

CLINICAL INVESTIGATION

Radiation Oncology Practice

JAPANESE STRUCTURE SURVEY OF RADIATION ONCOLOGY IN 2005 BASED ON INSTITUTIONAL STRATIFICATION OF PATTERNS OF CARE STUDY

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Purpose: To evaluate the structure of radiation oncology in Japan in terms of equipment, personnel, patient load, and geographic distribution to identify and improve any deficiencies.

Methods and Materials: A questionnaire-based national structure survey was conducted between March 2006 and February 2007 by the Japanese Society of Therapeutic Radiology and Oncology. These data were analyzed in terms of the institutional stratification of the Patterns of Care Study.

Results: The total numbers of new cancer patients and total cancer patients (new and repeat) treated with radiotherapy in 2005 were estimated at approximately 162,000 and 198,000, respectively. In actual use were 765 linear accelerators, 11 telecobalt machines, 48 GammaKnife machines, 64 ⁶⁰Co remote-controlled after-loading systems, and 119 ¹⁹²Ir remote-controlled after-loading systems. The linear accelerator systems used dual-energy function in 498 systems (65%), three-dimensional conformal radiotherapy in 462 (60%), and intensity-modulated radiotherapy in 170 (22%). There were 426 Japanese Society of Therapeutic Radiology and Oncology-certified radiation oncologists, 774 full-time equivalent radiation oncologists, 117 medical physicists, and 1,635 radiation therapists. Geographically, a significant variation was found in the use of radiotherapy, from 0.9 to 2.1 patients/1,000 population. The annual patient load/FTE radiation oncologist was 247, exceeding the Blue Book guidelines level. Patterns of Care Study stratification can clearly discriminate the maturity of structures according to their academic nature and caseload.

Conclusions: The Japanese structure has clearly improved during the past 15 years in terms of equipment and its use, although the shortage of manpower and variations in maturity disclosed by this Patterns of Care Study stratification remain problematic. These constitute the targets for nationwide improvement in quality assurance and quality control. © 2008 Elsevier Inc.

Structure survey, Radiotherapy facility, Radiotherapy personnel, Radiotherapy equipment, Caseload.

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INTRODUCTION

The medical care systems of the United States and Japan have very different backgrounds. In 1990, the Patterns of Care Study (PCS) conducted a survey of the 1989 structure of radiation oncology facilities for the entire census of facilities in the United States. The results of the survey, together with trends in the structure of specialization since 1974, were reported in detail by Owen *et al.* (1). In 1991, the Japanese Society of Therapeutic Radiation Oncology (JASTRO) conducted the first national survey of the structure of radiotherapy (RT) facilities in Japan based on their status in 1990, with the results reported by Tsunemoto (2). The first comparison of these two national structure surveys to illustrate the similarities and differences present in 1989–1990 was conducted by Teshima *et al.* (3) and reported in 1995. The resultant international exchange of information proved valuable for both countries, because each could improve their own structure of radiation oncology using those data.

The Japanese structure of radiation oncology has improved in terms of the greater number of cancer patients who are treated with RT, as well as the public awareness of the importance of RT, although problems still exist that should be solved. The JASTRO has conducted national structure surveys every 2 years since 1990 (4). In Japan, an anticancer law was enacted in 2006 in response to patients' urgent petitions to the government. This law strongly advocates the promotion of RT and increasing the number of radiation oncologists (ROs) and medical physicists. The findings of the international comparisons and the consecutive structural data gathered and published by the JASTRO have been useful in convincing the Japanese bureaucracy of the importance of RT. In this report, the recent structure of radiation oncology in Japan is presented, with reference to data obtained from previous international comparisons.

METHODS AND MATERIALS

Between March 2006 and February 2007, the JASTRO conducted a questionnaire using a national structure survey of radiation oncology in 2005. The questionnaire included the number of treatment machines by type, number of personnel by category, and number of patients by type, site, and treatment modality. For variables measured over a period, data were requested for the calendar year

2005. The response rate was 712 (96.9%) of 735 of active facilities. The data from 511 institutions (69.5%) were registered in the International Directory of Radiotherapy Centres in Vienna, Austria in April 2007.

The PCS was introduced in Japan in 1996 (5–11). The PCS in the United States used structural stratification to analyze the national averages for the data in each survey item using two-stage cluster sampling. The Japanese PCS used similar methods. We stratified the RT facilities nationwide into four categories for the regular structure surveys. This stratification was based on academic conditions and the annual number of patients treated with RT in each institution, because the academic institutions require, and have access to, more resources for education and training and the annual caseload also constitutes essential information related to structure. For the present study, the following institutional stratification was used: A1, university hospitals/cancer centers treating ≥ 440 patients/y; A2, the same type of institutions treating ≤ 439 patients/y; B1, other national/public hospitals treating ≥ 130 patients/y; and B2, other national hospital/public hospitals treating ≤ 129 patients/y.

The Statistical Analysis Systems, version 8.02 (SAS Institute, Cary, NC), software program (12) was used for statistical analyses, and statistical significance was tested using the chi-square test, Student *t* test, or analysis of variance.

RESULTS

Current situation of radiation oncology in Japan

Table 1 shows that the numbers of new patients and total patients (new plus repeat) requiring RT in 2005 were estimated at approximately 162,000 and 198,000, respectively. According to the PCS stratification of institutions, almost 40% of the patients were treated at academic institutions (categories A1 and A2), even though these academic institutions constituted only 18% of the 732 RT facilities nationwide.

The cancer incidence in Japan in 2005 was estimated at 660,578 (13) with approximately 25% of all newly diagnosed patients treated with RT. The number has increased steadily during the past 10 years and is predicted to increase further (4).

Facility and equipment patterns

Table 2 lists the RT equipment and related function. In actual use were 767 linear accelerators, 11 telecobalt machines, 48 Gamma Knife machines, 65 ^{60}Co remote-controlled afterloading systems (RALSs), and 119 ^{192}Ir RALSs. The linear accelerator system used dual-energy function in 498 systems

Table 1. PCS stratification of radiotherapy facilities in Japan

Institution Category	Description	Facilities (n)	New patients (n)	Average new patients/facility* (n)	Total patients (new + repeat) (n)	Average total patients/facility* (n)
A1	UH and CC (≥ 440 patients/y)	66	45,866	694.9	54,885	831.6
A2	UH and CC (< 440 patients/y)	67	17,161	256.1	21,415	319.6
B1	Other (≥ 130 patients/y)	290	71,627	247.0	88,757	306.1
B2	Other (< 130 patients/y)	289	21,664	75.0	26,116	90.4
Total		712	156,318 [†]	219.5	191,173 [†]	268.5

Abbreviations: PCS = Patterns of Care Study; UH = university hospital; CC = cancer center hospital; Other = other national, city, or public hospital.

* $p < 0.0001$.

[†] Number of radiotherapy institutions was 735 in 2005, and number of new patients was estimated at approximately 162,000; corresponding number of total patients (new plus repeat) was 198,000.

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