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Special Report

Radiation Therapy Infrastructure and Human Resources in Low- and Middle-Income Countries: Present Status and Projections for 2020

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Summary

Availability of radiation therapy infrastructure and staffing for cancer treatment in low- and middle-income countries (LMICs) is one of the crucial global health care issues. Presently, one-third of the global teletherapy units exist in LMICs to treat nearly 60% of the world's cancer patients. A systematic assessment of the present gaps in radiation therapy capacity and those needed by 2020 in these LMICs has been conducted. Twelve pragmatic steps to address this crisis are proposed.

Purpose: Radiation therapy, a key component of cancer management, is required in more than half of new cancer patients, particularly in low- and middle-income countries (LMICs). The projected rise in cancer incidence over the next decades in LMICs will result in an increasing demand for radiation therapy services. Considering the present cancer incidence and that projected for 2020 (as listed in GLOBOCAN), we evaluated the current and anticipated needs for radiation therapy infrastructure and staffing by 2020 for each of the LMICs.

Methods and Materials: Based on World Bank classification, 139 countries fall in the category of LMICs. Details of teletherapy, radiation oncologists, medical physicists, and radiation therapy technologists were available for 84 LMICs from the International Atomic Energy Agency—Directory of Radiotherapy Centres (IAEA-DIRAC) database. Present requirements and those for 2020 were estimated according to recommendations from the IAEA and European Society for Therapeutic Radiology and Oncology (ESTRO-QUARTS).

Results: Only 4 of the 139 LMICs have the requisite number of teletherapy units, and 55 (39.5%) have no radiation therapy facilities at present. Patient access to radiation therapy in the remaining 80 LMICs ranges from 2.3% to 98.8% (median: 36.7%). By 2020, these 84 LMICs would additionally need 9169 teletherapy units, 12,149 radiation oncologists, 9915 medical physicists, and 29,140 radiation therapy technologists. Moreover, de novo radiation therapy facilities would have to be considered for those with no services.

Conclusions: Twelve pragmatic steps are proposed for consideration at national and international levels to narrow the gap in radiation therapy access. Multipronged and

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coordinated action from all national and international stakeholders is required to develop realistic strategies to curb this impending global crisis. © 2014 Elsevier Inc.

Introduction

Cancer has been designated the second most important cause of death among noncommunicable diseases, and its incidence is expected to rise in the coming decades (1). According to the World Health Organization (WHO), the cancer incidence between 2008 and 2030 is projected to rise by 82%, 70%, and 58% in low, low-middle, and upper-middle income countries, respectively, compared with 40% in high-income countries. Moreover, two-thirds of the cases are expected in low- and middle-income countries (LMICs) (2).

Radiation therapy is estimated to be required in 45% to 55% of newly diagnosed cases (3). Of those cured, 40% are by radiation therapy alone or by combination with other modalities (4). The 66th United Nations (UN) General Assembly has listed cancer as a part of "a rising epidemic" of the noncommunicable diseases and has noted the inadequate radiation therapy services in developing countries (5). A number of authors have examined radiation therapy services in different continents, and the severe gap has been a major concern (6-10). At various international levels, efforts are underway to confront the impending "silent crisis" faced primarily by LMICs (11, 12).

A comprehensive analysis of present radiation therapy infrastructure and staffing in each LMIC and their projected needs for 2020 was undertaken. All estimates are based on data retrieved from public domain websites of the concerned UN agencies. Furthermore, 12 pragmatic steps that could be considered at various levels to address this global crisis are proposed.

Methods and Materials

Data sources

LMICs were classified according to the criteria adopted by the World Bank (gross national income [GNI] per capita ≤US $12,615) (13). Cancer incidence rates for "all cancers excluding non-melanoma cancers" for each LMIC were obtained from the GLOBOCAN, International Agency for Research on Cancer (IARC) (14). The present cancer incidence refers to 2012, whereas predicted incidence rates for 2020 were considered to compute the projected requirements for that year. Regarding radiation therapy infrastructure and human resources, the present availability of teletherapy and personnel (ie, radiation oncologists, medical physicists, and radiation therapy technologists) were taken from the Directory of Radiotherapy Centres (DIRAC) of the International Atomic Energy Agency (IAEA) (Supplementary Table S1) (15). All calculations presented below are based on information posted at GLOBOCAN and IAEA-DIRAC as of Jan 18, 2014. The geographical distributions of the LMICs and their populations in 2012 were derived from the UN Population Division (16).

Guidelines used for computation of radiation therapy capacity requirements

Computation of the requirements of radiation therapy units and staffing was based on recommendations from the European Society for Therapeutic Radiology and Oncology (ESTRO) in its ESTRO-QUARTS project and the IAEA (Table 1) (3, 17). In accordance with ESTRO-QUARTS and IAEA guidelines, it was assumed that 62.5% of all cancer patients in LMICs would require radiation therapy (50% of new cancer patients plus 25% of this number for reirradiation) (9, 18, 19). Estimation for brachytherapy has not been undertaken as specific guidelines were not available in ESTRO-QUARTS or in IAEA publications.

Results

Data availability for computation of radiation therapy facilities in LMICs

A total of 139 countries, whose GNI/capita data were available, were grouped as LMICs (13). Of these, 110 are member states of the IAEA (20). Radiation therapy status and cancer incidence were obtained from DIRAC and GLOBOCAN for 84 countries, 3 of which are not IAEA member states (DPR Korea, Guyana, and Suriname). In the remaining 55 countries, 29 IAEA member states had no radiation therapy facilities listed in DIRAC. No information on radiation therapy status was accessible for another 26 countries (Fig. 1). Thus, a total of 55 LMICs representing a population of 358 million presently lack any access to radiation therapy.

The cancer incidence for 2012 was available in 125 of these 139 countries in GLOBOCAN (14). Thus, 56.4% of the world's total cancer patients had access to only 31.7% of the global teletherapy units (Supplementary Fig. S1). It was evident that LMICs have 0.71 teletherapy units/million population, in contrast to 7.62 teletherapy units/million population for high-income countries. This assumes further significance because by 2020 the cancer incidence relative to 2012 is expected to increase by approximately 23.9% in LMICs.

Present radiation therapy capacity in LMICs with existing teletherapy facilities

Present and future radiation therapy needs were computed for the 84 countries whose details of radiation therapy