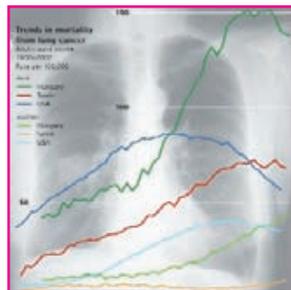
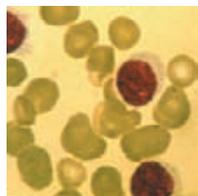
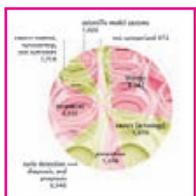


- Every year 7 million people die from cancer
- 16 million new cancer cases and 10 million deaths are expected by 2020
- Yet cancer can be one of the most preventable and curable of the life-threatening diseases

This atlas is a unique resource for professionals and individuals in the global battle to reduce cancer.

It illustrates compelling data from around the world in full colour maps and graphics to provide a clear picture and better understanding of cancer locally, nationally and globally. It shows the causes, stages of development, and rates of different types of cancers by sex, income group and region. It also examines the economics of the disease, both in terms of healthcare and commercial interests, and the steps being taken to curb the epidemic, from research and screening to cancer management programmes and health education.

- Topics include:
- Mechanism of tumour development
  - Risk factors: tobacco; reproductive and hormonal factors; infection; diet and nutrition; and ultraviolet radiation
  - Cancer in children
  - Cancer survivors
  - Cancer registries
  - Research
  - Primary prevention
  - Early detection
  - Management and treatment
  - Cancer organizations
  - Health education
  - Policies and legislation
  - The future of the epidemic



**m** a myriad edition

# THE CANCER ATLAS

Mackay, Jemal, Lee & Parkin

THE CANCER ATLAS

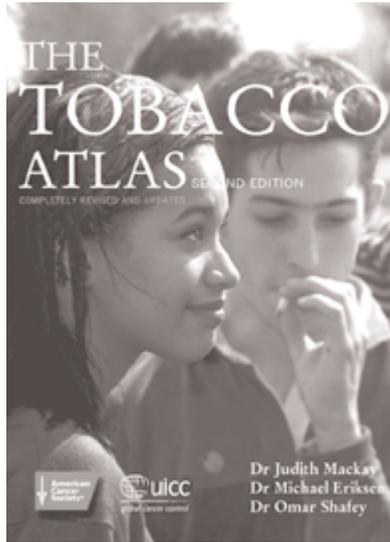
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 Dr Ahmedin Jemal  
 Dr Nancy C Lee  
 Dr D Maxwell Parkin



ACS

# THE CANCER ATLAS

Also published by the  
American Cancer Society:



## THE CANCER ATLAS

Dr Judith Mackay  
Dr Ahmedin Jemal  
Dr Nancy C Lee  
Dr D Maxwell Parkin



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# FOREWORDS

A message from

**John R Seffrin, PhD**  
Chief Executive Officer  
American Cancer Society



Cancer is potentially one of the most preventable and curable chronic life-threatening diseases. Nevertheless, in 2002 there were an estimated 11 million new cancer cases and nearly 7 million cancer deaths worldwide. By 2020, more than 16 million new cancer cases and 10 million deaths are expected. Seventy percent of these deaths will likely occur in developing countries that are unprepared to address their growing cancer burdens.

We know cancer can be controlled. Declining mortality rates for many cancers in developed nations prove it. But without aggressive intervention, similar results may not be seen elsewhere. Real progress requires a concerted effort at all levels of society. That's why the American Cancer Society and the International Union Against Cancer offer programmes designed to help the global cancer community – especially emerging cancer societies – achieve long-term success in cancer control. Along with our partners at the Centers for Disease Control and Prevention and International Agency for Cancer Research, we are working to lay a foundation for global cancer control and prevention.

Because these organizations share ambitious goals, I am proud to welcome the timely publication of *The Cancer Atlas*, another important step in our collective effort. Here are compelling, evidence-based data to help cancer control experts around the world combat the disease locally, nationally,

and globally. Information is a powerful tool in the hands of passionate, dedicated individuals, and this book is an important new resource to arm and inform cancer control professionals worldwide.

In addition to the leading-edge information we need to inform our cancer control strategies, *The Cancer Atlas* also provides an intangible, powerful weapon – hope. The significant and exciting updates chronicled within these pages prove that our broad network of determined cancer control professionals are making a difference for the world. Together, we can empower the developing world to alleviate its cancer burden. With *The Cancer Atlas* in our arsenal, we will continue to move toward victory over cancer.

JOHN R SEFFRIN  
Atlanta, USA

A message from

**Julie Louise Gerberding, MD, MPH**  
Director  
Centers for Disease Control and Prevention



The Centers for Disease Control and Prevention is pleased to have played a role in producing the first-ever *Cancer Atlas*, the third in a series of atlases describing important issues related to chronic diseases worldwide.

The cancer community has made extraordinary progress in many parts of the world. In Europe, death rates for several common cancers are decreasing steadily, and in the USA, death rates from all cancers combined have dropped 1.1 percent per year since 1993. These successes are due in part to public health efforts targeting prevention and early detection of cancer, as well as advances in cancer treatment.

Nonetheless, approximately 11 million people worldwide are diagnosed with cancer annually, and almost 7 million people die of the disease each year. Additionally, more than 25 million people are surviving for years after a cancer diagnosis.

A troubling fact is that cancer incidence, survival rates, and quality of life for survivors vary greatly from country to country, depending on differences in exposure to risk factors, availability of public health resources for cancer control efforts, and access to the latest advances in screening and treatment. For example, cervical cancer is the leading cancer in women in developing countries, where organized screening programmes do not exist. In developed countries, where cervical cancer screening is widespread, cervical cancer accounts for only four percent of cancers in women.

To address these disparities, public health agencies and organizations worldwide are assessing local resources, enhancing healthcare infrastructure, and implementing proven cancer-prevention strategies. These strategies must include efforts to prevent the initiation of smoking among adolescents, combat the rise in smoking among women in developing countries, increase the use of proven screening and early-detection methods, and close the large gap in health resources between rich and poor nations.

As the public health community works toward relieving the worldwide burden of cancer, it is important that we consider the entire cancer continuum – from prevention through screening, early detection, diagnosis, treatment, survivorship, palliation, and end-of-life care. To ensure success, we must join forces with researchers, healthcare providers, the private sector, and governments. I encourage you to use this atlas to improve and inform your efforts to prevent and control cancer.

JULIE LOUISE GERBERDING  
Atlanta, USA

## A message from

**Peter Boyle**  
**Director of the International Agency for  
 Research on Cancer**



Forty years ago, when the International Agency for Research on Cancer (IARC) was established, cancer was a disease largely confined to the industrialized, high-resource countries. Today, in marked contrast, the majority of the global cancer burden is in low- and medium-resource countries. This atlas illustrates the global scope of the cancer epidemic – highlighting the variations, similarities and sex differences in cancer incidence and deaths. While there are several clearly identified risk factors and we are steadily learning about additional risk factors, there remains a significant proportion of the global cancer burden that we are unable to explain, or advocate steps to avoid, within our current knowledge. The atlas also highlights the importance of cancer surveillance systems, including registries, and of cancer research. These are essential to our understanding of the epidemic, of planning resources, and of taking preventive action.

The IARC is part of the World Health Organization. The Agency's work has four main objectives: monitoring global cancer occurrence, identifying the causes of cancer, elucidating the mechanisms of carcinogenesis, and developing scientific strategies for cancer control. The role of IARC among cancer research institutes is characterized by its focus on research of direct relevance to cancer prevention in international populations, by its emphasis on studies that combine epidemiological and laboratory approaches, and by the special forum and support it provides for international collaborations.

The main emphasis of IARC's research programme is on epidemiology and environmental carcinogenesis and IARC also makes a significant contribution in the area of research training. This emphasis reflects the generally accepted notion that 80 percent of all cancers are, directly or indirectly, linked to environmental factors, and thus are potentially preventable; second, the recent

recognition of the fact that epidemiology may play an important part in cancer prevention and in the evaluation of prevention measures; lastly, the fact that geographical variations in cancer incidence almost certainly reflect differences in the environment and are therefore particularly well suited for international research efforts.

Epidemiological research is thus orientated towards two areas: on the one hand, descriptive studies show the trends of cancer incidence and mortality in different populations and geographical areas and, on the other hand, analytical studies focus on the relationships between incidence and mortality and specific risk factors (tobacco use, alcohol consumption, chronic infections, diet, some professional exposures, etc). IARC is, therefore, different from all other research institutes, in that it brings an international dimension to studies on human cancer and the relationships of people and their environment.

I commend the authors of this atlas for bringing a strong sense of the global nature of the cancer burden throughout this book. As Director of the IARC, I am very pleased to see that much of the data used in this atlas is from the IARC database, thus giving the collected statistics a wider audience.

PETER BOYLE  
 Lyon, France

With full-colour maps and graphics, this atlas illustrates the world's cancer burden and describes efforts to address that burden. It also includes historical highlights, predictions for the future and useful contact information. Readers will learn about the various risk factors for cancer; the costs of cancer; the remarkable differences and similarities in the patterns of cancer around the world; and efforts to prevent, detect and treat cancer. The atlas is for anyone concerned about cancer, including cancer survivors, their families and friends. It is also for those concerned with health policy, public health, health economics, gender issues, resource allocation and human development.

Highlighting the fact that the burden of cancer is increasing in developing countries, which have fewer resources to address the problem, the atlas asserts the importance of a multifaceted approach to reducing the burden of cancer. Such an approach requires the participation of governmental agencies in many nations, the business sector, non-profit organizations, the World Health Organization and the general public. In short, it requires the input of all of civil society.

The anti-cancer movement has developed many successful strategies contributing to the control of cancer around the world, and this atlas highlights a few of those successes, including the establishment of cancer registries; research efforts in developing and developed countries; breakthroughs in prevention, early detection and treatment; and improvements in the lives of those affected by cancer.

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## 1 Mechanism of tumour development

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## 18 Cancer registries

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## 25 Health education

Thailand World Cancer Day 2003 © WHO/H Anenden

## 27 The future

Amy, Hong Kong © Guy Nowell

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**Dr D Maxwell Parkin** is an epidemiologist attached to the Clinical Trials Service Unit and Epidemiological Studies Unit at the University of Oxford, UK. He worked at the International Agency for Research on Cancer from 1981-2004 as head of the Descriptive Epidemiology Unit. He is currently President of the International Association of Cancer Registries (IACR). His main research interests are in descriptive epidemiology (international cancer patterns and trends), with a major concern for cancer registration, and in early detection (screening) for cancer. He has published more than 300 papers in the international scientific literature.



# GLOSSARY

**Adenocarcinoma** – cancer that begins in cells that line certain internal organs and that have glandular properties (the ability to generate a substance).

**Aflatoxin** – harmful substance made by certain types of *Aspergillus* mould that may be found on poorly stored grains and nuts. Consumption of foods contaminated with aflatoxin is a risk factor for hepatocellular (liver) cancer.

**Age-specific rate** – a rate for a specified age group. The numerator and denominator refer to the same age group.

**Age standardization** – a technique that allows comparison of incidence (or mortality) rates between populations, without the effect of any differences that are due to their age structures. **The Age-Standardized Rate (ASR)** used in this atlas is the rate that a population would have if it had the same age structure as a “standard” population. The most frequently used standard population is the world standard population. The calculated incidence or mortality rate is then called the world age standardized incidence or mortality rate. It is expressed as a rate per 100,000.

**Asbestos** – a natural material that is made of tiny fibres and used in insulation. Asbestos exposure is a risk factor for several cancers, including lung cancer.

**Benign tumour** – an abnormal growth that is not cancer and does not spread to other areas of the body.

**Body mass index (BMI)** – a measure of a person’s weight in relation to his or her height calculated as weight in kilogrammes divided by height in metres squared.

**Cancer** – a disease in which abnormal cells divide uncontrollably. Cancer cells can invade nearby tissues, and spread through the bloodstream and lymphatic system to other parts of the body.

**Cancer screening programmes** – programmes organized at a national or regional level that have (1) an explicit policy, (2) a team responsible for organizing the screening and delivering appropriate healthcare, and (3) a structure for assuring quality screening and follow-up of abnormal screening tests.

- national screening programme: population-based screening programme organized at the national level
- sub-national screening programme: population-based screening programme organized at the sub-national level
- pilot screening programme: pilot population-based screening programme, typically organized at the sub-national level
- public health policy only: established national policy for cancer screening, but no population-based screening programme (in the USA, opportunistic screening and organized programmes for HMO private health provider members and low-income qualified individuals are available).

**Carcinogen** – any substance – chemical, physical or biological – that causes cancer. Examples include tobacco smoke, asbestos, human papillomavirus and ultraviolet radiation.

**Carcinoma** – a cancerous tumour that begins in the lining layer (epithelial cells) of organs. At least 80% of all cancers are carcinomas.

**Cervical cancer** – cancer of the lower, narrow end of the uterus that forms a canal between the uterus and vagina. Development of cervical cancer requires previous infection with human papillomavirus (HPV).

**Chemotherapy** – treatment with drugs to destroy cancer cells. Chemotherapy may be used alone, or in combination with surgery or radiation, to treat cancer when the cancer has spread, when the cancer has come back (recurred), or when there is a strong chance that the cancer could recur.

**Cobalt machines** – use a radioactive form of the metal cobalt as a source of radiation to treat cancer.

**Colonoscopy** – examination of the colon with a long, flexible, lighted tube called a colonoscope. The doctor looks for polyps or early cancers during the exam and removes them using a wire passed through the colonoscope.

**Computerized Tomography (CT)** – a series of detailed pictures of areas inside the body taken from different angles; the pictures are created by a computer linked to an x-ray machine. Also called computerized axial tomography (CAT) scan. A special kind of CT machine, the spiral CT, has been used to look for early lung cancer, but it is still uncertain whether such a test will be an effective cancer screening tool.

**Developed countries** – the United Nations Population Division divides the world’s regions into two categories – “more developed” and “less developed.” The more developed regions include Australia/New Zealand, Europe, Northern America, and Japan.

**Developing countries** – the United Nations Population Division divides the world’s regions into two categories – “more developed” and “less developed.” The less developed regions which this atlas calls “developing countries” include all the regions of Africa, Asia (excluding Japan), Latin America, and the Caribbean, as well as Melanesia, Micronesia, and Polynesia. The World Bank excludes from “developing” regions such affluent countries as Singapore.

**Diagnosis** – the process of identifying a disease by the signs and symptoms, as well as medical tests and tissue biopsy as needed.

**Direct costs** – expenditures for medical procedures and services associated with the treatment and care of people with cancer.

**Electron accelerator machines** – used in medical radiation therapy, these machines accelerate tiny charged particles called electrons, and deliver uniform doses of high-energy x-ray to the region of the patient’s tumour. These x-rays can destroy the cancer cells while sparing the surrounding normal tissue.

**Endometrial cancer** – cancer of the layer of tissue that lines the uterus. A risk factor for endometrial cancer is exposure to excess amounts of the hormone oestrogen.

**Exogenous hormones** – hormones that are derived from outside the body, such as oral contraceptives and hormone replacement therapy.

**Epidemic** – occurrence of an illness, condition or behaviour that affects many people in the same region during a specified period of time. To constitute an epidemic, this occurrence must exceed normal occurrence in the region.

**European Union 25 (EU-25)** – Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Slovak Republic (Slovakia), Slovenia, Spain, Sweden and UK.

**Faecal occult blood test** – a test used to screen for colorectal cancer. It looks for hidden blood in the stools, the presence of which could be a sign of cancer.

**Hepatocellular carcinoma** – the most common type of cancer originating in the liver.

**Hormone replacement therapy (HRT)** – hormones (oestrogen, progesterone, or other types) given to women after menopause to replace the hormones no longer produced by the ovaries.

**Human papillomavirus (HPV)** – a virus that can cause abnormal tissue growth and other changes to cells. Infection with certain types of HPV increases the risk of developing cervical cancer.

**Incidence** – the number of new cases of cancer that occur in a defined population during a specified period of time. “Incidence rate” is the rate at which new cases occur in a population, and is calculated by dividing the number of new cases that occur during a specified time period by the total number of people in the defined population.

**Indirect costs** – costs related to – but not immediately associated with – the detection, diagnosis and treatment of cancer. These may include lost income due to premature death, short-term or long-term disability, and psychological costs.

**Kaposi sarcoma** – a type of cancer characterized by the abnormal growth of blood vessels that develop into skin lesions or occur internally. It is caused by Human herpesvirus-8. The risk of developing Kaposi sarcoma in a person who has Human herpesvirus-8 increases significantly if the person also has the virus that causes AIDS.

**Leukaemia** – cancer of the blood or blood-forming organs.

**Lumpectomy** – surgery to remove a breast lump or tumour and a small amount of surrounding normal tissue.

**Lymphoma** – a cancer of the lymphatic system. The lymphatic system is a network of thin vessels and nodes throughout the body. The two main types of lymphoma are Hodgkin lymphoma (or disease) and non-Hodgkin lymphoma. The treatment methods for these two types of lymphomas are different.

**Malignant tumour** – a mass of cancer cells that may invade surrounding tissues or spread (metastasize) to distant areas of the body.

**Melanoma** – a cancerous (malignant) tumour that begins in the cells that produce the skin coloring (melanocytes). Melanoma is almost always curable in its early stages. However, it is likely to spread, and once it has spread to other parts of the body the chances for a cure decrease.

**Menarche** – the first menstrual period, usually occurring during puberty.

**Menopause** – the time period marked by the permanent cessation of menstruation, usually occurring between the ages of 45 and 55.

**Metastasis** – the distant spread of cancer from its primary site to other parts of the body.

**Morbidity** – any departure from physiological or psychological well-being. Measures of morbidity for people living with cancer may include disability, pain, time away from work, or days spent in the hospital.

**Mortality** – the number of deaths from cancer that occur in a population during a specified period of time. Mortality rate is the rate at which deaths occur in a population, and is calculated by dividing the number of deaths that occur during a specified period of time by the number of people in the specified population.

**Ovarian cancer** – cancer occurring in one of a pair of female reproductive glands in which the ova, or eggs, are formed. The ovaries are located in the pelvis, one on each side of the uterus.

**Neoplasm** – an abnormal growth (tumour) that starts from a single altered cell; a neoplasm may be benign or malignant. Cancer is a malignant neoplasm.

**Neuroblastoma** – cancer that arises in immature nerve cells and affects mostly infants and children.

**Palliative care** – an approach that aims to improve the quality of life for patients and families facing the problems associated with life-threatening cancers. It provides for prevention and relief of suffering, through treatment for pain and other symptoms, as well as through spiritual and psychosocial support, at the time of cancer diagnosis, through the end of life, and during family bereavement.

**Prevalence** – a measure of the proportion of persons in the population with a certain disease, condition or behaviour at a given time.

**Prognosis** – prediction of the course of a cancer, and the outlook for a cure.

**Radiotherapy** – the use of radiation to kill cancer cells or stop them from dividing.

**Radon** – a radioactive gas that is released by uranium, a substance found in soil and rock. Radon is a risk factor for lung cancer.

**Retinoblastoma** – a rare form of eye cancer that affects the retina of infants and young children.

**Sarcoma** – a cancer of the bone, cartilage, fat, muscle, blood vessels, or other connective or supportive tissue.

**Sigmoidoscopy** – a test to help find cancer or polyps on the inside of the rectum and part of the colon. A slender, hollow, lighted tube is placed into the rectum. The doctor is able to look for polyps or other abnormalities. The sigmoidoscope is shorter than the colonoscope.

**Solar irradiation** – see ultraviolet radiation below.

**Survival** – the proportion (or percentage) of persons with a given cancer who are still alive after a specified time period (eg 1, 3, or 5 years) following diagnosis.

**Total fertility rate** – average number of births during a woman’s lifetime, given current childbearing patterns.

**Ultraviolet (UV) radiation** – invisible rays that are part of the energy that comes from the sun. UV radiation also comes from sun lamps and tanning beds. UV radiation can damage the skin, lead to premature aging, and cause melanoma and other types of skin cancer.

**Wilms tumour** – a type of kidney cancer that usually occurs in children younger than 5 years of age.