Current status and future prospects of radiation oncology in Sri Lanka

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ABSTRACT

Purpose: To investigate the current status of radiation treatment facilities in Sri Lanka and to explore future possibilities required to adequately address increasing cancer care.

Methods: Hospitals with radiation therapy facilities from across the country were identified. Data pertaining to the types of radiotherapy equipment, radiation oncology staffing, and radiotherapy education were collected by onsite visit, conversation over the phone, and from other available cancer resources in Sri Lanka.

Results: Seven government hospitals and two private sectors were identified with radiation therapy facilities over nine provinces in Sri Lanka for 21.4 million people. At present, there are twenty megavoltage machines (MVMs) operating. This is 0.93 MVMs per one million people. After completion of proposed radiotherapy facilities, it will be able to provide 1.21 MVMs per million people. In addition, multidisciplinary staffing has also been identified as inadequate.

Conclusions: There is a significant shortfall in radiotherapy facilities and workforce in Sri Lanka. The current and future scope of radiation facilities is sub-optimal compared to internationally recognized guidelines.

1. Introduction

Sri Lanka, officially named the “Democratic Socialist Republic of Sri Lanka”, formally Ceylon, is an island country in the Indian Ocean. Sri Lanka is a lower middle income country with a Gross Domestic Product (GDP) per capita of $4,020 (USD) and a total population of 21.4 million in 2020 [1]. Generally, economic growth is associated with health. Globally, all countries face the burden of communicable diseases such as Covid-19, HIV/AIDS, malaria, tuberculosis, diarrheal disease, etc., and noncommunicable diseases such as cardiovascular disease, cancer, diabetes, etc. In particular, developing countries are at increased risk for communicable diseases due to various demographic, geographic and socio-economic factors. These diseases create major obstacles to economic and human development [2].

Cancer is one of the leading causes of death worldwide among men and women. According to GLOBOCAN 2020, about 10 million deaths and 19.3 million new cases were reported in 2020 globally [3]. In addition, it has been predicted that new cases and death due to cancer will be doubled by 2040 [4]. In Sri Lanka, there were 29604 new cases diagnosed and 16691 deaths in 2020 [5]. Total crude incidence rate, crude incidence rate of males and females are shown in Fig. 1. The national hospital based-cancer registry was initiated in 1985 in Sri Lanka [6].

The most common cancer in Sri Lanka is lip/oral cavity cancer in men and breast cancer in women. It has been reported that the usage of tobacco in both ways of smoked such as cigarettes, beedi and cigar, and smokeless tobacco (chewing and snuffing) are the main causes for oral cancer in Sri Lanka [7]. The short summary of cancer incidence in 2020 is given in Table 1.

About 50% of cancer patients receive radiotherapy during the course of their treatment due to the low cost compared with other treatment options [9,10]. Modern radiotherapy requires precise application. Qualified medical professionals in the field of radiotherapy are required. Modern radiotherapy equipment, maintenance of the equipment, and training health professionals are expensive processes for developing countries [11]. As new cancer cases are dramatically increasing globally
it is useful to analyze the radiation therapy facilities in each countries. This paper presents the current status and future perspectives of radiotherapy facilities, education systems and staffing in Radiation Oncology in Sri Lanka.

2. Materials and methods

The Sri Lankan health policy started in 1951 and covers all Sri Lankans. The health system is publicly funded and its facilities are freely accessible to all citizens. The system covers approximately 50% of outpatient services and 90% of hospital services. Prevention services are free [12]. The first cancer institute in the western province of Sri Lanka, National Cancer Institute of Sri Lanka, currently known as Apeksha Hospital was established in 1958 at Maharagama, Colombo. There are altogether 24 government cancer treatment centers, 7 provide radiotherapy, which are shown in Fig. 2. Also included two private hospitals, Ceylinco Healthcare center [13] and Asiri Surgical Hospital [14] which provide radiotherapy treatment facilities in the western province (Table 2).

From the 9 identified radiotherapy centers data was collected by on site visit, conversation over the phone, online resources from Sri Lanka Atomic Energy Regulatory Council [16] and Directory of Radiotherapy Centres (DIRAC) [17]. Data included radiation oncology staff details and information about the education system. The future work details were gathered from within the official sources Auditor Generals Department [18] and Office of the Cabinet of Ministers – Sri Lanka [19].

3. Results

3.1. Radiotherapy equipment: current and future perspectives

Currently, there are 8-linear accelerators (linacs), 9-cobalt teletherapy machines, and 2-high dose rate (HDR) brachytherapy units operating at government hospitals (see Table 3). In addition, there are two private sector facilities - One hospital with Tomotherapy, a conventional linac, and a remote afterloader (RAL) for delivery of HDR brachytherapy and a second facility equipped with a single linac [20].

About ten years ago, the government of Sri Lanka has given the Cabinet approval to upgrade the radiotherapy treatment facilities in two phases [18,19]. In phase I as shown in Table 4, the Sri Lankan government agreed to purchase 9 linacs. Out of 9 linacs, the first linac was installed and started treatment in 2014 at Apeksha Hospital, followed by Karapitiya, Batticaloa, and Tellippalai Hospitals each receiving a single linac. Due to economic and bureaucratic problems, these linacs were not installed at that time even though those linacs were purchased in 2015. After a long struggle, a linac was installed in Base Hospital-Tellippalai and treatment started in 2019. Citizens from both the northern and eastern province benefited from this linac installation. Teaching

Table 1
Summary of cancer incidence in Sri Lanka in 2020. Source: Global Health Observatory Geneva [5].

|                  | Males       | Females    | Both sexes |
|------------------|-------------|------------|------------|
| Population       | 10 267 351  | 11 145 899 | 21 413 250 |
| New cancer cases | 14 136      | 15 468     | 29 604     |
| Cancer deaths    | 8 746       | 7 945      | 16 691     |
| 5 year prevalent cases | 32 512 | 43 397 | 75 909 |

The 5-most frequent cancers: Lip-oral cavity, Lung, Oesophagus, Coloorectum and Prostate, Breast, Cervix uteri, Thyroid, Coloorectum and Ovary, Breast, Lip-oral cavity, Coloorectum, Lung and Oesophagus.
Table 2
The hospital names which are indicated in Fig. 2. Source: [20,21].

| Province         | Population | Hospital                        |
|------------------|------------|---------------------------------|
| Western          | 6,219,000  | 1. Apeksha Hospital Maharagama |
|                  |            | 2. Base Hospital Avinavella     |
|                  |            | 3. University Hospital Kotelawala Defence University |
|                  |            | 4. Asiri Surgical Hospital     |
|                  |            | 5. Ceylinco Healthcare center  |
|                  |            | 6. Colombo North Teaching Hospital Ragama |
|                  |            | 7. District General Hospital Gampaha |
|                  |            | 8. District General Hospital Kalutara |
| Southern         | 2,696,000  | 9. Teaching Hospital Karapitiya |
|                  |            | 10. District General Hospital Hambantota |
|                  |            | 11. District General Hospital Matara |
| Eastern          | 1,783,000  | 12. Teaching Hospital-Batticaloa |
|                  |            | 13. District General Hospital Trincomalee |
|                  |            | 14. District General Hospital Ampara |
| Northern         | 1,061,315  | 15. Base Hospital-Tellippalai   |
|                  |            | 16. District General Hospital Vavuniya |
| North Central    | 1,402,000  | 17. Teaching Hospital-Anuradhapura |
| North Western    | 2,592,000  | 18. District General Hospital Polonnaruwa |
| Centra           | 2,811,000  | 19. Provincial General Hospital Kurunegala |
| Sabaragamuwa     | 2,088,000  | 20. District General Hospital Chilaw |
| Uva              | 1,400,000  | 21. Teaching Hospital-Kandy     |

Table 3
Radiotherapy facilities in Sri Lanka. * indicates installation has occurred, but treatment has not started yet. ** indicates private radiation oncology departments.

| Province      | Population | Hospital                        |
|---------------|------------|---------------------------------|
| Western       |            | Apeksha Hospital-Maharagama     |
|               |            | Cobalt - 1                      |
|               |            | HDR-RAL - 1                     |
|               |            | Tomotherapy - 1                 |
|               |            | **Ceylinco Healthcare center    |
|               |            | Linac - 1                       |
|               |            | HDR-RAL - 1                     |
| Southern      |            | **Asiri Surgical Hospital       |
|               |            | Linac - 1                       |
|               |            | Cobalt - 1                      |
| Eastern       |            | Teaching Hospital-Batticaloa    |
|               |            | Linac - 1                       |
|               |            | Cobalt - 1                      |
| Northern      |            | Base Hospital-Tellippalai       |
| North Central |            | Teaching Hospital-Anuradhapura  |
| North Western |            | Teaching Hospital-Kandy         |
| Sabaragamuwa  |            | Provincial General Hospital-Badulla |
| Uva           |            | Cobalt - 1                      |

Table 4
Sri Lankan government project – Phase I.

| Hospital                          | Allocated number of Linacs | Present status          |
|-----------------------------------|---------------------------|-------------------------|
| Apeksha Hospital Maharagama       | 4                         | Installed and functioning|
| Teaching Hospital-Kandy           | 2                         | Installed but treatment has not started yet |
| Teaching Hospital Karapitiya      | 1                         | Installed and functioning|
| Teaching Hospital-Batticaloa      | 1                         | Installed and functioning|
| Base Hospital-Tellippalai         | 1                         | Installed and functioning|

Table 5
Sri Lankan government project – Phase II.

| Hospital                          | Allocated number of Linacs | Present status |
|-----------------------------------|---------------------------|----------------|
| Teaching Hospital-Anuradhapura    | 1                         | Not installed  |
| Teaching Hospital Ratnapura       | 1                         | Not installed  |
| Provincial General Hospital       | 1                         | Not installed  |
| District General Hospital Hambantota | 1                      | Not installed  |
3.3. Education and training

3.3.1. Consultant clinical oncologist

There are fundamentally two different models of postgraduate education and training in the world. In the first model, the specialist title is “radiation oncologist” or “radiotherapist” depending on the country. This model focuses almost entirely on radiation oncology and relevant subjects excluding medical oncology. Canada, USA and Australia follow this model. In these countries radiation oncology and medical oncology training are separate postgraduate courses. In the second model, the specialist name is “consultant clinical oncologist”. The education and training in this model consists of both radiation oncology and medical oncology and related subjects. This specialist training in clinical oncology takes place in countries such as United Kingdom, Sri Lanka etc. [23].

In Sri Lanka, the postgraduate MD (Doctor of Medicine) program in clinical oncology is conducted by postgraduate institute of medicine (PGIM) at University of Colombo, Sri Lanka from 1986. Before 1986, specialist clinical oncologists completed their education and training overseas, mainly in the UK and obtained the FRCP (Fellow of the Royal College of Radiologists) qualification. The new recruitment rule was not retroactively applied and acquired rights were maintained for those who previously qualified with FRCP when the new MD program was introduced by PGIM. The MD specialist program is the mandatory requirement to practice as a clinical oncologist since 1986. It is difficult to consider separate postgraduate programs for radiation oncology and medical oncology in Sri Lanka for practical reasons. The current MD program in clinical oncology is a five years training program plus a year of rotating internship after completion of 5 years medical school. In addition, the oncology trainers must complete at least 1 year overseas training in the selected developed countries before being granted board certification. If they wanted to follow subspecialty training it will take additionally 2 years to complete their program [24]. The graduation rate for Oncologists per year is 5 to 10.

3.3.2. Medical physicist

The minimum requirement for a Medical Physicist in Sri Lanka is a special degree in physics (4 years program). Medical physicists are recruited by Sri Lanka Scientific Service (SLSS), which publish recruitment Gazette notifications, usually every five years. Following this, they conduct the selection examination and conduct interviews to confirm candidate qualifications. If they are selected in the interview they will be appointed as a medical physicist. As they don’t have either postgraduate degree in Medical Physics or any clinical experience as a Medical Physicist, after their appointment, they will get on-the-job-training under a senior medical physicist in any of the government cancer treatment centres. In addition, they need to complete a Master’s degree program in medical physics. This degree program is conducted by two Sri Lankan government Universities: University of Peradeniya (UOP) and University of Colombo (UOC). The first postgraduate degree program in Medical physics was started in 1996 at UOP, then UOC started MSc in Medical physics program in 2013 [25]. A maximum of 20 students are recruited to each batch. The students for this postgraduate program are not recruited yearly but according to staffing needs. Biomedical engineers and other relevant professionals also do this degree program. The graduation rate for Medical Physicists is 2 to 3 per year.

IAEA recommends clinical training for a period of not less than two years in radiation oncology medical physics in the form of a structured competency based clinical training supervised by a senior QCMP [27] to become a QCMP. The M.Sc program in medical physics at University of Peradeniya incorporates at least 6 months clinical training and assessment [26]. This short training is below the length of training recommended by IAEA to become a clinically qualified medical physicist (CQMP) in radiation oncology.

3.3.3. Radiation therapy technologist

Radiation therapy technologist are internal members of the inter-disciplinary radiation oncology team. Sri Lanka school of Radiography has produced qualified Therapists since 1957 through a diploma course. It is preferred for radiation therapy technologist to have a degree in radiotherapy which will provide wider knowledge and skills. Currently, two universities; University of Peradeniya and General Sir John Kotelawala Defence University offer Bachelors (Honours) degree programs in Radiotherapy. A Radiation therapist with a Bachelor’s degree in Radiotherapy is entitled to registration with the Sri Lanka Medical Council (SLMC). Approximately 10 radiation therapists graduate from these programs per year. Radiation therapists are recruited by the Ministry of Health according to the cadre requirements.

4. Discussion

4.1. Megavoltage radiotherapy units according to the population

Looking at currently functioning MVMs, there are 20 machines available for a population of 21.4 million. It provides 0.93 MVMs per one million people. International Atomic Energy Agency (IAEA) recommends an ideal ratio of 4–8 radiotherapy centers per 1 million people or 1 MVM per 250,000 people [28,29]. Compared to this international benchmark, Sri Lanka faces a significant shortfall.

According to phase I of the project for the supply of equipment of high quality radiotherapy for cancer patients in Sri Lanka, 2 linacs have been installed at Teaching Hospital-Kandy but treatment has not started yet. When Phase I is completed, the total available linear accelerators will be 13 including private sector radiation oncology facilities. If including the currently available cobalt units, there would be 22 MVMs for 21.4 million people, nearly four times less than the recommended levels. If the Phase I and Phase II projects could be completed, Sri Lanka will have 26 MVMs for 21.4 million population. It will provide 1.21 MVMs per million people. If we follow the IAEA recommendations of the ideal ratio for radiotherapy treatment of 4 to 8 MVMs per million people, at least 60 MVMs need to be installed. Even if Sri Lanka completes their Phase I and Phase II projects, it will not be adequate for the treatment of cancer patients. If we don’t have enough radiotherapy machines it will lead to longer waiting lists and it will worsen the cancer patients’
condition. As the number of cancer diagnosis are increasing dramatically, the radiotherapy treatment facilities will have to be upgraded.

Fig. 3 shows estimated cancer incidence and mortality rates in males and females from 2020 to 2030 in Sri Lanka. The population of Sri Lanka is projected to reach 22 million in 2030 [33]. With steadily increasing cancer cases it is necessary to upgrade the radiotherapy facilities according to the population and cancer incidence rate.

4.2. Megavoltage radiotherapy units according to cancer incidence

There is an alternative metric to estimate the number of megavoltage radiotherapy units in a country or region. The IAEA recommends a MVM for every 500 new treatment courses per year. These courses can include new cases, recurrences, metastasis and non-malignant tumor, etc. [30]. By considering the number of patients treated in 2019 as shown in Table 6 and available MVMs (Table 3), the required MVMs for each hospital have been shown in Table 7. Overall, Apeksha Hospital Maharagama has a significant shortfall.

4.3. Staffing

Considering the number of radiotherapy patients in government hospitals, the number allocated patients per oncologist is in the range of 4.3. Staffing of medical physicists and number of radiotherapy patients according to the IAEA recommendations, which may lead to compromises in quality and suboptimal outcomes [31].

If we look at the workload of medical physicists, we have to consider the number of MVMs and type of radiotherapy machines. Some centers only have cobalt teletherapy machines. Therefore, workload of medical physicists is going to vary according to the type of machines. Looking at staffing of medical physicist and number of radiotherapy patients treated in 2019, allocated number of patients per physicist is in the range of 195–1038. Overall, the staffing of medical physicists is not adequate according to the IAEA recommendations. Staffing of radiation therapists also is not adequate but it can be overcome in future since number of students intake into their degree program has been increased recently.

4.4. Education and training

Recent trends in professional and medical education demand the inclusion of disciplines and competencies that were not considered in the past. These include, but are not limited to, principles of management, professionalism, basics of medical research, interpersonal communication. These additional skills are important for effective teamwork in this multidisciplinary profession. There is a general mandatory registration system available for medical graduates with an MBBS degree with SLMC. However, there are no special registration or maintenance of board certification system with continuous professional development requirements available for specialist consultant doctors (including clinical oncologists) in Sri Lanka.

In this context, for medical physicists competency based structured clinical training is recommended over traditional learning from on-the-job training. Certification for CQMP is highly recommended by IAEA in the recent publication [34] in line with other medical specialist professions to recognize and ensure professional competency. IAEA recommends that when the process of certification is first introduced, the new rule of recruitment is not retroactively applied and acquired rights are maintained for the existing experienced CQMP according to the Sri Lankan national law. This is similar to medical consultant specialists who do not hold MD and board certification from PGIM but hold FRCS or FRCP before the MD system was introduced in 1986. IAEA guidelines also recommend having a regulatory state registration system for CQMP with a mandatory continuous professional development (CPD) requirement and recency of practice requirement to maintain the registration. This is important to satisfy the “safe to practice” requirement and lifelong learning as technology is rapidly changing. Due to staff shortages, lack of research funding and incentives, clinical medical physicists are not involved in research activities in the hospital. The postgraduate Master’s degree in medical physics incorporates a six month research project, this should be improved according to the IAEA recommendations [35].

Continuous professional development and recency of practice are

Table 7

| Hospital                      | RT patients in 2019 | Required MVMs | Available MVMs |
|-------------------------------|---------------------|---------------|---------------|
| Apeksha Hospital Maharagama   | 14314               | 29            | 5             |
| Teaching Hospital Karapitiya  | 2635                | 5             | 2             |
| Base Hospital Tellippalai     | 1186                | 2             | 2             |
| Teaching Hospital Anuradhapura| 1453                | 3             | 1             |
| Teaching Hospital Kandy       | 4153                | 8             | 2             |
| Provincial General Hospital   | 1248                | 3             | 1             |
| Ceylinco Healthcare center    | 545                 | 1             | 2             |
| Asiri Surgical Hospital       | 389                 | 1             | 1             |

Fig. 3. Estimated numbers from 2020 to 2040, Males & Females, age (0–85+) All cancers Sri Lanka. Source:[32].
also important to radiation therapy technologist. Conducting conferences, workshops and relevant training programs can help to improve their knowledge.

5. Conclusion

The purpose of this study was to analyze the radiotherapy facilities in Sri Lanka. The current status is far behind the IAEA recommendation and rapidly evolving radiotherapy technology. The results of this study development programs for all medical professionals relevant to radiation oncology in order to tackle the increasing number of cancer patients and rapidly evolving radiotherapy technology. The results of this study could be used to outline a plan to improve the necessary radiation treatment facilities and resources as recommended by the IAEA to effectively address the needs of Sri Lanka.

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