

235. Ugolini, F. *et al.* WNT pathway and mammary carcinogenesis: loss of expression of candidate tumor suppressor gene *SFRP1* in most invasive carcinomas except of the medullary type. *Oncogene* **20**, 5810–5817 (2001).

236. Uematsu, K. *et al.* Activation of the Wnt pathway in non small cell lung cancer: evidence of dishevelled overexpression. *Oncogene* **22**, 7218–7221 (2003).

237. Uematsu, K. *et al.* Wnt pathway activation in mesothelioma: evidence of Dishevelled overexpression and transcriptional activity of β -catenin. *Cancer Res.* **63**, 4547–4551 (2003).

238. Wissmann, C. *et al.* WIF1, a component of the Wnt pathway, is down-regulated in prostate, breast, lung, and bladder cancer. *J. Pathol.* **201**, 204–212 (2003).

239. Yoshikawa, S., McKinnon, R. D., Kokel, M. & Thomas, J. B. Wnt-mediated axon guidance via the *Drosophila* Derailed receptor. *Nature* **422**, 583–588 (2003).

240. Tao, Q. *et al.* Maternal wnt11 activates the canonical wnt signaling pathway required for axis formation in *Xenopus* embryos. *Cell* **120**, 857–871 (2005).

241. Li, X. *et al.* Sclerostin binds to LRP5/6 and antagonizes canonical Wnt signaling. *J. Biol. Chem.* **280**, 19883–19887 (2005).

242. Semenov, M., Tamai, K. & He, X. SOST is a ligand for LRP5/LRP6 and a Wnt signaling inhibitor. *J. Biol. Chem.* **280**, 26770–26775 (2005).

243. Takeda, H. *et al.* Human sebaceous tumors harbor inactivating mutations in LEF1. *Nature Med.* **12**, 395–397 (2006).

244. Martello, G. *et al.* MicroRNA control of Nodal signalling. *Nature* **449**, 183–188 (2007).

245. Barker, N. *et al.* Identification of stem cells in small intestine and colon by marker gene *Lgr5*. *Nature* **449**, 1003–1007 (2007).

Acknowledgements

We thank C. Birchmeier and R. Hodge for helpful discussions and improving our text. J. Fritzmänn advised us on drugs and clinical aspects. The work of our laboratory is funded by the German Research Foundation (DFG), the German Cancer Aid (Deutsche Krebshilfe), and the German Federal Minister of Research and Technology (BMBF).

DATABASES

Entrez Gene: <http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?db=gene>
[Apc](#) | [armadillo](#) | [\$\beta\$ -TrCP](#) | [caveolin](#) | [CBP](#) | [CCL9](#) | [CK1 \$\alpha\$](#) | [CTNNB1](#) | [dishevelled](#) | [DKK1](#) | [FAM123B](#) | [EGF4](#) | [EGF18](#) | [Frizzled](#) | [FZD10](#) | [Hyrax](#) | [Indian hedgehog](#) | [Int1](#) | [Islet1](#) | [KRAS](#) | [Kremen](#) | [lef1](#) | [Legless](#) | [LRP5](#) | [LRP6](#) | [MYC](#) | [Norrin](#) | [NRCAM](#) | [OLIG3](#) | [porcupine](#) | [Pygopus](#) | [SMAD2](#) | [SMAD4](#) | [TP53](#) | [Ultrabithorax](#) | [VEGF](#) | [WIF1](#) | [WNT1](#) | [WNT2B](#) | [Wnt5a](#) | [Wntless](#) | [zeste.white.3](#)
National Cancer Institute: http://www.cancer.gov/colon_cancer | [hepatocellular carcinoma](#) | [medulloblastoma](#) | [melanoma](#) | [thyroid tumours](#) | [Wilms tumours](#)

FURTHER INFORMATION

W. Birchmeier's homepage: http://www.mdc-berlin.de/en/research/research_teams/signal_transduction_invasion_and_metastasis_of_epithelial_cells/index.html
Avalon: <http://www.avalonrx.com/content.aspx?id=36>
Curis: <http://www.curis.com/pipeline.php>
Nuvelo: <http://www.nuvelo.com>
Roel Nusse's webpage: <http://www.stanford.edu/~nusse/wntwindow.html>
The Genetics Company: <http://www.the-genetics.com/?menu=therapeutics&sub=wntinhibitors&doc=main>

SUPPLEMENTARY INFORMATION

See online article: [S1](#) (table)

ALL LINKS ARE ACTIVE IN THE ONLINE PDF

to tackle this disease. Raising awareness of this looming epidemic in Africa is the first step. If the international cancer community takes concerted action now, working in partnership with the African Health Ministries, another tragedy can be prevented. To establish cancer care programmes in African countries requires the integration of clinical and public-health systems so as to be truly comprehensive, and must bring together prevention, early detection and diagnosis, treatment, palliative care and the investment needed to deliver these services. This will require trained staff, equipment, relevant drugs and information systems, supported by broad and effective partnerships between local health-care delivery systems, research institutions, international organizations, non-governmental organizations (NGOs), national governments in developed and developing countries, and the pharmaceutical industry. The relevant organizations and individuals must be brought together to develop achievable and sustainable national cancer plans that are evidence-based, priority-driven and resource-appropriate for African countries.

Cancer burden

In 2002, 7.6 million people worldwide died of cancer. This was 13% of the global mortality burden and, perhaps surprisingly, more than the number of deaths from HIV/AIDS, TB and malaria combined (~5.6 million)³ (FIG. 1a).

The World Health Organization (WHO) has estimated that the global cancer burden will increase, according to current trends, from 10 million new cases per year in 2000 to 16 million in 2020. Remarkably, 70% of these cases will be in the developing world, rising from 5.2 million annually to 8.8 million by 2020, an increase of ~60%. Sub-Saharan Africa will account for >1 million of these cases by 2020 (REF. 4).

Although the AIDS epidemic has seen the relatively indolent tumour [Kaposi sarcoma](#) leap to the top of the cancer league tables for Uganda, Swaziland, Malawi and Zimbabwe, FIG. 2 shows the other prevalent tumour types, with [cervical](#) and [breast carcinoma](#) predominating in women and [prostate](#) and [liver cancer](#) in men⁵.

Cancer infrastructure in Africa

One of the levers used to promote investment in cancer control in developed countries was the international comparison of relative spend and infrastructure in neighbouring nations, the lobbyists using these

SCIENCE AND SOCIETY

The challenge of cancer control in Africa

Rebecca J. Lingwood, Peter Boyle, Alan Milburn, Twalib Ngoma, John Arbutnott, Ruth McCaffrey, Stewart H. Kerr and David J. Kerr

Abstract | While the world is focused on controlling the spread of diseases such as HIV and malaria in the developing world, another approaching epidemic has been largely overlooked. The World Health Organization predicts that there will be 16 million new cancer cases per year in 2020 and 70% of these will be in the developing world. Many of these cancers are preventable, or treatable when detected early enough. Establishing effective, affordable and workable cancer control plans in African countries is one step in the right direction toward limiting this epidemic.

In the developing world, one-third of cancers are potentially preventable and another third are treatable if detected early¹. However, in many developing countries, governments and institutions face a wide range of serious health problems and cancer is often not a priority in limited-resource settings. Currently, a cancer diagnosis in the developing world means a painful and distressing death in most cases. Although there is increasing awareness of the magnitude of the growing cancer problem in the

developing world, the challenges posed are substantial (BOX 1).

The world is focused on controlling the spread of HIV, tuberculosis (TB) and malaria, which are all acknowledged to be major killers in the developing world, and huge sums of money are currently available to help combat these diseases². Cancer is set to become the newest epidemic in the developing world, with the potential to claim a vast number of lives, but currently there is limited funding available

data as the main drive for further inward investment. For example, in the UK in the late 1990s, the then Prime Minister and then Health Secretary (A.M.) were swayed by international league tables suggesting that the UK was toward the lower end of cancer survival tables and had significantly longer treatment waits and fewer cancer specialists and treatment facilities than European neighbours. This led to the creation of a funded National Cancer Plan.

If we make the comparison, however, between developed and developing countries, the difference is orders of magnitude starker. The estimated spend on health by investment in the UK National Health Service for 2008 is approximately £2,000 per annum per capita of the UK's population, somewhat more (approximately a 500-fold difference) than the sum for citizens of Kenya (\$8.3 per annum per capita; see Kenyan Health Ministry URL in Further information).

London declaration on cancer control

A summit meeting was organized that brought together international leaders in the oncology community, health policy makers and African Health Ministries (see AfrOx URL in Further information). This African Cancer Reform convention, aptly held in the Reform Club in London, UK, had the following aims: to determine the degree of priority that cancer is afforded in national programmes in Africa; to determine the most affordable and effective components of cancer control; to decide on a clear implementation strategy for establishing these programmes in African countries; to design mentorship and training programmes for African health-care workers and scientists and engage the support of the University of Oxford, UK and the international cancer care community to initiate these programmes; and to identify a strategy to raise the necessary funds to enable the implementation of the cancer control programmes.

Given the extraordinary financial pressures on all African Health Ministries, the most important questions that this convention posed were “Does your government recognize the growing cancer problem and does it want to develop cancer control programmes as a matter of urgency?” The African Health Ministers and their representatives from the 23 different nations who presented at the meeting stated unanimously that they recognize the impending explosion in cancer incidence, that they would greatly

welcome the support of the international oncology community in tackling the growing cancer epidemic, but that in order to deliver comprehensive cancer control to Africa we must integrate with existing programmes that are tackling HIV/AIDS, TB and malaria.

This was the first collective and definitive statement by a representative cross-section of African Health Ministries of the urgent need to initiate cancer control programmes. It lays to rest the myth that the only health priorities in Africa are infectious diseases and it follows that there is an opportunity to vertically integrate care of a chronic disease such as cancer with existing programmes. A collective statement, the London Declaration (see AfrOx URL in Further information), was published at the end of this meeting, effectively calling on the international community to recognize the impending cancer crisis in the developing world and to work with the Health Ministries to coordinate the development of affordable and sustainable national cancer control programmes.

The six elements of cancer control

Clearly, it would be impossible to superimpose a national cancer plan from, say, the UK to Sierra Leone, given the disparity in wealth and relative health prioritization. Therefore, a significant proportion of the African Cancer Reform convention was given over to workshops that stripped cancer control programmes down to the following bare essentials, which would be expected to return most health gain for money invested.

Cancer intelligence units. A cancer intelligence unit or registry is a vehicle to enable the systematic collection of regionally relevant data on cancer incidence, making it possible

to assess reliably the types and prevalence of cancers experienced by populations on the African continent, assess changes in these patterns over time and, therefore, assess the effect of any interventions associated with the cancer control programme. There are few cancer intelligence units in Africa at the moment and those that do exist invariably suffer from lack of funds and do not cover enough of the population to allow reliable extrapolation of data for the whole country. Cancer registries also form a useful framework for evidence-based cancer research and, therefore, the lack of provision is undermining research capacity within African nations. In common with all other areas of cancer control in Africa, there is a need for infrastructure, appropriate software and hardware, human resources and training, together with incentives for sustainability. The obvious partner to drive this programme forward is the International Agency for Research on Cancer (IARC) — the world leader in this field. IARC has developed a cost-effective training programme with scalable capacity to accommodate more African trainees.

Tobacco control. As we are frequently reminded by Sir Richard Peto, “tobacco consumption is the world's most avoidable cause of cancer”, thought to be responsible for up to 30% of all cancer deaths worldwide. In Africa, tobacco use is estimated to be related to only 6% of deaths ([lung](#), [throat](#), [mouth](#), [pancreas](#), [bladder](#), [stomach](#), liver and [kidney](#) cancers), although this might be a hidden but rapidly evolving problem⁶.

Recent evidence suggests an increase in smoking in the region, especially among young people. Further, decreasing markets for the tobacco industry in the developed world will cause the industry to seek new markets, such as in sub-Saharan Africa, where it sees enormous potential for growth.

Box 1 | Barriers to effective cancer planning

- Insufficient political priority and funding among donor agencies and governments of developing countries, which have many competing priorities.
- Limited ability to counter lifestyle changes following modernization and urbanization.
- Fragmented and under-financed health care systems that have not been set up for chronic disease management.
- A lack of cancer awareness, knowledge and capacity among health workers.
- Lack of diagnostic and treatment capacity.
- Too few effective cancer medicines that are easy to administer and do not require hospitalization.
- Weak referral systems.
- Limited data on cancer incidence and mortality in developing countries due to a lack of functioning cancer registries and limited death certification.

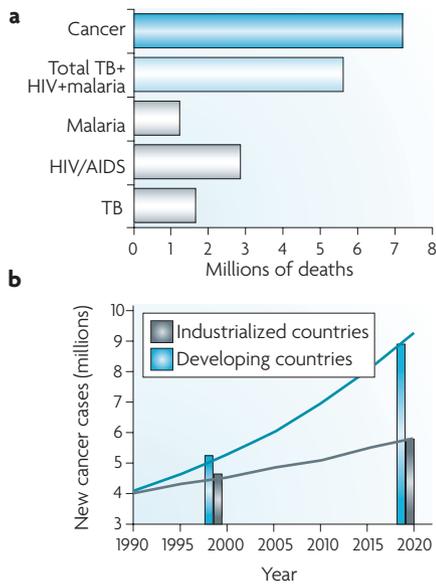


Figure 1 | Global cancer trends. a | The graph shows the World Health Organization (WHO) data of global mortality in 2002. Worldwide 7.6 million people died of cancer and this was 13% of the global mortality burden, and more than the number of deaths from HIV/AIDS, tuberculosis (TB) and malaria combined (~5.6 million). **b** | WHO has estimated that according to current trends the global cancer burden will increase from 10 million new cases per year in 2000 to 16 million in 2020, with 70% of these cases in the developing world. Data from GLOBOCAN 2002 database (see URL in further information).

Use of chewed tobacco is high in some African countries, especially in villages in rural areas. Efforts must be made to control this more traditional use of tobacco in order to avert cancers of the mouth and throat.

It is possible to avert the epidemic of tobacco-related morbidity and mortality manifest in the developed world and much of the developing world by acting now in Africa⁶. To educate civil society about the dangers of tobacco use and the benefits of cessation, special efforts are needed to educate young people, health-care practitioners and policy makers. It is necessary to adopt effective policies such as tax and price increases on tobacco, which will not only lower prevalence but also increase government revenues, which can be used to pay for tobacco control measures and other health and social programmes. Other required policy changes include the placing of effective warning labels on tobacco products, banning advertising and promotion of tobacco use, prohibiting smoking in public places, banning sales of single cigarettes and prohibiting the sales of tobacco to the young. In order to implement effective tobacco control poli-

cies and programmes, civil society must be mobilized in support of this issue. A key to this is the nomination of champions who will promote the cause of tobacco control. In both the developing and developed world, such individual champions have proved to be essential in influencing policy makers, educating civil society and exposing and fighting the tactics of the tobacco industry.

In countries where farmers rely on growing tobacco for income, support needs to be provided to farmers to encourage planting of alternative crops, and to establish the infrastructure for distribution of the alternative crops.

Surveillance data are needed to track tobacco use and related behaviours, knowledge and attitudes. Without such data, evaluations of tobacco control programmes are not possible.

Early diagnosis and prevention. Liver cancer (predominantly hepatocellular carcinoma (HCC)) is by far the main cause of death by cancer in sub-Saharan Africa in males⁷. The main aetiological agents are chronic infections by hepatitis viruses, mainly hepatitis B (HBV), which is endemic on the continent and present in 8–16% of the general population. The effect of HBV is compounded by widespread exposure to a potent carcinogen, aflatoxin, a mycotoxin that contaminates staple diets across the African continent.

Thus, the two main risk factors for HCC are relatively well known and effective strategies are at hand to reduce their effect. A safe and efficient HBV vaccine has been available since the early 1980s. Simple, behavioural methods to reduce aflatoxin exposure have been tested in the field, with significant improvements on individual contamination. Despite these advances, WHO's records show that <7% of subjects in sub-Saharan Africa actually receive HBV vaccination, and efforts to limit aflatoxin exposure are erratic and ineffective. This situation is mainly due to economic and logistic constraints. Although the cost of the HBV vaccine has dropped significantly over the past 15 years (it is now in the range of \$0.30 per dose), it remains too high for many African countries and needs to be supported by international efforts.

Worldwide there are more than 273,000 deaths from cervical cancer each year and it accounts for 9% of female cancer deaths. Mortality rates vary 17-fold between the different regions of the world. Cervical cancer contributes over 2.7 million years of life lost among women between the ages of 25 and 64 worldwide, of which, tellingly, some 2.4

million occur in developing areas and only 300,000 in developed countries⁸. Cervical cancer incidence and mortality rates have decreased substantially in Western countries following the introduction of screening; however, such programmes are either rudimentary or non-existent in Africa. The vast majority of women who suffer cervical cancer in sub-Saharan Africa present with disease advanced far beyond the capacity of surgery or other treatment modalities to offer cure (FIG. 3). Palliative care services are poorly developed and, therefore, these unfortunate women are often sentenced to a miserable end of life.

Human papillomavirus (HPV) types 16 and 18 cause 70% of cervical cancer cases and two vaccines that guard against these HPV types have been developed by the pharmaceutical industry. There is a large, international trials database that suggests that these vaccines can offer 100% protection against infection by these HPV types (given as three injections over 6 months). The data are sufficiently compelling that the UK recently announced its commitment to a national vaccination programme for all 12–13-year-old girls. These remarkable vaccines give us the opportunity to eradicate 70% of all known cervical cancer within a generation, saving almost 200,000 lives per annum, the vast majority in the developing world.

Cure the curable. Although treatment is often considered to be overemphasized relative to primary prevention, it has been estimated that between 2000 and 2020 approximately 10 million patients will die of cancer in Africa. Although it is crucially important to institute primary preventive measures, even if all such measures were fully implemented today they would have little effect on cancer mortality in the next 10–15 years⁶. Mortality:incidence ratios are much higher in Africa than in more affluent world regions and therefore improved access to proven, cost-effective therapy, efficiently delivered, would save many lives. However, as the majority of African patients present with advanced disease, when cure is unlikely, treatment programmes must be undertaken in concert with attempts to diagnose cancer earlier; it is essential, if such programmes are to be successful, that patients diagnosed with early-stage cancer have immediate access to care, with a preliminary focus on childhood cancer.

Cancer treatment should be included in national cancer control plans and afforded a proportion of the available resources. Treatment programmes will need to be

built in the context of the available human resources and infrastructure and supported to the degree feasible by in-country resources as well as by external assistance. Ideally, countries should have at least one National Cancer Centre with access to surgery, radiation and chemotherapy. Radiation programmes might be built on models provided by the International Atomic Energy Agency (IAEA), and their excellent Programme for Action on Cancer Treatment (see IAEA URL in Further information) and chemotherapy regimens based on simplified regimens using drugs from the WHO Essential Drugs List. Regional or trans-national networks could be built on a hub-and-spoke model, integrating vertically with existing AIDS programmes, and would greatly benefit from the sort of teleconferencing or telemedicine being pioneered in India by the Tata Memorial Centre and its associate centres (see IndOx URL in Further information). In addition, it is important to exploit modern innovations in delivering chemotherapy in a predominantly out-patient setting. It should prove possible to design effective treatment regimes that do not require access to costly in-patient beds and seek to use oral agents when available. One other aspect of such an approach is to consider carefully the clinical pharmacology and therapeutic window for each anti-neoplastic drug so as to widen the safety margin as effectively as possible. Conventional cytotoxic drugs have steep dose–response curves, but if we aim to generalize drug usage and widen access then we must think how we might train paramedical personnel to deliver cancer therapeutics with a simplified dosing algorithm that minimises toxicity. Clearly we must not carry this utilitarian approach too far, especially when considering treatment of childhood cancer, but this could be the subject of important research in Africa.

Palliative care. All delegates at the African Cancer Reform convention emphasized the essential role that palliative care must have in the continuum of cancer care. The workshop acknowledged and reiterated that palliative care must be a priority component of affordable and effective cancer care. It should be provided as early as possible after diagnosis as it provides pain and symptom control, terminal care and bereavement support. Palliative care greatly improves the quality of life of patients and their families facing problems associated with cancer. It is ideally suited to home-based care, where it supports people during illness, enabling them to die with dignity.

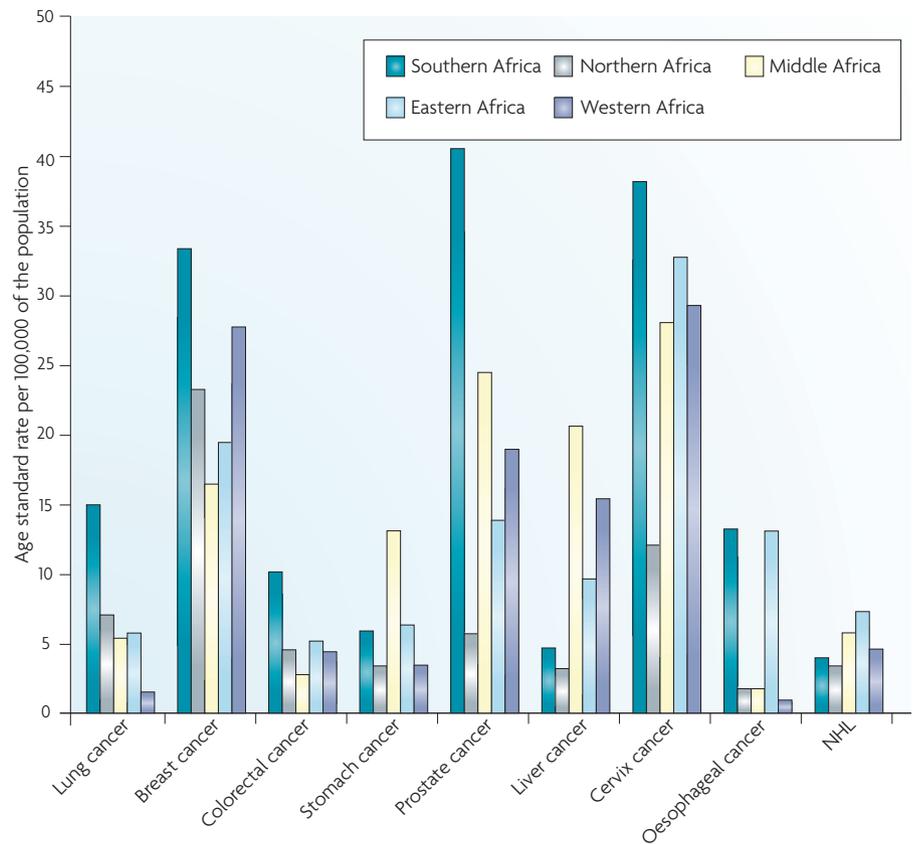


Figure 2 | **Differential cancer rates in Africa.** The graph shows the cancer incidence rates for a number of different cancer types in Africa. NHL, non-Hodgkin lymphoma. Reproduced, with permission, from REF. 5 © European Society for Medical Oncology (2007).

There is relatively little use of oral morphine in Africa, although it is a therapeutic mainstay in the developed world, and a process of education, awareness raising and destigmatization, with due attention paid to cultural sensitivity, will presage its more widespread introduction.

Training and education. Within the context of prevalent cancers in the region, it was agreed by delegates at the African Cancer Reform convention that training, education and partnership programmes are of primary importance for both civil society and health practitioners if the cancer care plan is to be successful on a sustainable basis. Priorities have been identified from each component of the cancer action plan. These priorities are as follows: first, to reduce the prevalent lack of cancer awareness; second, to improve knowledge and capacity through effective partnerships such that expectations are understood and met and that national plans are sustainable for the future; third, to ensure that national plans are evidence-based (that is, based on research evidence relevant to the countries/

regions), priority-driven and resource-appropriate, and, where appropriate, aligned with HIV/AIDS, TB and malaria programmes; fourth, to ensure that training and education plans are developed such that they can be rolled out to other countries/regions, thus sharing best practice; and fifth, to ensure that education and training programmes cover specialist and generic requirements, from specialist clinical disciplines to research training to healthcare management and operational/logistical healthcare disciplines, as well as initial and continuing needs.

Successfully tackling each of these identified priorities could be considered a major project in its own right, but, of course, sustainable and comprehensive integration of the clinical and public health systems requires a parallel approach. The key to cost-effective and successful implementation of the fit-for-purpose training, mentorship and public and professional education programmes that are required to meet the priority objectives is connectivity. Connectivity at all levels, namely in a country, across regions and internationally,

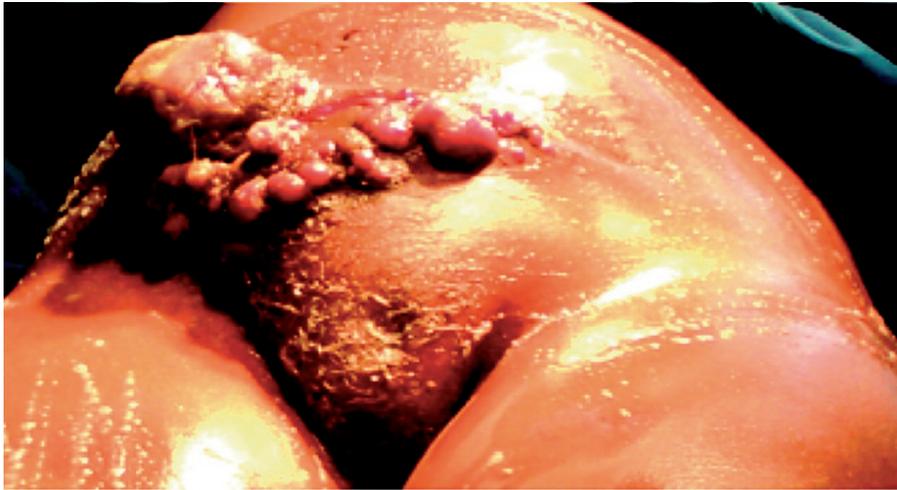


Figure 3 | Cutaneous metastases arising from cervical cancer. Because of the lack of treatment opportunities, funding and awareness of cancer, many cancer patients in Africa present with advanced disease that is beyond the capacity of surgery or other treatment modalities to offer cure. Reproduced, with permission, from REF. 5 © European Society for Medical Oncology (2007).

is needed to achieve strong collaborative leadership and effective sharing of existing and newly created resources. With the rapidly rising number of cancers in the developing world, partnerships between existing bodies, health-care organizations and consortia in developed and developing countries (including local health-care delivery systems, research institutions, international organizations, NGOs, national governments and the pharmaceutical industry) will be essential.

The Africa–Oxford Cancer Consortium (AfrOx) will provide broad support and guidance on design, delivery and funding to achieve sustainable national cancer plans, but also has an important facilitating role in

coordinating, commissioning and developing the various (face-to-face and online and other forms of remotely delivered) educational activities and partnerships.

The Consortium will forge appropriate partnerships to formalize links between individual health workers, building on existing relationships and creating new opportunities for health workers from the UK and other non-African nations to exchange experiences with African health workers. In this way, the Consortium will formalize organizational links between hospitals, cancer centres and medical schools, supporting various forms of exchange programme, such as bilateral staff transfer and training, equipment sharing and re-use, and provision of

recognized elective opportunities in Africa. The Consortium will also develop sustainable training and education in-country programmes on a cascade model, whereby African healthcare personnel are trained not only to deliver healthcare services, but also to provide initial training to others within the locality to increase capacity without draining skilled workers from other sectors, and also to provide continuing and updated training to those with a background in the health sector. Where appropriate, telemedicine will be expanded to include telehealth (that is, to include non-clinical services such as medical and public-health education, administration, data reporting and research at a distance).

Moreover, AfrOx will seek to collaborate with the UK National Health Service, which is well placed to provide resources to underpin the cancer care training, education and partnership objectives for Africa. There are 34 cancer networks in the UK employing hundreds of cancer specialists and thousands of cancer nurses and other health professionals, and polls performed by the UK Oncology Nursing Society show there is an eagerness to support the action plan for Africa. With the backing of African national governments and building on the UK's existing networks, AfrOx will support the development of international Africa-focused cancer networks, comprising non-African hospitals and associated community care with individual African nations, collaborating across the spectrum of cancer control. Ultimately, the Consortium aims, through partnership links within Europe, the United States and throughout the Cochrane Collaboration and supported by a sustainable infrastructure based entirely in Africa, to establish, pilot and, importantly, to hand over knowledge services such as a National Cancer Library for Africa and Cancer Decision Support Services.

It is crucial, as with all aspects of the cancer care plan, that the African governments mobilize real and visible political and financial backing for the training, education and partnership programmes, especially in raising awareness in civil society. We discovered at the Cancer Reform Convention that there are many African cultures that do not have a word for cancer, immediately magnifying the already difficult task of health promotion. The vast majority of cancer patients present late with advanced disease (FIG. 3) and often seek alternative medical advice before accessing more conventional practitioners. One of us (D.J.K.) was puzzled to find zigzag marks on examining the

Box 2 | Cancer plan delivery

- Building capacity of local government and non-governmental organization staff: clinical, managerial and other training as relevant.
- Strengthening systems and quality assurance: this would include training and management systems to improve feedback systems, management and quality assurance.
- Community engagement: raising of awareness in the communities and in the health sector, enrolment of volunteers in outreach programmes, and so on.
- Infrastructure: there would be limited investment in physical infrastructure. Where possible, existing buildings and hospitals in the government health-care system would be used.
- Monitoring and evaluation: the programme would establish monitoring and evaluation systems that collect and analyse data that contributes to a better understanding of the cost-effectiveness of different interventions.
- Supply-chain management: government systems for supply-chain management of drugs, laboratory supplies and other essentials would be strengthened and improved in terms of management and responsiveness.
- Policy and sustainability: the programme will involve the relevant departments of the African Ministries of Health, professional associations and key opinion leaders in developing appropriate policies, based as far as possible on high-quality evidence.

abdomen of a baby recently diagnosed with a massively advanced nephroblastoma, to be told that these were scarifications caused by the local witch doctor. There is no doubt that the leading international cancer societies have an important role here in helping to establish national cancer societies in African states and develop these as the bedrock for training 'cancer champions', increasing recognition of the problem, naming it as cancer and supporting the public in attempts to promote prevention and earlier detection.

Summary of key outcomes

The African Cancer Reform convention gave a clear and positive message that the time for concerted action against cancer in Africa had come. Although each of the Health Ministries recognized the need to develop national cancer plans, they requested that these were broken down into deliverable workstreams that would cover the spectrum of necessary activity in the well-defined work programmes outlined earlier in this article. These must be managed in partnerships forged between the African Health Ministries, NGOs, the pharmaceutical industry and international cancer communities (BOX 2).

Over the next decade, we predict that relatively modest funding of these programmes to the order of around \$100 million per annum will provide cancer

intelligence on up to 250 million African citizens. Early cancer detection and vaccination could prevent 100,000 deaths and the paediatric cancer treatment programme could save the lives of 5,000 children. Furthermore, expansion of palliative care will ease the lives of some 100,000 people with terminal cancer.

The established partnership with African health ministries and NGOs suggests that sustainable programmes can be developed and delivered in a cost-effective way that can affect the lives of millions of Africans.

Rebecca J. Lingwood is at the Department for Continuing Education, University of Oxford, Littlegate House, 16–17 St Ebbs Street, Oxford, OX1 1PT, UK.

Peter Boyle is at the International Agency for Research on Cancer, 150 cours Albert Thomas, 69372 Lyon Cedex 08, France.

Alan Milburn is at the Houses of Parliament, London, SW 1A 0AA, UK.

Twalib Ngoma is at the Ocean Road Cancer Institute, PO BOX 23175, Dar es Salaam, Tanzania.

John Arbuthnott, Ruth McCaffrey, Stewart H. Kerr and David J. Kerr are at the Institute of Cancer Medicine, Department of Clinical Pharmacology, University of Oxford, Old Road Campus Research Building, Old Road Campus, off Roosevelt Drive, Headington, Oxford OX3 7DQ, UK.

*Correspondence to D.J.K.
e-mail: David.Kerr@clinpharm.ox.ac.uk*

doi: 10.1038/nrc2372
Published online 3 April 2008

1. Parkin, D. M., Bray, F., Ferlay, J. and Pisani, P. Global cancer statistics, 2002. *CA Cancer J. Clin.* **55**, 74–108 (2005).
2. Abimbola, S. Clinton brokers deal to lower price of antiretrovirals. *Br. Med. J.* **334**, 1026 (2007)
3. Stewart, B. W. & Kleihues, P. (eds). *World Cancer Report* (International Agency for Research on Cancer, Lyon, 2003).
4. Parkin, D. M. *et al.* (eds). *Cancer in Africa: Epidemiology and Prevention* IARC Scientific Publications No. 153 (International Agency for Research on Cancer, Lyon, 2003).
5. Pezzatini, M., Marino, G., Conte, S. & Catracchia, V. Oncology: A forgotten territory in Africa. *Ann. Oncol.* **18**, 2046–2047 (2007)
6. World Health Organization and International Union Against Cancer. *Global Action Against Cancer 2005*.
7. Boyle, P. The globalisation of cancer. *Lancet* **368**, 629–630 (2006).
8. Yang, B. H. *et al.* Cervical cancer as a priority for prevention in different world regions: an evaluation using years of life lost. *Int. J. Cancer* **109**, 418–424 (2004).
9. Kerr, F. & Kerr, D. J. Do we bear any moral responsibility for improving cancer care in Africa? *Ann. Oncol.* **17**, 1730–1731 (2006).

DATABASES

National Cancer Institute: <http://www.cancer.gov/>
bladder cancer | breast carcinoma | cervical carcinoma |
Kaposi sarcoma | kidney cancer | liver cancer | lung cancer |
oral cancer | pancreatic cancer | prostate cancer | stomach
cancer | throat cancer

FURTHER INFORMATION

AfrOx: <http://www.afrox.org/>
GLOBOCAN 2002 database:
<http://www-dep.iarc.fr/globocan/database.htm>
IndOx: <http://www.indox.org.uk/>
International Atomic Energy Agency:
<http://www.iaea.org/>
Kenyan Health Ministry:
<http://www.health.go.ke>

ALL LINKS ARE ACTIVE IN THE ONLINE PDF

CORRIGENDUM

The challenge of cancer control in Africa

Rebecca J. Lingwood, Peter Boyle, Alan Milburn, Twalib Ngoma, John Arbutnott, Ruth McCaffrey, Stewart H. Kerr & David J. Kerr

Nature Reviews Cancer **8**, 398–403 (2008)

The reference for the source of the content of Box 1 on page 399 is missing. The reference shown below should have been cited.

Reeler, A. V. & Mellstedt, H. Cancer in developing countries: challenges and solutions. *Ann. Oncol.* **17**, 7–8 (2006)