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Original Article

# Current and Future Challenges of Radiation Oncology in Iran: A Report from the Iranian Society of Clinical Oncology

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## Abstract

*Aims:* Growth of the cancer incidence rate in Iran has been very high in recent years. Therefore, the Iranian health care system should be prepared for the treatment of a huge number of patients in the foreseeable future. One of the most important treatment options for cancer is radiation. However, there is no comprehensive information on infrastructure for radiation oncology in this country.
*Materials and methods:* In 2015, a questionnaire was designed by the Iranian Society of Clinical Oncology (ISCO) and all radiation oncology centres in the country were visited to determine four important components of radiation oncology services, including facilities, equipment, personnel and patients.
*Results:* In 2015, 94 radiotherapy centres were identified in Iran. Sixty-one centres were fully operational, six centres were commissioning, 26 centres were under construction and one was inactive. Among the fully operational radiotherapy centres, 54 offered three-dimensional conformal radiotherapy and two-dimensional radiotherapy, eight offered brachytherapy, two intensity-modulated radiotherapy, two intraoperative radiotherapy, ostereotactic radiosurgery, two hyperthermia and 59 chemotherapy. Moreover, the survey identified 110 linear accelerators, 25 cobalt-60, one gamma knife, 21 remote brachytherapy afterloaders and six orthovoltage units. Treatment planning equipment included 15 graphy simulators, 19 dedicated computed tomography simulators, 22 multileaf collimator and 12 electronic portal imaging devices. Moreover, in 2015, 243 clinical oncologists participated in the treatment of 42 350 cancer patients in need of radiotherapy, which is about one radiation oncologist for 175 patients. During 2010–2015, number of cobalt-60 reduced 70%, from 25 units to 8 units.
*Conclusions:* There is a significant gap between Iran's available facilities for radiation therapy and international standards. Moreover, during international economic sanctions against Iran this gap widened.


*Key words:* Economic sanctions; infrastructure; Iran; radiotherapy

## Introduction

About 60% of the world's new cancer cases and 70% of the world's cancer deaths occur in developing countries [1]. In Iran, cancer is the third leading cause of death [2]. Although the age-standardised cancer incidence rate in Iran is lower compared with the global average rate (134 versus 188), the growth of cancer incidence in Iran has been very high in recent years [3–5]. In fact, the incidence of all types of cancer is significantly increasing [3,6–12] and health care systems should be prepared to offer sufficient cancer care in the near future.

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Radiotherapy is one of the most important treatment options for cancer. In fact, 50–70% of cancer patients require radiotherapy at some point during their treatment. This treatment is highly cost-effective compared with other treatment options, such as surgery and chemotherapy [13]. Among cancer specialists, clinical oncologists have carried out non-surgical treatment of cancer in Iran. Demand for radiotherapy treatment is steadily increasing because of its benefits and the growing number of patients who need such treatment. However, no comprehensive information about the infrastructure of radiation oncology, including equipment, personnel, patient load and geographic distribution exists in Iran. Therefore, the Iranian Society of Clinical Oncology (ISCO) proposed to conduct this national study.

## Materials and Methods

In 2015, ISCO designed a national survey questionnaire examining nearly 400 variables. This questionnaire assesses 11 elements in radiation oncology facilities. The first element considers the general characteristics of a radiotherapy centre, including its status (active or not), staffing and patients. The studied centres were divided into four groups: (i) fully operational; (ii) commissioning, i.e. centres in which the accelerator is installed but does not admit patients; (iii) under construction, i.e. centres that are under construction, thus the accelerator is not installed; and (iv) non-operational, i.e. centres that were previously operational and equipped with cobalt-60.

The second element includes the linear accelerator (linac) of the centre. The third element includes the cobalt-60 system, as an older radiation treatment device that applies a cobalt-60 radioactive source. The remaining eight elements include as follows: (4) orthovoltage system, which is the oldest radiation treatment device; (5) simulators; (6) brachytherapy; (7) treatment planning systems (TPS); (8) other equipment and facilities in the wards; (9) treatment information; (10) chemotherapy and (11) other facilities and upgrade programmes.

In 2015, one clinical oncologist visited all radiation treatment centres in the country to collect data. For centres that were under construction, the data were gathered via e-mail and telephone calls. In the case of a low response or no response, multiple telephone calls and e-mails were used. If the response was not satisfactory, contact with regulatory authorities ensured a 100% response rate from all centres.

## Results

### *Radiotherapy Facilities*

This survey identified 94 radiotherapy centres in Iran in 2015. Sixty-one centres were fully operational, six centres were commissioning, 26 centres were under construction and one was inactive. These 94 centres had four types of management organisation. Eleven centres were charity based; 14 centres were teaching centres with public services managed by academic organisations; the rest were 28 public-service centres and 41 private centres. The fully operational centres included eight charity-based centres, 13 teaching centres, 18 public service centres and 22 private centres. It should be noted that among 61 fully operational centres, 54 centres provided external beam radiotherapy with or without brachytherapy and seven centres provided only brachytherapy. Furthermore, 43 (80%) fully operational external beam radiation treatment centres had chemotherapy facilities. Overall, 59 of 94 radiation oncology centres (including fully operational, commissioning, under construction) provided chemotherapy treatment as well. Therefore, some of these 59 centres did not have an active linac.

In terms of functionality, among fully operational radiotherapy centres, 54 centres offered three-dimensional conformal radiotherapy (3DCRT) and two-dimensional radiotherapy, eight offered brachytherapy, two offered intensity-modulated radiation therapy (IMRT), two offered intraoperative radiation therapy, one offered stereotactic radiosurgery, two offered hyperthermia and 51 offered chemotherapy.

Considering the geographical distribution of facilities, significant differences emerged between provinces. For example, Tehran had 26 fully operational centres, whereas nine provinces, including Ilam, Lorestan, Ghazvin, Semnan, Khorasan-e-Shomali, Kohkiloyeh-va-Boyerahmad,Bushehr, Khorasan-e- Jonobi, Sistan-va-Balochestan, had no fully operational centre (Figure 1).

Figure 2 shows the radiation oncology centres that had physiotherapy, palliative medicine, nutrition counselling and other sections that help rehabilitation, management of complications and better care.

### *Equipment*

During 2010–2015, the number of fully operational linacs increased from 32 to 77 units, representing a 130% increase, whereas installed cobalt-60 units decreased from 25 units to 8 units, which is a 70% decrease (see Table 1) [14]. At the end of 2015, there were 110 linacs, 25 cobalt-60, one gamma knife, 21 brachytherapy afterloaders and six orthovoltage units. Among these, fully operational units included 77 linacs, eight cobalt-60, one gamma knife, eight brachytherapy afterloaders and two orthovoltage units. Moreover, during the survey period, there were 19 brachytherapy centres with 21 brachytherapy afterloaders. From these 21 systems, nine were low dose rate and 12 were high dose rate. The source in seven was iridium-192, in seven was cobalt-60, in five was cesium-137 and in two was iridium-192 and cobalt-60. In terms of treatment plan equipment, there were 15 plain simulators, 19 dedicated computed tomography simulators, 22 multileaf collimators, 12 electronic portal imaging devices and 52 treatment planning software.

### *Staffing*

The number of clinical oncologists in Iran increased from 147 to 243 between 2010 [14] and 2015, which is an increase

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