Radiation therapy services in South Africa

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Abstract **A survey of both private and public sector radiation therapy facilities in South Africa shows that they are available in only 7 major urban centres.**

About 20 000 cases are treated yearly by 58 therapists and 190 therapy radiographers, with 37 megavoltage and 24 X-ray machines. Brachytherapy, imaging and planning equipment is also inadequate. With limited epidemiological data it appears that less than 50% of all patients appropriately treated with radiation therapy present for such treatment. Increased referrals from sub-Saharan Africa place further strains on the system.

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Radiation therapy (RT) is one of the mainstays of the management of the cancer patient. About 60% of all cancer patients should receive RT.[1]

The safe and successful administration of therapy requires an adequate medical and surgical infrastructure combined with the components of adequate RT: localising systems (computed tomography (CT) scanners and simulators), planning equipment, radiation machines for both teletherapy and brachytherapy, skilled therapy radiographers, physicists and radiation therapists.

A survey was undertaken to determine the adequacy and distribution of RT facilities in South Africa.

Material and methods

Interviews were held with individuals in public and private radiotherapy practice. In each case, the facilities available were pooled according to health regions and related to population data derived from Department of National Health and Population Development statistics.[2]

Results

Centres

Public service units are situated in Johannesburg, Pretoria, Bloemfontein, Durban, Bellville and Cape Town in association with medical schools. Satellite units associated with Cape Town are located in Port Elizabeth and East London. Small units for follow-up clinics operate at Mossel Bay, George, Kimberley, Medunsa and Pietermaritzburg. There are radiation therapists in private practice in Bellville, Johannesburg, Pretoria and Durban who have their own machines; one private practice in Bloemfontein uses state-run machines.

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Planning systems

Of the 9 major planning systems available, some are outdated and have been condemned. One multi-user multi-tasking planning system is situated in the Cape. Personal computer-based systems, of which only 2 are operational in private practice, are not suitable for larger units.

Localising systems

Only 8 simulators are available in South Africa. The Cape Province has only 1 simulator and 5 image intensifier C-arm radiology units, extensively used as an inexpensive alternative. CT scanners linked to planning computers are superior localising devices. Two full-time machines are available in the Cape, and another in Natal; 3 shared machines operate in the Transvaal. None is available in the Orange Free State.

Teletherapy equipment

Eleven orthovoltage units (100 kV) are distributed between all centres in South Africa, as are the 13 supervoltage (250 kV) machines. Cobalt units are utilised in all provinces except the Orange Free State. A total of 19 such units is operational.

Twenty linear accelerators are operational, 1 without electron capability and 1 with both photons and electrons, yet with an energy capacity under 10 MEV. The remaining 18 are dual-modality machines, all with maximum electron energy capacity greater than 10 MEV. Nine machines have a maximum photon energy capacity below 10 MEV (Table I). A cyclotron-based 66 MEV neutron therapy machine used as a national facility is based in the Cape.

TABLE I.
Megavoltage radiation therapy units in South Africa

Machine	Photon energy	Electron beam	Tvl	Cape	Natal	OFS
Cobalt 60	1,25	None	6	10	3	0
Linac	< 10	None	1	0	0	0
Linac	< 10	< 10	0	1	0	0
Linac	< 10	> 10	4	1	2	2
Linac	> 10	> 10	4	3	1	1

Brachytherapy equipment

A wide range of brachytherapy devices is extensively used for cervical cancer. Of the 5 high-dose-rate afterloading systems (HDRAL), only 2 utilise small-volume sources with innovative techniques. Cancer of the oesophagus is treated at two centres by intraluminal HDRAL. Hot loading radium devices are used at three Cape centres.

Interstitial and intraluminal implants and plaques are used at various centres, according to the medical and physicist expertise available. No brachytherapy is available in the private sector.

Personnel

While 77 specialist radiotherapists are registered with the South African Medical and Dental Council only 58 are actively practising in South Africa. A total of 190 therapy radiographers is employed out of 399 registered, while 30 medical physicists are involved mainly in RT.

Population

South Africa is at present divided into 9 health regions which are served by 6 academic centres (Table II). A more realistic assessment of the regional services provided is gained by considering the population of greater South Africa as a single unit and attributing estimated referral patterns to the major therapy centres (Table III).

Discussion

The major radiotherapy units have developed in conjunction with academic hospitals. Port Elizabeth and East London with orthovoltage and megavoltage therapy machines operate as satellites of the University of Cape Town, while Pietermaritzburg and Medunsa with orthovoltage alone are satellites of university departments at Durban and Pretoria, respectively. Private practice has recently proliferated in Bellville, Johannesburg and Durban with the commissioning of new machines and attendant loss of hospital-based radiotherapists.

This urban concentration of radiation therapy results in poor access to oncological services in places where adequate regional hospitals do exist. The northern Cape, southern Transvaal region, Transkei, northern Natal and far-northern Transvaal would benefit from the introduction of more oncological services.

TABLE II.
Radiation therapy centres relative to populations of the official health regions (1990) and megavoltage mechines

	Region	Population (millions)	Machines	Population/machine (millions)
Cape Town	Western Cape	3,568		
(TBH & GSH)	Northern Cape	0,809		
	Eastern Cape	2,020		
		6,397	15	0,426
Bloemfontein	Orange Free State	2,506	3	0,835
Durban	Natal	2,792	6	0,465
Johannesburg	Western Transvaal	1,125	9	1,078
	Central Transvaal	7,047		
	Eastern Transvaal	1,534		
		9,706		
Pretoria	Northern Transvaal	0,574	6	0,095
		21,975	39	0,563

TBH = Tygerberg Hospital; GSH = Groote Schuur Hospital.

TABLE III.
Radiation therapy centres relative to regions served (including independent homelands), populations and megavoltage machines

	Region	Population (incl. homelands)	Machines	Population/machine (millions)
TBH	Western Cape (west)			
GSH	1/2 Northern Cape (west)	4,98	12	0,42
Port Elizabeth	1/2 Eastern Cape (east)	3,83	3	1,28
East London	Ciskei 1/2 Transkei (west)			
Bloemfontein	Orange Free State 1/2 Northern Cape (east) 1/3 Bophuthatswana Qua Qua	3,78	3	1,26
Durban	Natal 1/2 Transkei KwaZulu	10,07	6	1,68
Johannesburg	Transvaal 1/3 Bophuthatswana C Transvaal E Transvaal KaNgwane 1/2 Gazankulu	11,62	9	1,29
Pretoria	Northern Transvaal Lebowa 1/3 Bophuthatswana Venda 1/2 Gazankulu	4,78	6	0,80
		39,04	39	1,00

TBH = Tygerberg Hospital; GSH = Groote Schuur Hospital.

Localisation and planning systems are used to determine optimal radiation field size and direction for megavoltage units. Radical therapy demands more planning time and personnel than palliative therapy. The lack of availability of modern high-speed planners at many satellites results in suboptimal planning of therapy parameters with the possible consequences of lower control probability and increased morbidity.

It is proposed that modern high-speed multi-user planning systems located at academic units can support modem-linked consoles at secondary satellite units. This would permit not only planning for the teletherapy machines locally available but also access to the planning parameters of the academic unit; this would allow for an informed decision regarding gains that may be achieved by referring patients and optimising locally available therapy.

The need for megavoltage machines has been determined by the American Society of Radiotherapists.[1] Based on an annual incidence of 3,5 new cases of cancer per 1 000 population, of whom 60% receive radiation therapy over an 8-hour day, a single megavoltage machine can serve a population of 120 000 people. In South Africa the reported annual incidence is 1 per 1 000 based on proven cases reported by the National Cancer Registry (SAIMR). The likely incidence is double that, as many cases are diagnosed clinically and treated symptomatically because of inaccessibility of oncology units. The proportion who should receive radiation therapy may arguably be higher than 60% as surgically amendable early-stage disease is less frequent in South Africa. On this basis a single megavoltage machine can serve a population of 200 000. This is not achieved in any health region: only 44% of the machines required are available in the western Cape, and an average 13,7% in the eastern Cape, Orange Free State, Natal and southern Transvaal (Table III). Unacceptable delays in commencing therapy discourage referrals for short, cost-effective palliative treatments.

Remote afterloading brachytherapy devices have developed over the past decade, significantly reducing the medical staff's exposure hazard to below that experienced with hot loaded (radium) or manually afterloaded devices. These hot devices have been condemned as hazardous.[3] Remote afterloading should be available at all major therapy units.

With a population of 39 million and an annual incidence of 2 cancers per 1 000, of which 60% require radiation therapy, 46 800 new cases are to be expected each year. These patients are served by 58 therapists, i.e. 350 new patients per therapist per annum. This figure exceeds the optimal standards of 200 - 250 patients per annum by an average of 50%.[1]

Similarly, therapy radiographers are overloaded with existing patient referrals. Various training centres throughout the country qualify 30 therapy radiographers per annum. Overseas recruitment, poor service packages and moves to centres without therapy units continue to erode these numbers.

The establishment of a regional population-based cancer register providing cancer incidence data by site, staging and region is essential for the planning of more detailed radiotherapy services.

Only 35% of countries in Africa have any RT facilities.[4] Other than in Egypt where 31 megavoltage machines serve a population of 54 million, the facilities are grossly inadequate. The International Atomic Energy Agency (IAEA) in conjunction with the World Health Organisation is actively involved in southern African projects, notably in Harare, Zimbabwe.[5] At present, however, South Africa provides a service to patients from Namibia, Lesotho, Mozambique, Botswana, Swaziland, Mauritius and, to a lesser extent, from as far as Zaire where existing small services cannot cope with the patient load.

Conclusion

South Africa is not yet able to satisfy the basic RT requirements for the existing population.

The paucity of these services in South Africa reflects the perception of RT as a capital-intensive form of therapy and the consequent concentration of these services in major centres. This contrasts with the needs of patients which would best be served by easier access to regional services.

Recent changes have made treatment in South Africa an attractive alternative to treatment in Europe for cancer sufferers in sub-Saharan Africa; this has caused the system further strain.

The basic infrastructure for the delivery of RT remains sound. Revision of aspects of RT resources could ensure improved and more economical services.

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