Radiotherapy in Africa: Current needs and prospects

In many countries, cancer control strategies are urgently needed

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Available data indicates that between 3 million and 7 million new cancer cases are diagnosed worldwide per year, with over 50% of these coming from developing countries.[1,2,3]

Status of high-energy teletherapy and brachytherapy facilities in Africa

Country	High-energy teletherapy facilities	Brachytherapy facilities
Algeria	1 Linac 3 Cobalt	Caesium
Cameroon*	3 Cobalt	None
Congo	1 Cobalt	None
Egypt	9 Linacs 22 Cobalt	Caesium Radium
Gabon	1 Cobalt	None
Kenya	2 Cobalt	Caesium
Liberia	1 Cobalt	None
Libya**	1 Cobalt	Not known
Madagascar	1 Cobalt	Not known
Mauritius	1 Cobalt	Caesium Radium
Morocco	3 Cobalt	Iridium Caesium Radium
Mozambique	1 Cobalt	Caesium
Nigeria	2 Cobalt	Caesium Strontium
Senegal	Not known	Radium
Sudan	1 Linac 1 Cobalt	Caesium Radium
Tanzania	2 Cobalt	Radium Strontium
Tunisia	3 Cobalt	Radium Caesium Iridium
Uganda	250 Kv X-ray	None
Zaire	1 Cobalt	Not known
Zimbabwe	1 Linac 3 Cobalt	Radium Caesium

* Brachytherapy facilities will be available in 1991/92.
** More radiotherapy machines including Linacs are on order.

In the developing countries of Africa, the disease is of growing concern. Nearly half—45%—of the 560 million people now living in the continent's 53 countries are under 15 years old. Only about 3% are older than 64 years, and the average life expectancy is about 50 years. With this picture of a relatively large younger African population, it is almost certain that cancer and its management will constitute a major health problem by the year 2000.

Worldwide, radiotherapy continues to be a major part of the armamentarium in the fight against cancer. Estimates are that about 60% of all cancer patients will require radiation treatment at one point or another during the course of their disease. Other treatment modalities include surgery, chemotherapy, hormonotherapy, and immunotherapy. They are sometimes used singly or in combination with radiotherapy, often with much improved results.

In African countries, unfortunately, radiotherapy facilities are not available to a majority of cancer patients, many of whom are diagnosed late, when the diseases are far advanced.[4]

Only about 35% of the countries in Africa have any facilities for radiation therapy, and in many cases these are grossly ill-equipped and understaffed. There are shortages of radiation oncologists, medical physicists, dosimetrists, radiation technologists, radiotherapy nurses, and other technicians.[5] *(See table at left and graph on next page.)* Worldwide, radiotherapy facilities are not available in 40% of all developing countries, and those that do exist are insufficient with regard to the needs of patients in 60% of these countries.[6]

This article analyses and suggests possible solutions to the causes of this rather disastrous state of radiation therapy in Africa. It also explores the potential role of international or-

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ganizations, especially the current activities of the IAEA in assisting these countries.[10]

What are the causes of the problems?

Answers are multi-factorial to the vital question of what causes the problems. Some factors, not in any particular order of priority, include:

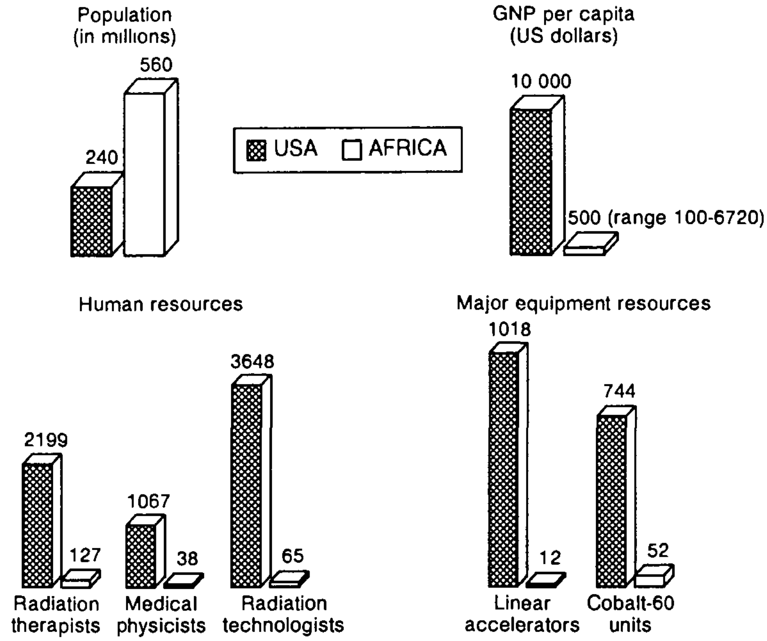
- Lack of awareness by the competent authorities of the extent of the cancer problem in many countries owing to an absence of cancer registries and statistics;
- Underestimation of the role of radiotherapy in cancer management;
- Low priority for cancer care against other diseases competing for scarce funds;
- Absence of health and cancer control policies in many African countries;
- High capital outlay involved in establishing the required infrastructure;
- High cost of equipment purchase and maintenance;
- High cost of training staff and then keeping the trained people;
- Poor economies in almost all African countries;
- Poor budgetary allocation to health.

Health authorities in many African countries still mistakenly consider cancer a disease of the more industrialized countries and completely alien to Africa. However, social and demographic trends show a different picture. More timely vaccinations, progress in sanitation and personal hygiene, among other factors, have improved the life expectancy in many Third World countries, thereby creating a larger ageing population more prone to developing cancer.

In some African countries, the potential role of radiotherapy in curative or palliative care of cancer patients is not appreciated. This is true even among medical practitioners who still cherish the old idea that cancer is not a curable disease. Consequently, they believe they cannot justify the heavy financial investment involved in the establishment of a radiotherapy facility.

The apparent absence of cancer control policies in many African countries also tends to compound the problem. This is closely tied to the scarcity of funds. The annual per capita income is less than US $500 in more than 60% of all African countries,[6] and only about 10% of the countries can spend at least 5% of their Gross National Product (GNP) on health, as recommended by the World Health Organization (WHO).[1] In this competition for scarce resources, radiotherapy gets low priority against the needs of other health problems associated with communicable and infectious diseases.

Radiotherapy resources: United States and Africa



The high cost of developing the basic infrastructure, and buying equipment for establishing a medium-sized radiotherapy centre, is probably beyond the means of many African countries. The cost of setting up a unit capable of treating up to 2000 cases per year is about US $2.5 million. *(See table below.)*

Estimates for establishing a medium-sized radiotherapy centre

Equipment	Number	Estimated cost (thousands of US $)
Cobalt-60 machine with source	1	400
Source change	1	70
Orthovoltage machine	1	300
Simulator	1	400
Basic mould-room facilities	1	30
Computer planning system (PC-based)	1	30
Brachytherapy:		
Remote after-loader with sources (low dose/high dose rate)	1	400
Manual after-loader (low dose rate) with sources	1	40
Radiation physics laboratory	1	80
Departmental cancer registry	1	25
Basic infrastructure (buildings, etc.)		700
Equipment maintenance (costs/year)		
Add running costs (staff salaries, electricity, water, etc.)		Variable
TOTAL		2490+

Estimated training costs in Europe for radiotherapy personnel from Africa

In thousands of US $

Personnel	Minimum duration (person-months)	Tuition fees	Subsistence allowance*	Book allowance	Travel	Cost per trainee	Number of trainees	Total cost
Radiotherapist	24	6	43.2	0 2	1 5	50 9	2	101.8
Medical physicist	24	10	43.2	0 2	1.5	54.9	2	109.8
Radiation technologist	24	5	43.2	0.2	1.5	49.9	4	199.6
Radiotherapy nurse	12	5	21 6	0 1	1.5	28.2	1	28.2
Engineer	12	–	21.6	0.1	1.5	23.2	1	23.2
Cancer registry clerk	3	–	5.4	–	1.5	6.9	1	6.9
Mould-room technician	3	–	5.4	–	1.5	6.9	1	6 9
Total	102	26	183 6	0.8	10.5	216.9	12	468.4

* Based on rate for Austria.

It becomes obvious, therefore, that the capital outlay has to be reduced to make the units affordable to many countries in Africa. This can be done by encouraging manufacturers of radiotherapy equipment to design cheaper models devoid of costly electronic and mechanical parts, but which will still maintain the same beam quality and optimum radiation safety standards as the more expensive designs. Such a machine will be simple, rugged, and more mechanical than electrical. It is also more likely to withstand damage to electronic parts from fluctuations in electric power supply, and the humid, warm, and dusty climate common in Africa.

The cost of training adequate staff to support the centre can also be enormous considering that suitable candidates have to be sent abroad for training. Only two African countries, Egypt and Zimbabwe, offer training of the various cadre of manpower required. The costs involved in training the minimum number of personnel to run a medium-sized radiotherapy centre total about US $500 000. *(See table.)* This includes 2 years of additional training abroad, which is the barest minimum for this field, in radiotherapy and oncology, after an initial 2–3 years of specialized work and training at the local level. Ordinarily, training a competent and confident radiotherapist takes 4-5 years.

The minimum number of personnel required for a medium-sized radiotherapy centre should include two radiotherapists; two medical physicists; four radiation technologists; one radiotherapy nurse; one engineer; one cancer registration clerk; and one mould–room technician.

Despite the desirable benefits of training staff abroad, experience has shown that it should be discouraged. Many trainees do not receive the training designed to equip them for work on return to their home countries, where the pattern of disease and the equipment are different from the sophisticated types and techniques they were trained in. Many candidates are not successful at the end of their training due to language and other cultural difficulties. The few successful ones are more likely to stay behind or emigrate to other countries where they are likely to obtain better paying jobs than they would otherwise obtain in their home countries. This "brain drain syndrome" is a major handicap to developmental efforts in many developing countries.

These shortcomings can be effectively checked through organization of locally based regional training programmes. Such training will be more relevant to the cancer situation and needs in Africa. It would be cheaper and provide training opportunities for many African candidates who are more likely to stay back and work among their people.

IAEA activities

The Statute which established the IAEA clearly stated an important assignment: to enlarge the contribution of atomic energy to peace, *health* and prosperity throughout the world. In the health field, the IAEA has established many activities tailored towards the needs and wishes of individual Member States. They are implemented through technical co–operation projects, research programmes, training courses, seminars, and symposia, often in co-operation with WHO.

Technical co-operation projects. During the last 10 years, requests for assistance related to radiation therapy projects have been received from 13 African countries. Such assistance includes establishment or upgrading radiotherapy facilities by provision of equipment and accessories, expert assignments, fellowship awards, and organization of training courses. *(See table and graph.)*

Symposia, seminars, and training courses. Many participants from African countries have attended various IAEA symposia, seminars, and training courses related to radiotherapy and medical physics. During the period 1983-88, an annual training course on brachytherapy of cervical cancer was organized in Cairo under a technical co-operation project, which was attended by trainees from Cameroon, Egypt, Kenya, Sudan, Ethiopia, Tanzania, and Nigeria. A total of 124 specialists have been trained in intracavitary brachytherapy for cervix carcinoma under this programme. African specialists also participated in the International Symposium on Radiotherapy in Developing Countries, which was held in 1986. In 1989, a regional seminar for Africa on organization and training in radiotherapy was held in Cairo, where 15 African countries participated.

Cancer control strategies

The complexity of the cultural, economic, and demographic factors in development creates great difficulties in defining a uniform cancer control strategy for African countries. However, considering the heavy cancer patient load now and the load anticipated in the year 2000, some cancer control policies and strategies are urgently needed.

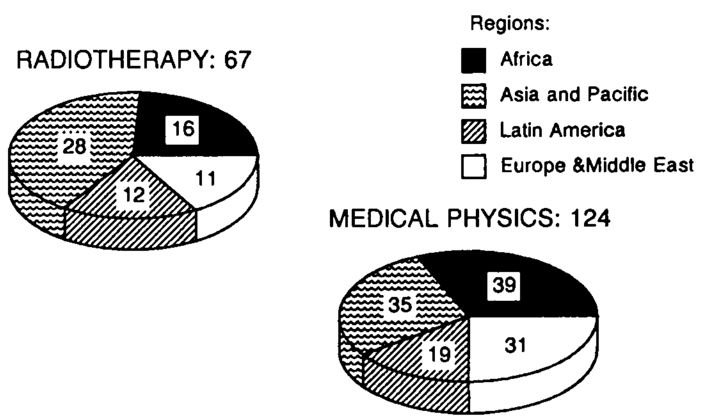
The following guidelines are proposed:

- Promote awareness about cancer control among health administrators, medical and paramedical professionals, and students. This can be achieved through establishment of cancer registration systems, possibly starting with departmental registries, which can later develop into hospital and national cancer registries. A multidisciplinary approach to cancer care through establishment of joint oncology clinics in hospitals should also be encouraged, and the principles of cancer control and treatment should be taught in medical and paramedical schools.

IAEA technical assistance to radiotherapy projects in Africa, 1981–91

	● Seminars/ training courses	▲ Fellowships/ Scientific visits	■ Experts	○ Treatment planning system	□ Radiation protection equipment	△ Provision of brachy-therapy machine	⊡ Provision of cobalt machine	◬ Upgrading services
Cameroon	●		■	○	□	△		◬
Egypt	●	▲	■	○	□	△		◬
Ethiopia	●	▲	■					
Kenya	●	▲	■		□	△		◬
Libya	●		■					
Morocco	●		■	○				◬
Nigeria	●	▲	■	○	□	△	⊡	◬
Tunisia	●	▲	■					
Sudan	●	▲			□	△		◬
Tanzania	●						⊡	◬
Uganda	●	▲	■	○			⊡	◬
Zambia		▲						
Zimbabwe	●	▲	■					

IAEA Fellowships in radiotherapy and medical physics, by regions (1977–88)



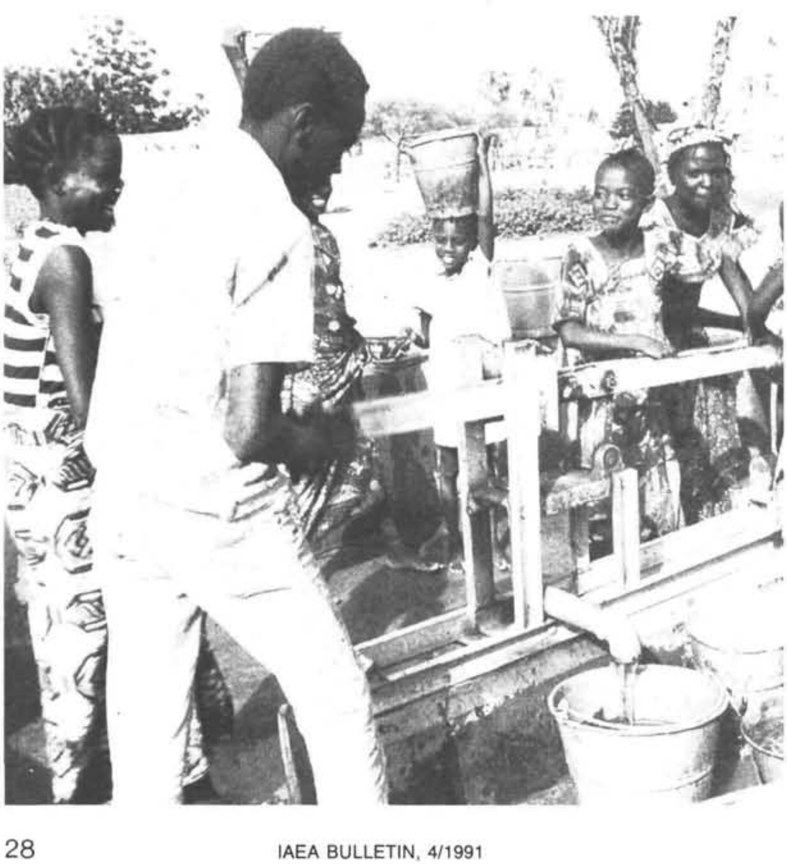
- Promote prevention, early detection and treatment of cancer.
- Provide adequate facilities for both curative as well as palliative treatments, especially radiotherapy services.
- Make maximum use of available health resources from international, multilateral or bilateral, governmental, and non-governmental sources in developing cancer control programmes especially in radiotherapy.
- Encourage development of centres of excellence for radiotherapy and oncology through pooled resources which ensure availability of adequate facilities and staff for efficient services, research, and training within the region.
- Promote public education programmes aimed at cancer prevention (e.g. anti-smoking, breast self examination, cervical screening, etc.).

In order to cope with the projected radiotherapy needs in Africa by the year 2000, about 250 radiotherapy centres will be required for the estimated 500 000 cancer cases per year.[3]

The enormous cost for supporting such services could be significantly reduced by designing and manufacturing simple, robust, and safe teletherapy and brachytherapy equipment which will be affordable and available to many African countries. This can be achieved without loss of quality, by minimizing the costly electronic and mechanical parts in the more expensive models now available. Prototypes of such simple machines have been in existence in Hungary and China, for example, since the 1960s and only need to be modernized.

The establishment of centralized, well-equipped regional radiotherapy centres for radical treatments, with smaller peripheral units mainly concentrating on palliative care, needs to be encouraged. So do regional training programmes for radiotherapists, medical physicists, engineers, technologists, and nurses. The training must be relevant to the local needs and available facilities. Such a programme is being run in Zimbabwe, organized by WHO with support from the Swiss Government and the IAEA. A similar training programme is also in existence in Cairo, Egypt, to which trainees from Ethiopia and Uganda are being sent. It is highly desirable to establish a few more such centres for East and West Africa if the regional needs are to be met by the year 2000.

Nearly half of Africa's population is under the age of 15 years. (Credit: BRGM, France)



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