases and Deaths for Leading Cancer Sites in Africa and North America, 2008



Males

Africa

Estimated Cases		Estimated Deaths	
Prostate	39,500	Liver	33,800
Liver	34,600	Prostate	28,000
Non-Hodgkin lymphoma	21,900	Lung & bronchus	19,400
Lung & bronchus	20,800	Non-Hodgkin lymphoma	18,100
Colon & rectum	19,000	Esophagus	16,700
Esophagus	17,500	Colon & rectum	14,700
Urinary bladder	16,900	Stomach	11,900
Stomach	12,600	Urinary bladder	11,400
Leukemia	11,200	Leukemia	10,600
Oral cavity	8,400	Pancreas	4,600
All sites but skin	302,800	All sites but skin	248,100

North America

Estimated Cases		Estimated Deaths	
Prostate	213,700	Lung & bronchus	101,200
Lung & bronchus	125,900	Prostate	32,600
Colon & rectum	91,800	Colon & rectum	28,700
Urinary bladder	54,500	Pancreas	19,400
Non-Hodgkin lymphoma	39,300	Leukemia	13,800
Melanoma of skin	38,000	Liver	13,700
Kidney	37,400	Esophagus	12,600
Leukemia	28,000	Non-Hodgkin lymphoma	11,400
Pancreas	20,600	Urinary bladder	11,300
Oral cavity	17,200	Kidney	9,500
All sites but skin	831,800	All sites but skin	332,500

Females

Africa

Estimated Cases		Estimated Deaths	
Female breast	92,600	Cervix uteri	53,300
Cervix uteri	80,400	Female breast	50,000
Liver	16,900	Liver	16,600
Colon & rectum	15,800	Non-Hodgkin lymphoma	12,700
Non-Hodgkin lymphoma	15,300	Colon & rectum	12,300
Ovary	14,000	Ovary	10,400
Esophagus	10,400	Esophagus	9,900
Stomach	10,100	Stomach	9,500
Leukemia	8,300	Leukemia	7,800
Corpus uteri	7,400	Lung & bronchus	5,500
All sites but skin	378,300	All sites but skin	264,300

North America

Estimated Cases		Estimated Deaths	
Breast	205,500	Lung & bronchus	79,300
Lung & bronchus	110,700	Breast	45,600
Colon & rectum	85,300	Colon & rectum	29,700
Corpus uteri	44,700	Pancreas	18,700
Non-Hodgkin lymphoma	34,000	Ovary	17,200
Thyroid	31,500	Non-Hodgkin lymphoma	10,700
Melanoma of skin	30,100	Leukemia	10,200
Ovary	23,900	Corpus uteri	8,100
Kidney	23,900	Liver	6,500
Leukemia	20,900	Brain, nervous system	6,400
All sites but skin	772,100	All sites but skin	305,900

Source: GLOBOCAN 2008.

Note: Estimated cases for Kaposi sarcoma are not available for all regions of Africa.

Stage at diagnosis: A majority of cancers in Africa are diagnosed at advanced stage of the disease because of lack of screening and early detection services, as well as limited awareness of early signs and symptoms of cancer among the public and health care providers. Stigma associated with a diagnosis of cancer also plays a role in late stage presentation in most parts of Africa.

Survival: Survival after a diagnosis of cancer is much poorer in Africa than in the developed world for most cancer types (Table 10), especially those affected by screening and improved treatment. For example, the five-year survival rate for breast cancer is less than 50% in Gambia, Uganda, and Algeria, compared to nearly 90% in the United States. In addition to being diagnosed at advanced stage of the disease, which limits treatment options, cancer patients in most parts of Africa have limited access to timely standard treatment, further diminishing their chance of survival. According to a World Health Organization (WHO) government survey of national capacity for cancer control programs in 2001, anti-cancer drugs were only available in 22% and affordable in 11% of the 39 African countries that participated in the survey.[4]

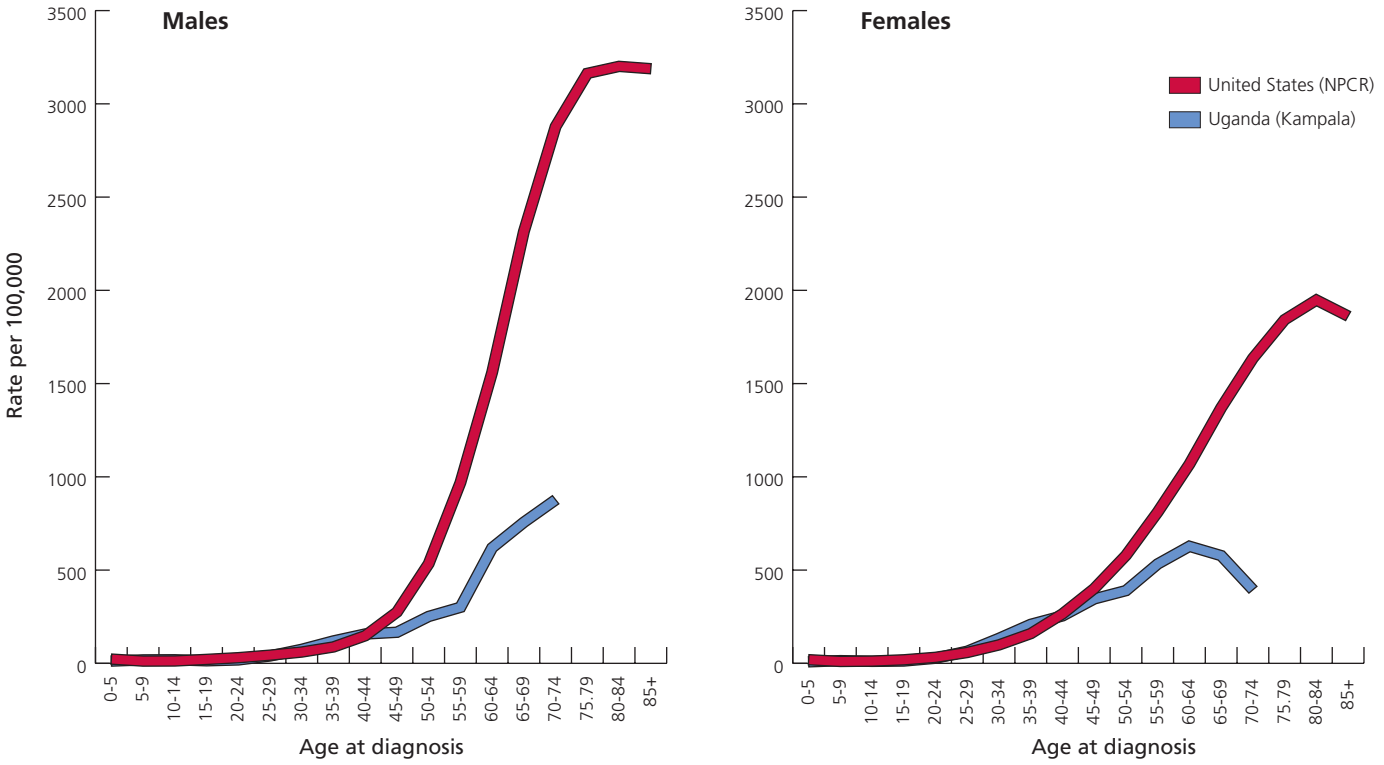
Table 10. Five-year Relative Survival for Select Sites and Countries for the Most Recent Year for Which Data Are Available

	Year of Diagnosis	Colon & Rectum			Lung	Stomach	Breast	Cervix	Ovary
		M&F	M	F	M&F	M&F	F	F	F
Gambia	1993-1997	4.0	–	–	20.0	3.0	12.0	22.0	–
Uganda (Kyadondo)	1993-1997	8.0	–	–	0.0	0.0	46.0	13.0	9.0
Algeria (Setif)	1990-1994	–	11.4	30.6	–	–	38.8	–	–
United States	1990-1992	62.2	62.1	62.4	14.0	21.6	85.4	70.6	42.6
United States	1999-2006	66.6	66.9	66.3	16.4	26.7	89.9	71.1	45.3

Survival data for African countries are based on cases followed through 1999. US cases were followed through 2007.

Sources: Gambia and Uganda – Sankaranarayanan et al.[44]; Algeria – Coleman et al.[5]; United States – Altekruse et al.[45]

Figure 21. Age-specific Cancer Incidence Rates in the United States and Uganda



Source: CI5 Vol. IX.[147]
NPCR = National Program of Cancer Registries.
*The last age group for Uganda is 70 and older.

Incidence and mortality: Although age-specific incidence rates (per 100,000 persons) for all cancers combined generally increase with age in both Africa and the economically developed world, rates are generally lower in Africa.[147] For example, the incidence rates are higher in the United States than in Uganda except in the 5- to 9-year and 30- to 40-year age groups in which rates are slightly higher in Uganda (Figure 21). The high incidence rates for ages 5-9 in the Uganda registry may reflect the high burden of non-Hodgkin lymphoma (especially Burkitt's lymphoma) that accounts for about 50% of the overall cancer rates at this age interval.[147] The elevated rates for ages 30-40 may reflect the early onsets of cervical cancer in women and liver cancer and Kaposi sarcoma in men.[147-148]

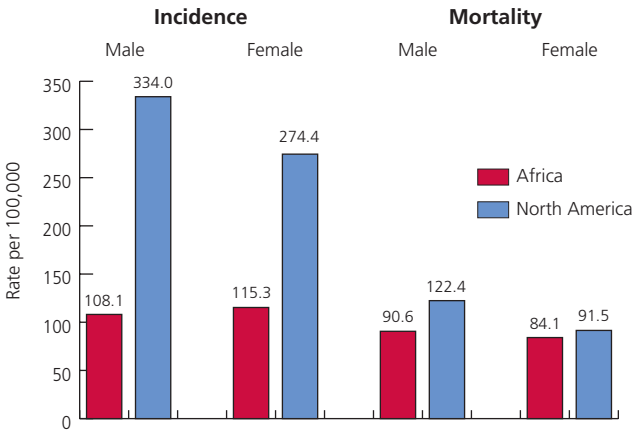
Compared to North America, the age-standardized incidence rate (per 100,000) for all cancers combined in Africa is about one-third as high for males (108.1 vs. 334.0) and less than half as high for females (115.3 vs. 274.4).[2] This contrasts sharply with the relatively small differences in the overall age-standardized cancer death rates between the two regions for both males (122.4 in North America, 90.6 in Africa) and females (91.5 vs. 84.1).[2] The high mortality rates relative to the incidence rates in Africa (Figure 22) show poor survival of cancer patients due to late stage at diagnosis and lack of timely and standard treatment, as well as a higher proportion of more fatal cancers such as esophagus and liver.

Regional Differences in Cancer Rates in Africa

Similar to the differences between Africa and the developed world, cancer incidence and mortality patterns vary remarkably across regions within Africa because of the substantial regional differences in economic development and social, cultural, and other environmental factors, including major known risk factors.

Women: Cervical cancer was the most frequently diagnosed cancer (31,500) and the leading cause of cancer death (21,600) in women in Eastern Africa in 2008, accounting for about 25% of the total new cancer cases and deaths (Tables 11a and 11b). Notably, some countries in this region, such as Zambia, Malawi, Mozambique, and Tanzania, show the highest cervical cancer rates (50 cases per 100,000) worldwide.[2] This is due to a high prevalence of human papillomavirus (HPV) infection that causes cervical cancer, coupled with a lack of screening services (Pap test) for prevention and early detection of the disease. It is noteworthy that before the introduction and wide dissemination of

Figure 22. Age-standardized Cancer Incidence and Mortality Rates in Africa and North America



Source: GLOBOCAN 2008.

Pap testing in the 1960s in the United States, cervical cancer incidence rates (per 100,000 females) in 10 select metropolitan areas in 1947-48 were 40.1 in whites and 73.1 in non-whites,[149] higher than the highest rates found today in Eastern Africa.

In contrast to Eastern Africa, breast cancer was the most commonly diagnosed cancer and the leading cause of cancer death among women in Southern Africa (9,000 cases, 4,500 deaths) and Northern Africa (28,000 cases, 14,600 deaths) in 2008 (Tables 11a and 11b). In fact, Southern African women have the highest breast cancer incidence rates of all African regions, in part because of the high proportion of whites in the population who are more affluent and have higher prevalence of reproductive risk factors for breast cancer, such as early menarche and late child bearing.[150] For example, the female breast cancer incidence rate in Harare (Zimbabwe) in 1990-1992 was six times higher in whites (129.0) than in blacks (20.0).[147]

Table 11a. Age-adjusted Incidence Rates* for the Most Common Cancers in Males and Females in Africa, 2008

	Africa		Sub-Saharan Africa		Southern Africa		Eastern Africa		Middle Africa		Northern Africa		Western Africa	
	Rank	Rate*	Rank	Rate*	Rank	Rate*	Rank	Rate*	Rank	Rate*	Rank	Rate*	Rank	Rate*
Males														
All sites†		108.1		115.9		235.9		121.3		88.1		109.2		92.0
Prostate	1	17.5	1	21.2	1	53.9	3	14.5	2	16.4	4	8.1	1	22.2
Liver	2	11.6	2	13.1	5	13.9	4	7.2	1	18.9	5	7.5	2	16.5
Lung	3	8.4	6	5.9	2	29.0	9	4.1	7	2.8	1	14.9	7	3.1
Esophagus	4	6.7	3	8.5	3	22.3	1	14.9		1.5		2.0		1.4
Colorectal	5	6.9	5	6.8	4	20.4	6	5.8	5	4.3	6	7.0	3	5.6
Non-Hodgkin lymphoma	6	6.3	7	5.5	9	5.7	5	6.2	3	5.4	3	8.4	4	4.8
Urinary bladder	7	6.7	9	3.7	8	7.3	10	3.4		1.5	2	14.5	6	3.9
Stomach	8	4.7	8	5.0		4.1	7	5.6	4	5.3	9	3.9	5	4.5
Leukemia	9	3.2		2.8		3.9		3.0	8	2.8	7	4.4	9	2.5
Larynx	10	3.0		2.6	10	5.5		2.6	10	1.8	8	4.0	10	2.1
Kaposi sarcoma		–	4	8.1	6	11.5	1	14.9	6	4.1		–		1.9
Females														
All sites†		115.3		124.7		161.1		125.3		96.7		98.9		123.5
Breast	1	28.0	2	26.3	1	38.1	2	19.3	2	21.3	1	32.7	2	31.8
Cervix uteri	2	25.2	1	31.7	2	26.8	1	34.5	1	23.0	2	6.6	1	33.7
Liver	3	5.3	3	6.3	7	5.1	9	3.6	3	9.6	8	2.5	3	8.1
Colorectal	4	5.0	4	4.7	4	8.2	5	4.7	7	3.3	3	5.8	4	4.3
Ovary	5	4.2	6	4.0		3.8	6	4.0	6	4.3	5	4.8	5	3.8
Non-Hodgkin lymphoma	6	4.1	7	3.8	9	4.3	8	3.7	4	4.8	4	5.0	7	3.2
Esophagus	7	3.5	5	4.2	3	11.7	4	6.4		0.8		1.6		1.0
Stomach	8	3.3	8	3.7		2.2	6	4.0	5	4.7	9	2.4	6	3.3
Uterus	9	2.5	10	2.6	6	6.9		2.4	9	1.9		2.2	10	1.9
Thyroid	10	2.1		1.7		2.3		1.7		1.2	6	3.4		1.7
Kaposi sarcoma		–	9	3.6	8	5.1	3	6.8		0.6		–		1.2

*Rates are per 100,000 and age standardized to the world population.

†Rate for all cancers combined for all of Africa excludes Kaposi sarcoma and non-melanoma skin cancer. The rank order of cancers for all of Africa also does not include cases of Kaposi sarcoma. For all other regions, the rates for all sites excludes only non-melanoma skin cancers.

Source: GLOBOCAN 2008.

While cervical cancer in East Africa and breast cancer in Southern and Northern Africa were the most commonly diagnosed cancer among women in 2008, these two cancers occured with similar frequency in Middle and Western Africa (Table 11a). In several sub-Saharan African countries, however, breast cancer has now become the most commonly diagnosed cancer in women (Figure 23), a shift from previous decades in which cervical cancer was the most commonly diagnosed cancer in many of these countries.[7] This may be due to increases in the prevalence of risk factors for breast cancer such as early menarche, late child bearing, having fewer children, and obesity, which are associated with economic development and western behaviors. Based on data from the Uganda (Kampala) and Algeria (Setif) cancer registries, breast cancer incidence rates have nearly doubled over the past 20 years, though the rates still remain about one-fifth of that in the US and several Western countries.[125, 151] However, cervical cancer still remains the leading cause of cancer death among women in sub-Saharan Africa, except Southern Africa where breast cancer ranks first.

Men: The regional patterns of cancer occurrence in Africa among men are much more variable than among women. Kaposi sarcoma was the most commonly diagnosed cancer and the leading cause of cancer death among men in Eastern Africa in 2008 (16,000 cases, 13,700 deaths).[2] The incidence and mortality rates in Eastern Africa were seven times as high as in Northern Africa, consistent with the geographic variations of the HIV/AIDS epidemic; Kaposi sarcoma is an HIV-associated cancer caused by human herpes virus-8.[155, 156]

Esophageal cancer was the second most commonly diagnosed cancer and the second leading cause of cancer death in Eastern African men, with an estimated 10,500 newly diagnosed cases and 10,000 deaths in 2008. Incidence and mortality rates for esophageal cancer in Eastern Africa are more than seven times as high as in Western, Middle, or Northern Africa, but about 30% lower than in Southern Africa (Tables 11a and 11b). Reasons for the high burden of esophageal cancers in several parts of Eastern and Southern Africa are not fully understood, but are thought to reflect smoking, alcohol intake, and poor dietary patterns, such

Table 11b. Age-adjusted Death Rates* for the Most Common Cancers in Males and Females in Africa, 2008

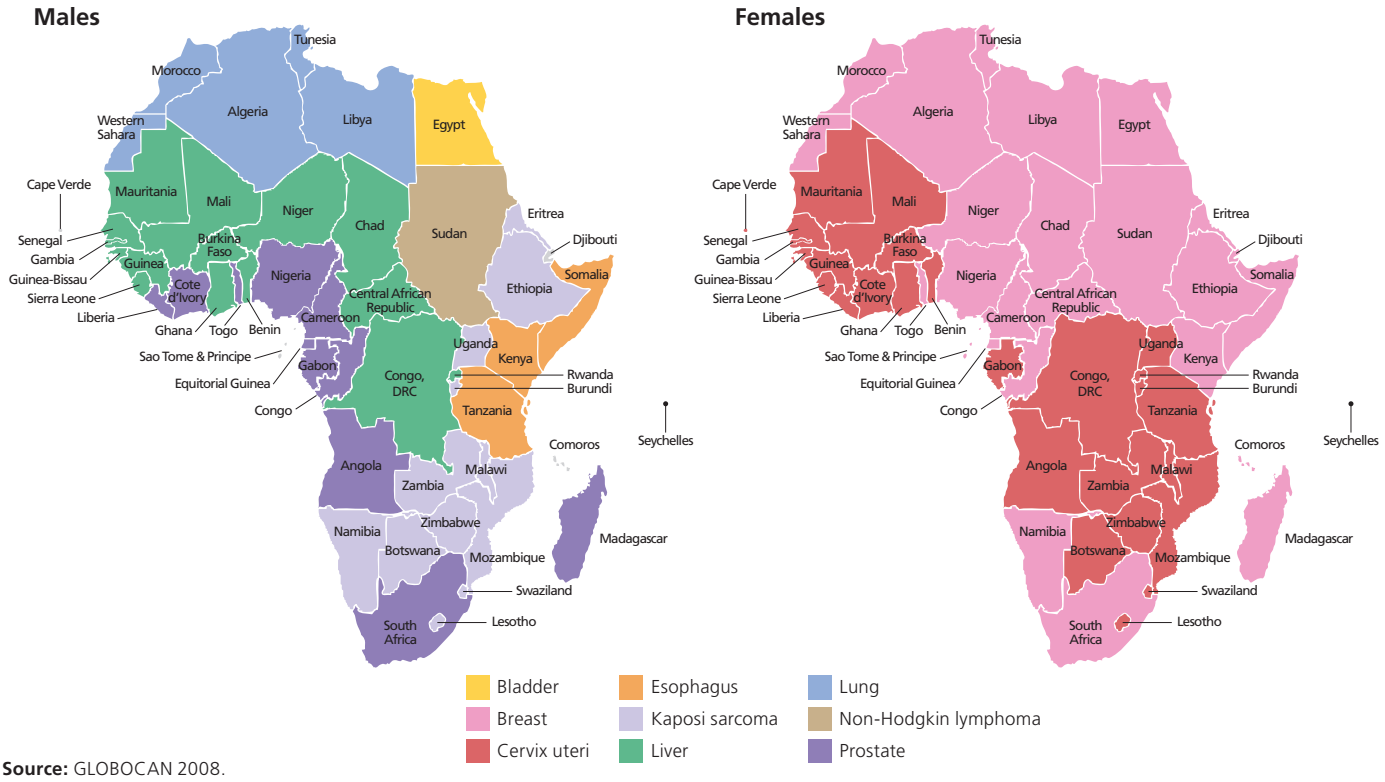
	All Africa		Sub-Saharan Africa		Southern Africa		Eastern Africa		Middle Africa		Northern Africa		Western Africa	
	Rank	Rate	Rank	Rate	Rank	Rate	Rank	Rate	Rank	Rate	Rank	Rate	Rank	Rate
Males														
All sites†		90.6		98.1		172.1		105.4		78.5		89.5		80.1
Prostate	1	12.5	1	15.0	3	19.3	3	11.7	2	13.4	5	6.2	1	18.3
Liver	2	11.7	2	13.2	5	14.0	4	7.3	1	19.2	3	7.4	2	16.5
Lung	3	7.9	5	5.6	1	27.4	8	4.0	7	2.7	1	14.0	7	2.9
Esophagus	4	6.5	3	8.2	2	21.4	1	14.3	9	1.4		2.0	10	1.4
Colorectal	5	5.5	6	5.5	4	15.8	7	4.7	5	3.5	6	5.5	3	4.6
Non-Hodgkin lymphoma	6	5.3	8	4.6	8	4.6	6	5.1	4	4.6	4	6.9	5	4.1
Urinary bladder	7	4.8	9	2.8	7	4.9	10	2.6		1.2	2	9.9	6	3.1
Stomach	8	4.5	7	4.9		3.9	5	5.4	3	5.2	8	3.7	4	4.4
Leukemia	9	3.0	10	2.7		3.6	9	2.8	8	2.6	7	4.1	8	2.3
Larynx	10	1.9		1.7		3.3		1.7		1.2	10	2.4	10	1.4
Kaposi sarcoma		–	4	6.9	6	9.6	2	12.7	5	3.5		–	9	1.5
Females														
All sites†		84.1		92.8		108.1		95.9		75.6		68.2		91.2
Uterine cervix	1	17.6	1	22.5	2	14.8	1	25.3	1	17.0	4	4.0	1	24.0
Breast	2	16.0	2	15.3	1	19.3	2	11.4	2	13.1	1	17.8	2	18.9
Liver	3	5.5	3	6.6	6	5.0	5	3.8	3	10.6	7	2.5	3	8.3
Colorectal	4	4.0	5	3.8	5	6.1	5	3.8	7	2.7	2	4.5	4	3.5
Non-Hodgkin lymphoma	5	3.5	7	3.2	9	3.5	9	3.1	5	4.1	3	4.1	7	2.7
Ovary	6	3.4	7	3.2	10	2.8	8	3.3	6	3.6	5	3.7	5	3.1
Esophagus	6	3.4	4	4.0	3	11.1	3	6.2		0.8		1.5		1.0
Stomach	8	3.2	6	3.5		2.0	5	3.8	4	4.6	8	2.3	5	3.1
Leukemia	9	2.1	10	1.9		2.0	10	1.7	8	1.8	6	2.8	8	2.0
Lung	10	1.9	10	1.9	4	7.4		1.3		0.8	9	2.0	9	1.1
Kaposi sarcoma		–	9	3.1	7	4.4	4	5.8		0.5		–	10	1.0

*Rates are per 100,000 and age standardized to the world population.

†Rate for all cancers combined for all of Africa excludes Kaposi sarcoma and non-melanoma skin cancer. The rank order of cancers for all of Africa also does not include cases of Kaposi sarcoma. For all other regions, the rates for all sites excludes only non-melanoma skin cancers.

Source: GLOBOCAN 2008.

Figure 23. Most Common Cancer Sites in Africa by Sex, 2008



Source: GLOBOCAN 2008.

as consumption of a maize-based diet that is low in fruits and vegetables.[152-154]

In Middle and Western Africa, liver cancer was the most commonly diagnosed cancer and the leading cause of cancer death in men. About 7,000 new cases and 6,800 deaths in Middle Africa and 13,900 new cases and 13,600 deaths in Western Africa occured in 2008. Chronic infections with hepatitis B virus (HBV) in sub-Saharan Africa regions and hepatitis C virus (HCV) in Northern Africa are the major causes of liver cancer,[157-158] accounting for 65%-80% of the total cases.[81, 159-160] The high burden of HCV-associated liver cancer in Egypt is largely the result of HCV-contaminated injection equipment during mass treatment campaigns against *Schistosoma*, a parasite (blood fluke) that causes chronic liver diseases and bladder cancer (see next paragraph), during the 1960s–1970s.[161-162] Contamination of staple foods, such as maize and ground nuts, with aflatoxin B1, a known cancer-causing agent produced by molds during inadequate storage of crops,[163-164] is another contributing factor to the liver cancer burden in many sub-Saharan African countries.[165]

In Northern Africa, lung cancer was the most commonly diagnosed cancer (10,400) and the leading cause of cancer death (9,600) among men in 2008. However, lung cancer incidence rates in Northern Africa were only half as high as the rates in Southern Africa (Table 11a) because of the more advanced stage of the tobacco epidemic in Southern Africa.[166-167] Smoking accounts for 65% of lung cancer cases in South Africa,[168] reminiscent of the tobacco epidemic in Western countries.

In contrast to lung cancer, bladder cancer incidence and mortality rates among men in Northern Africa are twice as high as those in Southern Africa, which has the second highest regional rates (Tables 11a and 11b). In fact, Egyptian men have the highest bladder cancer incidence rates worldwide.[114] About 40% of the disease in most parts of Africa is caused by a parasite known as *Schistosoma hematobium*.[3, 169-170] The infection occurs when people come into contact with free swimming larvae (early developmental stage) of the parasite, which are released by snails. In *Schistosome*-free regions such as Europe and North America, bladder cancer is caused mainly by smoking and occupational exposures to certain industrial chemicals.[171]

Prostate cancer was the most commonly diagnosed cancer among men in Southern Africa in 2008. The incidence rate in Southern Africa is twice as high as the second highest regional rate in Western Africa and nearly seven times higher than the lowest regional rate in Northern Africa. The high incidence rate in Southern Africa may reflect increased diagnosis, rather than disease occurrence.[172] However, high prostate cancer incidence rates have been reported among Western and Southern African descendents in Jamaica and Trinidad and Tobago, where prostate-specific antigen testing is not commonly practiced, suggesting a role for genetic susceptibility.[145]

Opportunities for Cancer Control in Africa

Opportunities for reducing suffering and death from cancer in Africa exist across all stages of the cancer control spectrum, from prevention, to early detection, treatment, and palliative care.[16, 173-175]

Prevention: Prevention of exposure to cancer-causing agents or risk factors, including infections, tobacco use, and obesity is by far the most feasible and cost-effective approach to cancer control in Africa.

Tobacco use: Tobacco use is the most preventable cause of cancer death, accounting for 20% of cancer deaths worldwide and for about 6% of cancer deaths in Africa.[176] The smaller contribution of tobacco use to cancer deaths in Africa reflects the early stage of the tobacco epidemic and low smoking prevalence, especially in women. Adult smoking prevalence is less than 10% in men and 2% in women in many African countries,[166] including Nigeria and Ethiopia, the two most populous nations on the continent. However, cigarette consumption is increasing in this region due to the adoption of western behaviors associated with economic growth and increased marketing by tobacco companies.[177] The smoking pattern among teens is even more disturbing. According to the Gobal Youth Tobacco Survey, in some African countries, the smoking prevalence among boys is higher than that among adults.[166]

In response to the globalization of the tobacco epidemic, the WHO established the Framework Convention on Tobacco Control (FCTC), which features internationally coordinated provisions to control tobacco that include raising the price of tobacco products, banning smoking in public places, restricting tobacco advertising and promotion, counter-advertising, and providing treatment and counseling for tobacco dependence.[13] Of the 53 African countries that are members of the WHO, 44 have ratified the FCTC (Figure 24). (See the Framework Convention Alliance Web site at fctc.org for continually updated statistics.) However, few African countries have implemented the tobacco control measures or policies according to the framework. In 2009, only seven countries had comprehensive advertising bans in place (Botswana, Djibouti, Eritrea, Madagascar, Niger, South Africa, and Sudan)[166]; only four countries had instituted complete public smoking bans (Botswana, Guinea, Niger, and Uganda); and 12 countries had implemented moderate public smoking bans (Djibouti, Egypt, Eritrea, Libya, Madagascar, Mali, Mauritius, Morocco, Mozambique, Nigeria, South Africa, and Zimbabwe).[166] These policies cover only 12.0%, 5.1%, and 40.3% of the African population, respectively, and they are not well enforced in many countries.

Tobacco use shortens life expectancy by 10-20 years.[178] The failure of Western countries to contain the tobacco epidemic in the beginning of the 20th century resulted in approximately 100 million premature deaths.[66] African countries have a unique opportunity to avoid this tragedy by curbing the tobacco epidemic at an early stage through the implementation and enforcement of proven and effective comprehensive tobacco control strategies.

Figure 24. FCTC Ratification* in Africa

* As of June 2010.
Source: WHO (http://www.who.int/fctc/signatories_parties/en/index.html).

Obesity: Unhealthy diet, physical inactivity, and obesity have been associated with increased risk of several cancers, including breast, colorectal, stomach, liver, kidney, and uterine cancers.[179] The prevalence of obesity and physical inactivity is increasing in several African countries, especially in urban areas, as a result of increased consumption of calorie-dense food and declines in energy expenditures at work and daily life.[180-184] For example, according to a 2003 survey in four urban districts of Cameroon, more than 25% of men and almost 50% of women were overweight or obese, and 6.5% of men and 19.5% of women were obese.[180] Notably, according to the Global School-Based Student Health Survey, more than 40% of 13- to 15-year-old teens in urban areas of Kenya and Zimbabwe spent three or more hours per day watching television and other sedentary activities.[185] While obesity has a negative connotation in most developed countries, it is a sign of wealth and high social standing for some in African countries, particularly in the older generation.

The WHO developed a global strategy to improve dietary patterns and physical activity through the development of national-, regional-, and/or community-level policies and programs that are comprehensive and sustainable.[14] Some countries in the WHO African Region, including Algeria, Mauritius, and South

Africa, have implemented this strategy, with a focus on promoting physical activity.[185] In school-based HIV/AIDS prevention projects in Benin and Burundi, there are efforts to incorporate prevention measures, such as increasing physical activity, eating a healthy diet, and not smoking, for noncommunicable diseases (noninfectious diseases).[185]

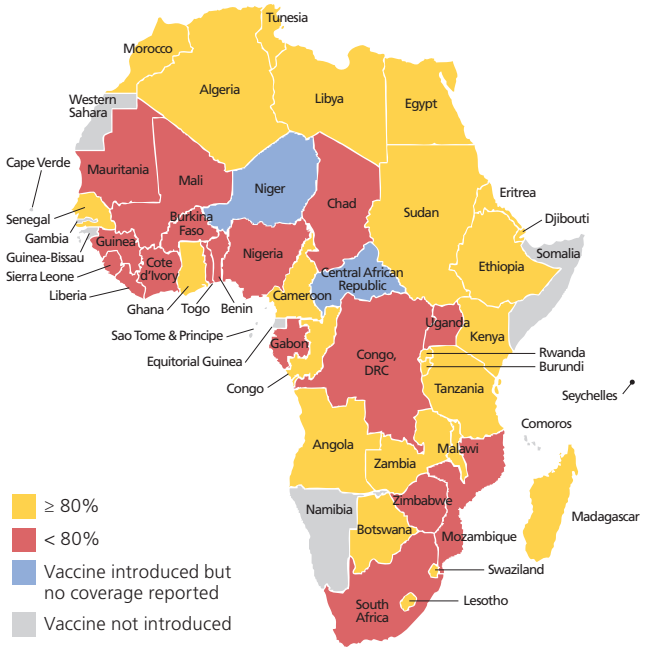
Infection: Infectious agents are the causes of some of the most commonly diagnosed cancers in Africa, including cervix, liver, and bladder cancers, as well as, Kaposi sarcoma. A substantial proportion of these cancers are potentially preventable by vaccination, improved hygiene, sanitation, and/ or treatment. A vaccine against HBV, which causes a majority of the liver cancers in sub-Saharan Africa, has been available since the early 1980s. The WHO has recommended the vaccine as part of routine national infant immunization programs since 1992.[186] Because of high cost however, the vaccine was introduced in few African countries until the establishment of the Global Alliance for Vaccination and Immunization (GAVI) initiative in early 2000, which made the vaccine more affordable in developing countries. As of 2008, 48 out of the 53 African countries included the vaccine as part of their national infant immunization schedules (Figure 25). However, the vaccination coverage was less than optimal (<80%) in many countries in sub-Saharan Africa, where HBV infection is more prevalent. In 2006, only 1% of newborns received the vaccine within 24 hours of birth.[87]

The human papillomavirus (HPV) is another cancer-causing infectious agent that is preventable through vaccination. The vaccines are administered to adolescent girls and offer protection against major strains of HPV infections that cause 70% of cervical cancer. Undoubtedly, these vaccines provide the best opportunity for substantially reducing the future burden of cervical cancer in sub-Saharan Africa, where it is a leading cause of cancer death among women. However, the high cost of the vaccine could be a major impediment to the introduction and widespread application in Africa and other poor-resource regions.

In 2008, the GAVI prioritized the introduction and wide dissemination of HPV vaccines in developing countries as part of its new vaccine investment strategy.[187] This offers some hope that the vaccines may be widely available in the near future in sub-Saharan Africa. Additional barriers to wide dissemination of the vaccine, especially in rural parts of Africa, include access to adolescent girls, few of whom attend school or receive regular preventive care, and lack of acceptance of vaccines by parents, who consider their children at low risk for sexually transmitted infections such as HPV.[103, 188]

Transmission of some cancer-causing infectious agents can be prevented by improving hygiene in the health care delivery system and by educating people to modify their high-risk behaviors. Infections that cause liver cancer and Kaposi sarcoma can be prevented by screening blood products, sterilizing injection needles and equipment, and/or by stopping injection drug use.

Figure 25. Proportion of Infants in Africa Covered by National Infant Hepatitis B Immunization Programs, 2008



* Includes some countries that may have introduced hepatitis B in adolescent immunization schedules.

Source: WHO/UNICEF coverage estimates, 1980-2008, July 2009.

Exposure to liver cancer-causing aflatoxins (AFB1) can be decreased by improving post-harvest food storage practices,[189] although efforts to reduce AFB1 exposure in sub-Saharan Africa have been limited due to economic and logistic constraints. HIV infection can be prevented by practicing safer sex (condom use, commitment to one partner) abstinence, and circumcision.[190]

A certain type of parasite (*Schistosoma hematobium*) causes a substantial proportion of bladder cancer in Africa. Infection from this parasite can be prevented by avoiding swimming, bathing, or wading in fresh-water areas known to contain the free-swimming stage (larvae) of the parasite. People who are already infected with the parasite can be successfully treated with a drug known as praziquantel. The use of this drug, as well as lower infection rates due to urbanization, is thought to have contributed to the substantial decrease in incidence of *Schistosoma*-associated bladder cancer in Egypt over the past few decades.[117, 191]

Early detection: Cancer prevention and control using standard screening methods such as mammography for breast cancer, fecal occult blood testing and sigmoidoscopy/colonoscopy for colorectal cancer, and Pap testing for cervical cancer are not only cost prohibitive in most parts of Africa, but they are also not supported by the existing health care infrastructure. However, early detection for cervical cancer or precancerous lesions by visual inspection using Lugol's iodine or acetic acid and low-cost

DNA tests to detect HPV infections have been shown to be feasible and effective in many parts of Africa, including Kenya and South Africa.[20, 192-193] Previous studies based on simulation modeling have reported that screening once or twice in a lifetime between ages 35-55 using these low-cost/low-tech screening methods can reduce cervical cancer by about 30%.[19-20] Early detection is the only viable option for reducing the currently high cervical cancer burden in sub-Saharan Africa because the current vaccines are only recommended for adolescent girls. Screening would be appropriate even for vaccinated girls once they reach the recommended screening age since the vaccines do not provide protection for 30% of chronic HPV infections that cause cervical cancer.

Increasing public awareness of early signs and symptoms of cancers of the breast, cervix, colorectum, oral cavity, urinary bladder, and prostate may increase detection of these diseases at earlier stages when there are more options for treatment and survival rates are higher.[194] Every effort must be made to expand the capacity of health care delivery systems to provide timely and effective treatment to patients diagnosed with early stage disease in order for increased awareness initiatives to result in improved patient outcomes.

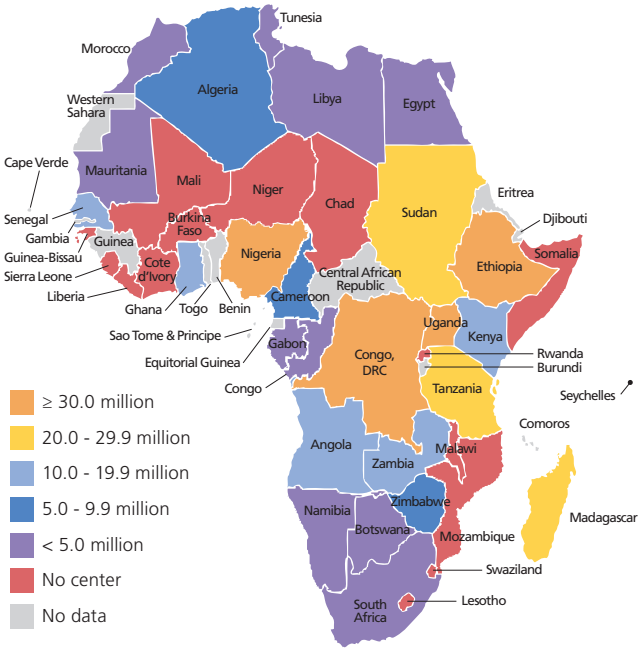
Curative Treatment: Surgery and/or radiation are the most important methods of treating early stage (local) cancers, including cancers of the breast, colorectum, cervix, head and neck, esophagus, stomach, and prostate.[195] However, the availability of such treatments in Africa is limited because of lack of skilled manpower, surgical equipment, and radiation facilities. Based on radiotherapy data from the International Atomic Energy Agency (IAEA) that have been updated through 2010, 16 out of 53 countries in Africa have no radiation treatment centers, and an additional 13 have no data reported (Figure 26). When countries have facilities, many are inadequate in number. For example, about 80 million people in Ethiopia are served by a single radiotherapy center. The actual supply of radiation treatment in Africa in 2002 was only 18% of the total needed.[196]

The IAEA, through its Programme of Action for Cancer Therapy, has been working with the WHO and other interested international and national organizations to establish safe and effective radiotherapy facilities to deliver high-quality treatment to cancer patients in Africa and other developing countries.[21] The IAEA is also launching a Virtual University for Cancer Control and Regional Training Network to fill in the skilled human resources gap in Africa (www.iaea.org). African countries must also do more to halt the exodus of their home-grown health care providers to the West in search of lucrative compensation and better opportunities for career development by providing financial incentives and other benefits.[197]

Palliative care: Lack of access to basic pain relief continues to make living and dying with cancer in Africa a very different experience from that in developed countries. About 80% of cancer patients in Africa are diagnosed at advanced stages of disease, when pain relief is often the only choice of treatment. In sub-Saharan Africa, in particular, weak health systems, legal and regulatory restrictions, inadequate training of health care providers, concern about diversion, addiction, and abuse, and cultural misperceptions about pain create a web of barriers that keep safe, effective, and inexpensive opioid analgesics out of the reach of more than a million people with treatable pain.

In 2008, there were approximately 421,000[2] deaths due to cancer and 1.4 million deaths due to HIV[198] in sub-Saharan Africa. It has been estimated that 50% of HIV deaths and 80% of cancer deaths require pain treatment lasting an average of three months; the amount of morphine needed for these deaths alone is approximately 6,413 kg.[199] However, in 2008, the actual procurement of morphine and equivalent opioids (pethidine, oxycodone, and hydromorphone) reported by sub-Saharan African governments to the International Narcotics Control Board was just 639 kg,[200] about 10% of the quantity needed just for the terminal months of cancer and HIV patients, and not considering the need for pain treatment among those living with cancer, HIV, traumatic injury, or chronic pain. These data clearly indicate that for the vast majority of those in severe pain in sub-Saharan Africa, treatment is simply not available.

Figure 26. Number of People Served by a Single Radiotherapy Center in Africa



Sources: International Atomic Energy Agency. Directory of Radiotherapy Centres. http://www.naweb.iaea.org/nahu/dirac/.

Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects: The 2008 Revision, http://esa.un.org/unpp.

While it is the responsibility of each African government to take the lead in making pain relief accessible to its citizens who need it, the activities of palliative care organizations and other civil society groups are critical to supporting government efforts. In several countries, these groups have been instrumental in getting pain relief on the agenda of governments, articulating technical solutions, and leading efforts to work across disease areas, particularly cancer and HIV, to address this issue jointly. International and national nongovernmental health organizations have generally been slow to integrate pain relief into their programs, often believing it is outside of their disease-specific treatment or prevention mandate. A re-classification of pain treatment from a separate entity to a part of comprehensive treatment of cancer and HIV – and a full recognition of pain relieving medications as a cornerstone of the global essential medicines agenda – would assist governments with a more rational programming of attention and resources to address untreated pain.

Establishing and Maintaining Cancer Control Programs in Africa

The WHO has developed guidelines for regional and national cancer control programs according to national economic development.[4] In its 58th World Health Assembly in 2005, the WHO urged member states to develop and reinforce comprehensive and evidence-based cancer control programs in order to curb the growing global burden of cancer.[10] The WHO recommends cancer control programs in Africa begin in a stepwise approach by implementing one or two key priorities in a demonstration project (Table 12). Such projects could be sustainable only when African countries take the initiative and make the political commitment to invest in the programs with a dedicated budget and required staff. Of course, international public health agencies and donors can and should play major roles in strengthening and broadening such government-based initiatives.

When possible, cancer control programs should be integrated with other established disease control programs because some diseases share the same risk factors or routes of transmission. For example, unsafe sexual practice is a risk factor for both HIV and HPV infections. Therefore, some aspects of cervical cancer prevention programs in sub-Saharan African countries could be integrated with ongoing HIV prevention programs. The successful integration of HBV vaccination into infant immunization programs in Africa and other parts of the world should serve as a model for the integration of preventive measures for many diseases.

The availability of a high-quality, population-based cancer registration system is an important component of any evidence-based cancer control program because cancer registration is essential for assessing the burden of cancer, setting priorities, and implementation and evaluation of cancer control programs.[201-202] However, only 11% of the African population is covered by population-based cancer registries.[203] Further, many cancer registries in Africa do not meet IARC's criteria for high-quality incidence data (completeness, validity, timeliness).[147, 204] Therefore, there is a greater need for establishing or strengthening population-based cancer registration systems in Africa in order to implement effective and evidence-based cancer control programs.

In addition to guiding and evaluating cancer-control programs, cancer registries are also useful for studying the causes (risk factors) of cancer.[205] There are opportunities to identify novel

Table 12. Priority Actions for National Cancer Control Programmes in Countries with Low Resources

National Cancer Control Programme	Prevention	Early Diagnosis	Screening	Curative Therapy	Pain Relief and Palliative Care
• Consider the implementation of one or two key priorities in a demonstration area with a stepwise approach. • Consider palliative care as an entry point to a more comprehensive approach. • Use appropriate technologies that are effective and sustainable in this type of setting.	• Focus on areas where there are great needs and potential for success. • Ensure that priority prevention strategies are targeted to those groups that are influential and can spearhead the process (e.g., policy-makers, and teachers). • Integrate HBV with other vaccination programmes in areas endemic for liver cancer.	• Use low-cost and effective communnity approaches to promote, in a first phase, early diagnosis of one or two priority detectable tumors in a pilot area with relatively good access to diagnosis and treatment.	• If there is already infrastructure for cervical cytology screening for women aged 35 to 40 years once in their lifetime or, if more resources are available, provide screening every 10 years for women aged 30 to 60 years.	• Organize diagnosis and treatment services, giving priority to early detectable tumours.	• Ensure that minimum standards for pain relief are progressively adopted by all levels of care in targeted areas and that there is high coverage of patients through services provided mainly by home-based care.

Source: World Health Organization. *National Cancer Control Programmes: policies and managerial guidelines*. 2nd ed. Geneva: World Health Organization; 2002.

risk factors for cancer in Africa that could advance cancer-prevention measures worldwide in view of the diverse African population with respect to culture, dietary patterns, and other environmental factors and the very limited prior efforts to study the causes of cancer in this population.

What Is the American Cancer Society Doing to Curb the Growing Burden of Cancer in Africa?

The American Cancer Society and its partners in Africa are working to prioritize cancer and other noncommunicable diseases on the region's health and development agenda, and to promote tobacco control throughout Africa. Together with regional stakeholders, the Society raises awareness about the growing burden of cancer in Africa and promotes evidence-based policies and programs for cancer prevention. The Society works with a number of partners in the public and private sectors, including the African Organization for Research and Training in Cancer, Cervical Cancer Action, International Union Against Cancer, International Union for Health Promotion and Education, The Corporate Council on Africa, World Economic Forum, World Health Organization, and a host of community-based civil society organizations as well as media networks, to achieve its regional cancer advocacy objectives. The Society is also working with several leading tobacco-control organizations, including the African-based African Tobacco Control Regional Initiative, African Tobacco Control Alliance, and Framework Convention Alliance, to prevent further increases and realize eventual reductions in the prevalence of smoking in Africa. These efforts are supported by a multi-year grant from the Bill and Melinda Gates Foundation. The American Cancer Society also supports the Global Access to Pain Relief Initiative (GAPRI), which was established in 2009 by the International Union Against Cancer to make pain relief accessible to all cancer patients by 2020. The GAPRI program supports partner governments in sub-Saharan Africa and other regions to improve safe access to opioid analgesics for all patients in treatable pain.

Fighting the Global Burden of Cancer

Effective measures to reduce cancer morbidity and mortality require the active participation of cancer survivors and their local communities; the mobilization and appropriate allocation of resources; the formulation of evidence-based policies and proven interventions; and the commitment of organizations and institutions in the nonprofit, for-profit, and governmental sectors. Ultimately, cancer control goes hand in hand with efforts to promote human and economic development and to improve standards of health, education, and medical care throughout the world.

The Society's Global Priorities

Recognizing the growing global cancer crisis, the American Cancer Society established its Global Health program in 2002. As part of this program, the Society has established three integrated priorities to reduce the burden of cancer: increasing funding for the control of cancer and other noncommunicable diseases; reducing tobacco use, with an initial focus on sub-Saharan Africa; and increasing awareness about the burden of cancer and its leading risk factor, tobacco.

The Global Burden of Noncommunicable Diseases (NCDs)

According to the World Health Organization, noncommunicable diseases (NCDs) – such as cancer, heart disease and diabetes – claim more than 35 million lives each year and account for about 60 percent of all deaths worldwide. About 28 million, or 80 percent, of the people who die, live in low- and middle-income countries.

In addition to the human catastrophe, cancer and other NCDs pose a significant threat to national economies and to the global economic system. The World Economic Forum recently highlighted NCDs as one of the three most likely and severe risks to the global economy, alongside fiscal crises and asset bubbles. According to the World Health Organization, heart disease, stroke, and diabetes alone could reduce the gross domestic product in Russia, China, and India by 1 to 5 percent within five years. In these countries, the cumulative loss in national income from chronic disease between 2005 and 2015 could exceed $1 trillion (US).

Despite these alarming figures, cancer and other noncommunicable diseases are largely overlooked by the global health community. It is estimated that less than 1 percent of private

and public funding for health is allocated to preventing and controlling cancer and other noncommunicable diseases in low- and middle-income countries. Here in the United States, the administration's global health initiative includes no meaningful funding for noncommunicable diseases, despite the existence of cost-effective solutions to prevent or treat these diseases, which can be integrated into existing global health programs.

The American Cancer Society has become actively involved in working with global partners including the International Union Against Cancer (UICC), the International Diabetes Federation, the World Heart Federation, Livestrong Foundation, and others to prioritize cancer and noncommunicable diseases on the global health agenda. We were among many nonprofits in the global health community to advocate for a special United Nations High-level Summit to take place in September 2011 focusing on noncommunicable diseases. This summit will be instrumental to balancing global health funding and integrating low-cost interventions for cancer and other NCDs into existing health care systems.

Tobacco Control in sub-Saharan Africa

In 2010, the American Cancer Society received a $7 million (US) grant from the Bill & Melinda Gates Foundation to spearhead a collaborative effort to prevent and reduce tobacco use in sub-Saharan Africa by implementing proven tobacco control strategies at the national and local level. Partners in this effort include the Africa Tobacco Control Regional Initiative based in Lagos, Nigeria; Africa Tobacco Control Alliance based in Lome, Togo; the Framework Convention Alliance; the Campaign for Tobacco-Free Kids; and the International Union Against Tuberculosis and Lung Disease.

The American Cancer Society and its partners will assist national governments and civil society to implement policies such as advertising bans, tobacco tax increases, graphic warning labels, and the promotion of smoke-free environments recommended by the WHO Framework Convention on Tobacco Control (FCTC), the world's first public health treaty. In addition, the partners will advocate for further tobacco control resources in the region and will protect existing laws from tobacco industry efforts to overturn them and halt crucial progress.

We will continue to work with our global partners to increase awareness for the growing global cancer and tobacco burden and its impact on low-and middle-income countries. As advocates for more focused attention on cancer and other noncommunicable diseases, we produce and share information on cancer and tobacco control issues for domestic and global audiences.

Data Sources and Methods

Cancer incidence data are available from the International Agency for Research on Cancer (IARC) in the Cancer Incidence in Five Continents (CI5) database for select registries worldwide with high-quality data. Cancer incidence data in the most recent volume (IX) of CI5 cover about 11% of the world population[147] (http://ci5.iarc.fr/CI5i-ix/ci5i-ix.htm). Cancer incidence estimates for all countries worldwide are prepared by IARC and made available in the GLOBOCAN 2008 database[2] (globocan.iarc.fr/). The methods used to estimate the sex- and age-specific incidence rates for specific countries are described elsewhere and are dependent on the availability and accuracy of cancer incidence and mortality data for each country.[206] For countries without any cancer incidence or mortality data, as is the case in many developing countries, estimates were created using frequency data or the rates of neighboring countries.

Mortality data are collected in all industrialized countries and some developing countries. These data, covering approximately one-third of the world population, are abstracted from death certificates and compiled by IARC in the WHO cancer mortality database (www-dep.iarc.fr/WHOdb/WHOdb.htm). The quality of mortality data varies by country, with high accuracy of underlying cause of death in developed countries and low accuracy in developing countries.

Incidence and Mortality Rates

Incidence and mortality rates are the two most frequently used measures of cancer occurrence. These statistics quantify the number of newly diagnosed cancer cases or deaths, respectively, in a specified population over a defined time period. Incidence and death rates are usually expressed per 100,000 people per year.

Age Standardization

Age standardization simplifies comparisons of incidence and mortality rates among populations that have different age compositions. The usual approach to age standardization in surveillance data is to apply the age-specific rates in the populations of interest to a standard set of weights based on a common age distribution. This eliminates the effect of the differences in age structure among the populations being compared and provides a hypothetical rate that would be observed in each population had its age composition been the same as that of the standard population. An age-standardized rate (ASR) is a

summary measure of a rate that a population would have if it had a standard age structure. Age-standardized rates are only comparable when the same age standard is applied to each of the populations being compared. This is not the case currently in surveillance data from different sources. The international data presented in this publication are all standardized to the 1960 world standard population used by IARC. In contrast, cancer incidence and mortality data in the United States and several European countries published elsewhere are standardized to the 2000 US and European standard populations, respectively.

Therefore, data presented in this publication cannot be compared with those published elsewhere using a different standard population for age adjustment.

New Cancer Cases and Deaths

Another measure of the cancer burden in a population is the total number of new cases and deaths that occur in a given year. These counts reflect the absolute number of affected individuals and patients who require medical care and social services. Estimates of the number of new cancer cases and deaths for the year 2008 were obtained from GLOBOCAN 2008.[2]

Survival Rates

The survival rate reflects the proportion of people alive at a specified period after a diagnosis, usually five years. The two basic measures of survival are observed and relative. The observed survival rate quantifies the proportion of cancer patients alive after five years of follow-up since diagnosis, irrespective of deaths from conditions other than cancer. In contrast, relative rate reflects the proportion of people alive five years after diagnosis compared to that in a population of equivalent age and sex without cancer. This accounts for deaths from other causes. Survival data are available for countries in North America and Europe and for some developing countries.[5, 44-45, 53, 140] The large variation in survival rates across countries/regions reflects a combination of differences in the mix of cancer types, the prevalence of screening and diagnostic services, and/or the availability of effective and timely treatment. Methodological problems relating to incompleteness of registration and follow-up also contribute to apparent differences.

Developed vs. Developing Countries

GLOBOCAN 2008 and United Nations

More economically developed regions' rates have been estimated as the population-weighted average of all regions of Europe plus North America, Australia/New Zealand, and Japan. Less developed regions' rates have been estimated as the population-weighted average of all regions of Africa, all regions of Asia (excluding Japan), the Caribbean, Central America, South America, Melanesia, Micronesia, and Polynesia.

World Bank Income Group

Economies are divided according to 2008 gross national income (GNI) per capita, calculated using the World Bank Atlas method. The groups are: low income, $975 (US) or less; lower-middle income, $976-$3,855 (US); upper-middle income, $3,856-$11,905 (US); and high income, $11,906 (US) or more. **Low-income economies:** Afghanistan, Bangladesh, Benin, Burkina Faso, Burundi, Cambodia, Central African Republic, Chad, Comoros, Congo Dem. Rep, Eritrea, Ethiopia, Gambia, Ghana, Guinea, Guinea-Bissau, Haiti, Kenya, Korea Dem Rep, Kyrgyz, Republic, Lao PDR, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Myanmar, Nepal, Niger, Rwanda, Senegal, Sierra Leone, Somalia, Tajikistan, Tanzania, Togo, Uganda, Uzbekistan, Vietnam, Yemen, Zambia, Zimbabwe. **Lower-middle income economies:** Albania, Angola, Armenia, Azerbaijan, Belize, Bhutan, Bolivia, Cameroon, Cape Verde, China, Congo Rep., Cote d'Ivoire, Djibouti, Ecuador, Egypt, Arab Rep., El Salvador, Georgia, Guatemala, Guyana, Honduras, India, Indonesia, Iran, Islamic Rep., Iraq, Jordan, Kiribati, Kosovo, Lesotho, Maldives, Marshall Islands, Micronesia Fed. Sts., Moldova, Mongolia, Morocco, Nicaragua, Nigeria, Pakistan, Papua New Guinea, Paraguay, Philippines, Samoa, Sao Tome and Principe, Solomon Islands, Sri Lanka, Sudan, Swaziland, Syrian Arab Republic, Thailand, Timor-Leste, Tonga, Tunisia, Turkmenistan, Ukraine, Vanuatu, West Bank and Gaza. **Upper-middle income economies:** Algeria, American Samoa, Argentina, Belarus, Bosnia and Herzegovina, Botswana, Brazil, Bulgaria, Chile, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Fiji, Gabon, Grenada, Jamaica, Kazakhstan, Latvia, Lebanon, Libya, Lithuania, Macedonia FYR, Malaysia, Mauritius, Mayotte, Mexico, Montenegro, Namibia, Palau, Panama, Peru, Poland, Romania, Russian Federation, Serbia, Seychelles, South Africa, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Turkey, Uruguay, and Venezuela, RB. **High-income economies:** Andorra, Antigua and Barbuda, Aruba, Australia, Austria, Bahamas The, Bahrain, Barbados, Belgium, Bermuda, Brunei Darussalam, Canada, Cayman Islands, Channel Islands, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Equatorial Guinea, Faeroe Islands, Finland, France, French Polynesia, Germany, Greece, Greenland, Guam, Hong Kong (China), Hungary, Iceland, Ireland, Isle of Man, Israel, Italy, Japan, Korea Rep., Kuwait, Liechtenstein, Luxembourg, Macao (China), Malta, Monaco, Netherlands, Netherlands Antilles, New Caledonia, New Zealand, Northern Mariana Islands, Norway, Oman, Portugal, Puerto Rico, Qatar, San Marino, Saudi Arabia, Singapore, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Trinidad and Tobago, United Arab Emirates, United Kingdom, United States, and Virgin Islands (US).

UN Areas

Eastern Africa: Burundi, Comoros, Djibouti, Eritrea, Ethiopia, Kenya, La Reunion (France), Madagascar, Malawi, Mauritius, Mozambique, Rwanda, Somalia, Tanzania, Uganda, Zambia, and Zimbabwe. **Middle Africa:** Angola, Cameroon, Central African Republic, Chad, Democratic Republic of Congo, Republic of Congo, Equatorial Guinea, and Gabon. **Northern Africa:** Algeria, Egypt, Libya, Morocco, Sudan, Tunisia, and Western Sahara. **Southern Africa:** Botswana, Lesotho, Namibia, South African Republic, and Swaziland. **Western Africa:** Benin, Burkina Faso, Cape Verde, Cote d'Ivoire, Gambia, Ghana, Guinea-Bissau, Guinea, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, and Togo. **Caribbean:** Bahamas, Barbados, Cuba, Dominican Republic, Guadeloupe (France), Haiti, Jamaica, Martinique (France), Puerto Rico, and Trinidad and Tobago. **Central America:** Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, and Panama. **South America:** Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, French Guyana, Guyana, Paraguay, Peru, Suriname, Uruguay, and Venezuela. **North America:** Canada, United States of America **Eastern Asia:** China, Japan, Democratic People's Republic of Korea, Republic of Korea, Mongolia, Taiwan **Southeast Asia:** Brunei Darussalam, Cambodia, Indonesia, Lao People Democratic Republic, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam. **South-Central Asia:** Afghanistan, Bangladesh, Bhutan, India, Islamic Republic of Iran, Kazakhstan, Kyrgyzstan, Nepal, Pakistan, Sri Lanka, Tajikistan, Turkmenistan, and Uzbekistan. **Western Asia:** Armenia, Azerbaijan, Bahrain, Gaza Strip and West Bank (Palestine), Georgia, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syrian Arab Republic, Turkey, United Arab Emirates, and Yemen. **Central and Eastern Europe:** Belarus, Bulgaria, Czech Republic, Hungary, Republic of Moldova, Poland, Romania, Russian Federation, Slovakia, and Ukraine. **Northern Europe:** Denmark, Estonia, Finland, Iceland, Ireland, Latvia, Lithuania, Norway, Sweden, and United Kingdom. **Southern Europe:** Albania, Bosnia Herzegovina, Croatia, Cyprus, Greece, Italy, Former Yugoslav Republic of Macedonia, Montenegro, Malta, Portugal, Serbia, Slovenia, Spain **Western Europe:** Austria, Belgium, France, Germany, Luxembourg, The Netherlands, Switzerland. **Australia/New Zealand:** Australia, and New Zealand. **Melanesia:** Fiji, New Caledonia, Papua New Guinea, Solomon Islands, and Vanuatu. **Micronesia:** Guam **Polynesia:** French Polynesia and Samoa.

WHO Regions

African Region: Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, Côte d'Ivoire, Democratic Republic of the Congo, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, South Africa, Swaziland, Togo, Uganda, United Republic of Tanzania, Zambia, and Zimbabwe. **Region of the Americas:** Antigua and Barbuda, Argentina, Bahamas, Barbados, Belize, Bolivia, Brazil, Canada, Chile, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, Trinidad and Tobago, United States of America, Uruguay, and Venezuela. **Eastern Mediterranean Region:** Afghanistan, Bahrain, Djibouti, Egypt, Iran (Islamic Republic of), Iraq, Jordan, Kuwait, Lebanon, Libyan Arab Jamahiriya, Morocco, Oman, Pakistan, Qatar, Saudi Arabia, Somalia, Sudan, Syrian Arab Republic, Tunisia, United Arab Emirates, and Yemen. **European Region:** Albania, Andorra, Armenia, Austria, Azerbaijan, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Luxembourg, Malta, Monaco, Montenegro, Netherlands, Norway, Poland, Portugal, Republic of Moldova, Romania, Russian Federation, San Marino, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Tajikistan, the former Yugoslav Republic of Macedonia, Turkey, Turkmenistan, Ukraine, United Kingdom, and Uzbekistan. **Southeast Asia Region:** Bangladesh, Bhutan, Democratic People's Republic of Korea, India, Indonesia, Maldives, Myanmar, Nepal, Sri Lanka, Thailand, and Timor-Leste. **Western Pacific Region:** Australia, Brunei Darussalam, Cambodia, China, Cook Islands, Fiji, Japan, Kiribati, Lao People's Democratic Republic, Malaysia, Marshall Islands, Micronesia (Federated States of), Mongolia, Nauru, New Zealand, Niue, Palau, Papua New Guinea, Philippines, Republic of Korea, Samoa, Singapore, Solomon Islands, Tonga, Tuvalu, Vanuatu, and Vietnam.

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