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Japanese structure survey of radiation oncology in 2009 based on institutional stratification of the Patterns of Care Study

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The ongoing structure of radiation oncology in Japan in terms of equipment, personnel, patient load and geographic distribution was evaluated in order to radiation identify and improve any deficiencies. A questionnaire-based national structure survey was conducted from March 2010 to January 2011 by the Japanese Society for Therapeutic Radiology and Oncology (JASTRO). These data were analyzed in terms of the institutional stratification of the Patterns of Care Study (PCS). The total numbers of new cancer patients and total of cancer patients (new and repeat) treated with radiation in 2009 were estimated at 201,000 and 240,000, respectively. The type and numbers of systems in actual use consisted of Linac (816), telecobalt (9), Gamma Knife (46), ^{60}Co remote afterloading system (RALS) (29) and ^{192}Ir RALS systems (130). The Linac systems used dual energy function for 586 (71.8%), 3DCRT for 663 (81.3%) and IMRT for 337 units (41.3%). There were 529 JASTRO-certified radiation oncologists (ROs), 939.4 full-time equivalent (FTE) ROs, 113.1 FTE medical physicists and 1836 FTE radiation therapists. The frequency of interstitial radiation therapy use for prostate and of intensity-modulated radiotherapy increased significantly. PCS stratification can clearly identify the maturity of structures based on their academic nature and caseload. Geographically, the more JASTRO-certified physicians there were in a given area, the more radiation therapy tended to be used for cancer patients. In conclusion, the Japanese structure has clearly improved during the past 19 years in terms of equipment and its use, although a shortage of manpower and variations in maturity disclosed by PCS stratification remained problematic in 2009.

Keywords: Structure survey; radiotherapy facility; radiotherapy personnel; radiotherapy equipment; caseload

INTRODUCTION

The medical care systems of the USA and Japan have very different backgrounds. In 1990, the Patterns of Care Study (PCS) conducted a survey of the structure of radiation oncology facilities in 1989 for the entire census of facilities in the USA [1]. In 1991, the Japanese Society for Therapeutic Radiation Oncology (JASTRO) conducted the first national survey of the structure of radiation therapy facilities in Japan based on their status in 1990, and the results were reported by Tsunemoto *et al.* [2]. The first comparison of these two national structure surveys to illustrate and identify similarities and differences in 1989–90 was conducted by the author and reported in 1996 [3]. The resultant international exchange of information proved especially valuable for Japan, where the structure of radiation oncology could be improved on the basis of those data.

The Japanese structure has gradually changed since a greater number of cancer patients are treated with radiation and public awareness of the importance of radiotherapy (RT) has grown. JASTRO has conducted national structure surveys every two years since 1990 [2] and every year since 2011. Furthermore, in 2006 the Cancer Control Act was approved in Japan, which strongly advocates the promotion of RT and an increase in the number of radiation oncologists (ROs) and medical physicists. The Japanese Ministry of Education, Sciences and Sports is supporting the education of these specialists at university medical hospitals. The findings of international comparisons and the consecutive structural data gathered and published by JASTRO have been useful for an understanding of our current position and future direction [4–7]. In this report, the recent structure of radiation oncology in Japan is analyzed and compared with the data of 2007 [6].

MATERIALS AND METHODS

From March 2010 to January 2011, JASTRO conducted a questionnaire based on the national structure survey of radiation oncology in 2009. The questionnaire dealt with the number of treatment systems by type, number of personnel by category and number of patients by type, site and treatment modality. To measure variables over a longer period of time, data for the calendar year 2009 were also requested. The response rate was 700 out of 770 (90.6%) of active facilities. The data from 241 institutions (31.3%) were also registered in the International Directory of Radiotherapy Centres (DIRAC) in Vienna, Austria in 2011.

The PCS was introduced in Japan in 1996 [8–17]. The Japanese PCS employed methods similar to those of the American version, which used structural stratification to analyze national averages for the data for each survey item by means of two-stage cluster sampling. For the regular structure survey, RT facilities throughout the country were stratified into four categories. This stratification was based on academic conditions and the annual number of patients treated with radiation at each institution, because academic institutions require and have access to more resources for education and training, while the annual caseload also constitutes essential information related to structure. For the study reported here, the following institutional stratification was used. A1: university hospitals/cancer centers treating 462 patients or more per year; A2: the same type of institutions treating 461 patients or fewer per year; B1: other national/public hospitals treating 158 patients or more per year; and B2: other national hospital/public hospitals treating 157 patients or fewer per year.

SAS 8.02 (SAS Institute Inc., Cary, NC, USA) [18] was used for statistical analyses and statistical significance was tested by means of the chi-squared test, Student's *t*-test or analysis of variance (ANOVA).

RESULTS

Current situation of radiation oncology in Japan

Table 1 shows that the numbers of new patients and total patients (new plus repeat) undergoing radiation in 2009 were estimated at 201 000 and 240 000, respectively, showing a 11.0% increase over 2007 [6], with 40% of the patients being treated at academic institutions (categories A1 and A2), even though these academic institutions constituted only 20% of the 700 radiotherapy facilities nationwide.

Cancer incidence in Japan in 2009 was estimated at 724 426 cases [19] with approximately 27.6% of all newly diagnosed patients treated with radiation. This number and corresponding rate have increased steadily over the last 19 years and is expected to increase further [14]. In 1990, the rate was estimated to be approximately 15% [3], and it was 16% in 1995, 17% in 1997, 20% in 1999, 22% in 2001, 23.3% in 2003 [4], 24.5% in 2005 [5], 26.1% in 2007 [6] and 27.6% in 2009.

Facility and equipment distribution patterns

Table 2 shows an overview of RT equipment and related functions. There were 816 Linac, 46 Gamma Knife, 29 ^{60}Co remote afterloading system (RALS), 130 ^{192}Ir and 1 ^{137}Cs RALS systems in actual use, as well as 9 of the 15 telecobalt systems installed. The Linac systems used dual energy function for 586 (71.8%), 3D conformal radiation therapy (3DCRT) for 663 (81.3%) and intensity-modulated radiation therapy (IMRT) for 337 units (41.3%). The IMRT function was employed more frequently for the equipment of academic institutions (A1: 73.4% and A2: 49.5%) than that of non-academic institutions (B1: 42.3% and B2: 18.1%). However, 3DCRT functions were disseminated widely in both academic and non-academic institutions, with 69% even in B2 institutions. The use of image-guided radiation

Table 1. PCS stratification of radiotherapy facilities in Japan

Institution category	Description	Facilities (n)	New patients (n)	Average new patients/facility[a] (n)	Total patients (new + repeat) (n)	Comparison with data of 2007[b] (%)	Average total patients/facility[a] (n)	Comparison with data of 2007[b] (%)
A1	UH and CC (≥462 patients/y)	70	52 078	744.0	62 124	2.9	887.5	4.3
A2	UH and CC (<462 patients/y)	70	18 842	269.2	22 717	3.9	324.5	5.4
B1	Other (≥158 patients/y)	280	84 938	303.4	101 730	8.0	363.3	11.1
B2	Other (<158 patients/y)	280	26,532	94.8	31 258	9.2	111.6	13.5
Total		700	182 390[c]	260.6	217 829[c]	6.2	311.2	9.4
						7.3		5.9

PCS = Patterns of Care Study; UH = university hospital; CC = cancer center hospital; Other = other national, city, or public hospital.
[a]$P < 0.0001$.
[b]Rate of increase compared with the data of 2007. Calculating formula: $\frac{data\ of\ 2009\ (n) - data\ of\ 2007(n)}{data\ of\ 2007(n)} \times 100\ (\%)$
[c]Number of radiotherapy institutions was 770 in 2009, and the number of new patients was estimated at approximately 201 000; the corresponding number of total patients (new plus repeat) was 240 000.

therapy (IGRT) has been steadily expanding from A1 institutions (30.4% to 33.5%) to the other types of institutions (14.0% to 35.5%). The annual numbers of patients/Linac were 393.2 for A1, 244.3 for A2, 339.1 for B1 and 118 for B2 institutions and showed a 9.8 % increase compared with the data from 2007. The number of institutions with telecobalt in actual use showed a major decrease to 9 and became stable compared with 2007. Gamma Knife was installed more frequently in B1 and B2 institutions. A significant replacement of ^{60}Co RALS with ^{192}Ir RALS was observed especially in academic institutions, while the number of new ^{60}Co RALS-type systems in use did not increase. Six particle machines were registered in this survey, two with carbon-beam and five with proton-beam irradiation. One machine in Hyogo Prefecture can deliver either carbon or proton beams. Although the HIMAC in Chiba Prefecture has two synchrotrons, it was registered as one machine in the 2009 survey. The total number of new cancer patients treated at these six institutions was estimated at 2038 (1.19% of all new patients in Japan). Twenty-seven advanced institutions were included in the A1 category and treated more than 800 patients per year. They were equipped with Linacs with dual energy (75.3% of the institutions), 3DCRT (97.2%) and IMRT function (82.2%), as well as with ^{192}Ir RALS (92.6%) and a computed tomography (CT) simulator (96.3%).

Table 3 shows an overview of RT planning and other equipment. X-ray simulators were installed in 51.6% of all institutions, and CT simulators in 82.1%, with the latter exceeding the former for the first time in 2007. There was a significant difference in the rate of CT simulators installed by institutional stratification, from 95.7% in A1 to 69.3% in B2 institutions. Very few institutions (16 institutions) used magnetic resonance imaging (MRI) for RT only, while computers were widely used for RT recording.

Staffing patterns and patient loads

Table 4 shows the staffing patterns and patient loads by institutional stratification. 'Full-time or part-time' refers to the style of employment. Since even full-time ROs must share the diagnosis in a week at smaller institutions such as found in the B2 category, we felt that these numbers were not adequate for an accurate evaluation of man power. Therefore, data for full-time equivalent (FTE: 40 h/week for radiation oncology service only) were assessed in terms of the clinical working hours in RT of each individual. This is thus a method to determine actual man power at each institution. The total number of FTE ROs in Japan stood at 939.4, while the average numbers were 4.6 for A1, 1.6 for A2, 1.3 for B1 and 0.6 for B2 institutions. The number in B1 improved by 30% compared with 2007 [6]. The overall patient load per FTE RO in Japan was 231.9, and for A1, A2, B1 and B2 institutions the loads were 193.5, 205.2, 290.6 and 198.4, respectively, with the patient load for B1 institutions being by far the highest. The increase in the overall patient load per

Table 2. Equipment, its function and patient load per equipment by PCS institutional stratification

Radiotherapy equipment and its function	A1 ($n = 70$)		A2 ($n = 70$)		B1 ($n = 280$)		B2 ($n = 280$)		Total ($n = 700$)		Comparison with data of 2007 (%)
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	
Linear accelerator	158		93		300		265		816		1.1[a]
with dual energy function	122	*77.2*[b]	70	*75.3*[b]	235	*78.3*[b]	159	*60.0*[b]	586	*71.8*[b]	5.0[c]
with 3DCRT function (MLC width ≥1.0 cm)	150	*94.9*[b]	81	*87.1*[b]	247	*82.3*[b]	185	*69.8*[b]	663	*81.3*[b]	12.5[c]
with IMRT function	116	*73.4*[b]	46	*49.5*[b]	127	*42.3*[b]	48	*18.1*[b]	337	*41.3*[b]	12.2[c]
with cone beam CT or CT on rail	48	*30.4*[b]	33	*35.5*[b]	73	*24.3*[b]	41	*15.5*[b]	195	*23.9*[b]	
with treatment position verification system (X-ray perspective image)	51	*32.3*[b]	31	*33.3*[b]	85	*28.3*[b]	37	*14.0*[b]	204	*25.0*[b]	
with treatment position verification system (other than those above)	53	*33.5*[b]	18	*19.4*[b]	77	*25.7*[b]	55	*20.8*[b]	203	*24.9*[b]	
Annual no. patients/Linac	393.2[d]		244.3[d]		339.1[a]		118.0[d]		266.9[d]		9.8[a]
Particle	3		0		3		0		6		
Microtoron	6		2		3		4		15		
Telecobalt (actual use)	2 (0)		2 (0)		3 (1)		8 (7)		15 (9)		
Gamma knife	3		2		32		9		46		
Other accelerator	2		1		1		1		5		
Other external irradiation device	4		2		1		0		6		
New type ^{60}Co RALS (actual use)	4 (4)	5.7[e] (5.7)	1 (1)	1.4[e] (1.4)	9 (9)	3.2[e] (3.2)	2 (1)	0.7[e] (0.4)	16 (15)	2.3[e] (2.1)	
Old type ^{60}Co RALS (actual use)	2 (2)	2.9[e] (2.9)	2 (1)	2.9[e] (1.4)	14 (11)	5.0[e] (3.9)	4 (0)	1.4[e] (0.0)	22 (14)	3.1[e] (2.0)	
^{192}Ir RALS (actual use)	60 (60)	85.7[e] (85.7)	32 (31)	45.7[e] (44.3)	37 (37)	13.2[e] (13.2)	4 (2)	1.4[e] (0.7)	133 (130)	19.0[e] (18.6)	
^{137}Cs RALS (actual use)	1 (0)		0 (0)		1 (1)		0 (0)		2 (2)		

PCS = Patterns of Care Study; RT = radiotherapy; 3D-CRT = three-dimensional conformal radiotherapy; MLC = multileaf collimator; IMRT = intensity-modulated radiotherapy; RALS = remote-controlled after-loading system.

[a]Rate of increase compared with the data of 2007. Calculating formula: $\frac{data\ of\ 2009\ (n) - data\ of\ 2007\ (n)}{data\ of\ 2007\ (n)} \times 100\ (\%)$

[b]Percentage calculated from the number of systems using this function and the total number of linear accelerator systems.

[c]Comparison with the data of 2007. Calculating formula: *data of* 2009 (%) – *data of* 2007 (%)

[d]The number of patients over the number of linear accelerators; institutions without linear accelerators excluded from calculation.

[e]Rate of institutions that have this equipment (≥2 pieces of equipment per institution).

Table 3. Radiotherapy planning and other equipments by PCS institutional stratification

RT planning and other equipment	A1 (*n* = 70)		A2 (*n* = 70)		B1 (*n* = 280)		B2 (*n* = 280)		Total (*n* = 700)		Comparison with data of 2007[b] (%)
	n	%[a]	*n*	%[a]	*n*	%[a]	*n*	%[a]	*n*	%[a]	
X-ray simulator	55	74.3	41	55.7	130	46.1	135	48.2	361	50.7	−10.2
CT simulator	74	95.7	61	84.3	235	78.6	205	69.3	575	77.1	11.5
RTP computer (two or more)	340 (63)	100 (90.0)	167 (35)	100 (50.0)	461 (99)	97.5 (35.4)	303 (37)	92.5 (13.2)	1271 (234)	96.0 (33.4)	0.7 (10.1)
MRI (two or more)	201 (60)	95.7 (85.7)	151 (56)	98.6 (80.0)	504 (184)	97.5 (65.7)	364 (86)	97.9 (30.7)	1220 (386)	97.6 (55.1)	1.8 (3.8)
for RT only	2	2.9	2	2.9	9	2.9	3	1.1	16	2.1	0.6
Computer use for RT recording	64	91.4	65	92.9	264	94.3	238	85.0	631	90.1	1.3

CT = computed tomography; RTP = radiotherapy planning; MRI = magnetic resonance imaging; other abbreviations as in Table 2.
[a]Ratio of institutions that have equipment (≥2 pieces of equipment per institution).
[b]Comparison with the data of 2007. Calculating formula: *data of 2009 (%) − data of 2007 (%)*.

FTE RO was 13.7% compared with 2007 (6). In Japan, 42.6 % of the institutions providing RT have their own designated beds, where ROs must also take care of their in-patients. The percentage distribution of institutions by patient load per FTE RO shown in Fig. 1a indicates that the largest number of facilities featured a patient/FTE staff level in the 101–150 range, and in the 151–200 range for the second largest number. The blue areas of the bars show that 47.7% of the institutions (334/700) had less than one FTE RO. Compared with 2007 [6], the patient load has increased even more.

A similar trend was observed for RT technologists and their patient load by institutional stratification with the percentage distribution of institutions by patient load per radiation technologist displayed in Fig. 1b. The largest number of facilities had a patient-per-radiotherapy technologist level in the 101–120 range, with the second largest number showing a range of 81–100 and the third largest a range of 121–140. There were 113.1 FTE medical physicists, 113.1FTE radiotherapy quality assurance (QA) staff and 1836FTE radiotherapists. For this survey, personnel numbers were checked for duplicate reporting by identification of individuals on staffing data and these data were analyzed in detail in another report [7]. Finally, there were 621.2 FTE nurses.

Distribution of primary sites, specific treatment and palliative treatment

Table 5 shows the distribution of primary sites by institutional stratification. The most common disease site was the breast, followed by the lung/bronchus/mediastinum and genito-urinary region. In Japan, the number of patients with prostate cancer undergoing RT was 17 919 in 2009, showing an increase of 10.4% over 2007 [6]. By disease site, the rate of increase compared with 2007 was the highest for prostate cancer at 10.4%, the second highest for breast cancer at 9.6% and the third highest for head and neck cancer at 9.3%. The stratification of institutions indicates that the rate of increase for lung cancer was notable for A1 institutions and the rates for prostate cancer were high for all categories, ranging from 8.0–20.3%. On the other hand, the rate for breast cancer was the lowest (–0.7%) for A2, while those for B1 and B2 ranged from 11.8–18.8%, and the rates for head and neck cancer were high for A2 (17.7%) and B1 (21.4%).

Table 6 shows the distribution of use of specific treatments and the number of patients treated with these modalities by PCS stratification of institutions. Use of interstitial irradiation, radioactive iodine therapy for prostate cancer, stereotactic body RT, IMRT and hyperthermia increased by 23.3%, 14.5%, 4.9%, 34.8% and 15%, respectively, compared with 2007 [6]. On the other hand, the use of intraoperative RT decreased significantly by –31.1%. Institutional stratification shows that there was a dramatic increase of 454.1% in the use of IMRT in B2 [5]. In 2009,

Table 4: Structure and personnel by PCS institutional stratification

	Structure and personnel					
	A1 (*n* = 70)	**A2** (*n* = 70)	**B1** (*n* = 280)	**B2** (*n* = 280)	**Total** (*n* = 700)	**Comparison with data of 2007 [a] (%)**
Institutions/total institutions (%)	10.0	10.0	40.0	40.0	100	-
Institutions with RT bed (*n*)	59 (84.3)	37 (52.9)	124 (44.3)	78 (27.9)	298 (42.6)	6.0 (3.6 [b])
Average RT beds/institution (*n*)	11.2	3.3	3.1	1.5	3.3	6.5
Number of ROs (full time + part time)	369 + 64	151 + 35	372 + 216	193 + 245	1085 + 560	6.7
JASTRO-certified RO (full time)	214	73	192	52	531	11.3
Average JASTRO-certified RO/institution (*n*)	3.1	1.0	0.7	0.2	0.8	14.2
Total (full-time and part-time) RO FTE*	321.1	110.7	350.1	157.5	939.4	13.7
Average FTE ROs/institution	4.6	1.6	1.3	0.6	1.3	18.2
Patient load/FTE RO	193.5	205.2	290.6	198.4	231.9	-6.7
Number of RT technologists (full time + part time)	492 + 22	280 + 13	1133 + 33	825 + 2	2730 + 70	4.4
Total (full-time and part-time) RT technologist FTE	434.3	206.8	758.6	436.2	1836.0	12.4
Average FTE RT technologists/institution	6.2	3.0	2.7	1.6	2.6	13.0
Patient load/FTE RT technologist	143.0	109.9	134.1	71.7	118.6	-5.5
Number of full-time nurse (full time + part time)	114 + 26	74 + 13	270 + 82	125 + 50	583 + 171	-37.1
Total (full-time and part-time) nurse FTE	135.4	68.7	290.4	126.8	621.2	25.6
Number of medical physicists (full time + part time)	70 + 5	27 + 2	125 + 10	65 + 5	287 + 22	10.8
Total (full-time and part-time) medical physicist FTE	32.3	8.7	54.4	22.0	117.6	71.9
Number of RT QA staffs (full time + part time)	79 + 0	52 + 0	174 + 3	85 + 3	390 + 6	-26.1
Total (full-time and part-time) RT QA staff FTE	25.8	15.2	50.3	25.0	116.3	9.1

JASTRO = Japanese Society of Therapeutic Radiation Oncology; RO = radiation oncologist; FTE = full-time equivalent (40 h/wk only for RT practice); QA = quality assurance; other abbreviations as in Table 2. RT QA staff: Japanese Organization of RT Quality Management has certified RT quality managers from RT technologist since 2005 mainly by educational session.Data in parentheses are percentages.

[a]Rate of increase compared with the data of 2007. Calculating formula: $\frac{data\ of\ 2009\ (n) - data\ of\ 2007\ (n)}{data\ of\ 2007\ (n)} \times 100\ (\%)$

[b]Comparison with the data of 2007. Calculating formula: *data of* 2009 (%) − *data of* 2007 (%)

101 institutions (14.4%) actually utilized IMRT, which was significantly lower than the 337 Linacs with IMRT function (41.3%) as shown in Table 2. Figure 2 lists the numbers of patients treated with SRT and IMRT for each survey year. Approximately 12 000 patients were treated with SRT for the brain in each survey year and this number has remained stable. On the other hand, the number treated with SRT for the rest of the body has been increasing gradually and exceeded 2000 in 2009. The corresponding number of patients for IMRT has been increasing more rapidly and exceeds 4000, or about 2% of all RT-treated patients in 2009.

Table 7 shows the number of patients with brain or bone metastasis treated with radiation according to the same institutional stratification. More patients with brain metastasis (12.2% of all patients) were treated at B1 than at the other types of institutions, while use of radiation for bone

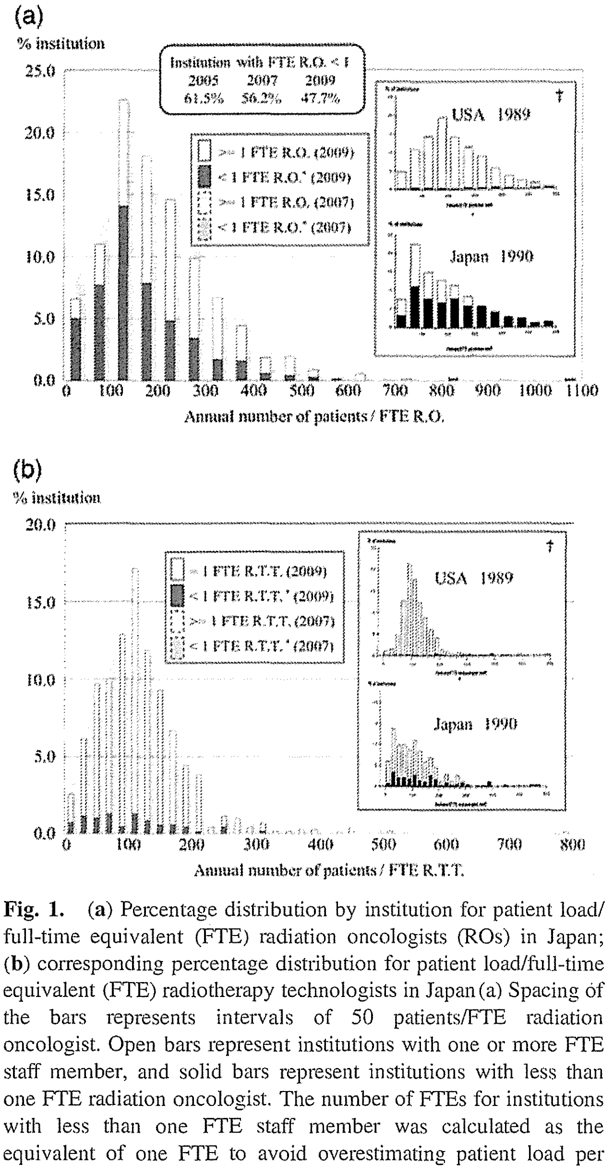

Fig. 1. (**a**) Percentage distribution by institution for patient load/full-time equivalent (FTE) radiation oncologists (ROs) in Japan; (**b**) corresponding percentage distribution for patient load/full-time equivalent (FTE) radiotherapy technologists in Japan (a) Spacing of the bars represents intervals of 50 patients/FTE radiation oncologist. Open bars represent institutions with one or more FTE staff member, and solid bars represent institutions with less than one FTE radiation oncologist. The number of FTEs for institutions with less than one FTE staff member was calculated as the equivalent of one FTE to avoid overestimating patient load per FTE RO or staff. (b) *Spacing of the bars represents intervals of 20 patients/FTE staff. †Corresponding data for the USA and Japan are shown for reference [3]. Originally published in Int. J. Radiat. Oncol. Biol. Phys. 34(1): 235–242.

metastasis ranged from 10.4% for A2 to 15.7% for B2. Overall, more patients with bone metastasis were treated with radiation at non-academic than at academic institutions. The number of patients with brain metastasis decreased slightly by –4.7% compared with 2007 [6].

Geographic patterns

Figure 3 shows the geographic distributions for 47 prefectures of the annual number of patients (new plus repeat) per 1000 population arranged in increasing order of the number of JASTRO-certified ROs per 1 000 000 population [20]. There were significant differences in the use of RT, from 1.1 patients per 1000 population (Saitama) to 2.3 (Tokyo). The average number of cancer patients per 1000 population per quarter ranged from 1.57 to 1.80 ($P = 0.1585$). The more JASTRO-certified physicians there were in a given area, the more RT tended to be used for cancer patients, although the correlation was of borderline significance. Similar trends were clearly observed in 2005 [5] and 2007 [6]. Compared with 2005 and 2007, the utilization rate of RT increased in every prefecture in 2009. However, the rates in 2007 and 2009 were not related to prefectural population density as was also observed in the data for 1990 [3].

DISCUSSION

In 1990, there were fewer facilities for radiation treatment and fewer patients treated with radiation in Japan than in the USA. Over the next 19 years, however, the number of patients in Japan increased significantly by a factor of 3.2 [3]. On the other hand, the utilization rate of radiation for new cancer patients remained at 27.6%, less than half that recorded in the USA and European countries, although the rate increased slightly by 0.75% per year between 2007 [6] and 2009. For implementation of the Cancer Control Act, comparative data of the structure of radiation oncology in Japan and in the USA as well as relevant PCS data proved to be very helpful.

Compared with 1990, the number of Linac systems increased significantly by a factor of 2.62 and increased by 1.1% over 2007 [6], while the number of systems using telecobalt decreased to only nine and remained stable. Furthermore, the use of various functions of Linac, such as dual energy, 3DCRT (MLC width <1 cm) and IMRT, improved significantly. The number of high dose rate (HDR) RALS in use has increased and ^{60}Co RALS has been largely replaced with ^{192}Ir RALS. In 2009, CT simulators had been installed in 82.1% of institutions throughout the country for a 15.7% increase over 2007 [6] and exceeded the number of X-ray simulators (51.6%). Radiotherapy planning systems (RTPs) were used at 96.0% of institutions for an increase in the number of RTPs of 6.59 times compared with 1990 [3]. Maturity of the functions of Linac and installation rates of CT simulators and systems using ^{192} Ir RALS also improved further compared with 2007 [6], but were still closely correlated with the PCS institutional stratification, which could therefore aid accurate differentiation between structural maturity and immaturity and the identification of structural targets for improvement.

The staffing patterns in Japan also improved in terms of numbers. However, institutions with less than one FTE radiation oncologist on their staff still account for 47.7% nationwide, although this represents an 8% decrease

Table 5. Primary sites of cancer treatment with RT in 2009 by PCS institutional stratification for new patients

Primary site	A1 ($n = 69$)		Comparison with data of 2007[a] (%)	A2 ($n = 66$)		Comparison with data of 2007[a] (%)	B1 ($n = 256$)		Comparison with data of 2007[a] (%)	B2 ($n = 253$)		Comparison with data of 2007[a] (%)	Total ($n = 644$)		Comparison with data of 2007[a] (%)
	n	%		*n*	%		*n*	%		*n*	%		*n*	%	
Cerebrospinal	1906	3.8	−5.7	994	5.4	38.1	4812	6.2	−13.6	1349	5.4	−3.4	9061	5.3	−6.6
Head and neck (including thyroid)	6444	12.8	−1.2	2500	13.6	17.7	7601	9.8	21.4	1560	6.3	−5.7	18 105	10.6	9.3
Esophagus	3247	6.5	−5.8	1196	6.5	1.4	3735	4.8	−8.2	1416	5.7	−3.9	9594	5.6	−5.7
Lung, trachea and mediastinum	7880	15.7	5.6	2771	15.0	−2.8	15 855	20.4	−5.7	5801	23.3	−0.7	32 307	18.9	−2.0
Lung	7335	14.6	8.0	2438	13.2	−0.6	14 358	18.5	−1.3	5060	20.4	−6.2	29 191	17.0	0.0
Breast	10 869	21.7	5.2	3637	19.7	−0.7	19 373	24.9	11.8	5955	24.0	18.8	39 834	23.3	9.6
Liver, biliary tract, pancreas	1948	3.9	1.0	806	4.4	19.6	2907	3.7	3.6	980	3.9	−4.2	6641	3.9	3.2
Gastric, small intestine, colorectal	2167	4.3	4.4	945	5.1	−6.9	3783	4.9	−6.2	1384	5.6	−7.6	8279	4.8	−4.0
Gynecologic	3430	6.8	3.5	1135	6.2	7.3	2914	3.7	−4.7	737	3.0	−5.6	8216	4.8	0.0
Urogenital	7167	14.3	5.8	2470	13.4	−1.1	10 019	12.9	2.8	3394	13.7	13.4	23 050	13.5	4.7
Prostate	5926	11.8	9.9	1888	10.2	8.0	7618	9.8	8.6	2487	10.0	20.3	17 919	10.5	10.4
Hematopoietic and lymphatic	2639	5.3	1.9	963	5.2	7.0	3264	4.2	−10.1	1083	4.4	15.8	7949	4.6	−1.3
Skin, bone and soft tissue	1269	2.5	−12.8	496	2.7	2.5	1590	2.0	−15.4	738	3.0	−1.7	4093	2.4	−10.4
Other (malignant)	541	1.1	−39.5	241	1.3	1.7	852	1.1	−5.0	307	1.2	5.1	1941	1.1	−16.3
Benign tumors	675	1.3	−31.7	278	1.5	4.5	1112	1.4	−13.7	155	0.6	−16.7	2220	1.3	−18.6
Pediatric <15 y (included in totals above)	461	0.9	4.8	145	0.8	25.0	349	0.4	−6.7	137	0.6	8.7	1092	0.6	3.4
Total	50 182	100	0.8	18 432	100	4.3	77 817	100	0.6	24 859	100.0	4.3	171 290	100	1.5

Abbreviations as in Table 2.

[a]Rate of increase compared with the data of 2007. Calculating formula: $\frac{data\ of\ 2009\ (n) - data\ of\ 2007\ (n)}{data\ of\ 2007\ (n)} \times 100\ (\%)$

[b]Total number of new patients different with these data, because no data on primary sites were reported by some institutions.

Table 6: Distribution of specific treatments and numbers of patients treated with these modalities by PCS stratification of institutions

Specific therapy	A1 ($n = 70$)		A2 ($n = 70$)		B1 ($n = 280$)		B2 ($n = 280$)		Total ($n = 700$)		Comparison with data of 2007[a] (%)
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	
Intracavitary RT											
Treatment facilities	64	91.4	28	40.0	58	20.7	1	0.4	151	21.6	
Cases	1864		421		848		6		3139		–3.0
Interstitial RT											
Treatment facilities	55	78.6	20	28.6	32	11.4	2	0.7	109	15.6	
Cases	2482		550		993		45		4070		23.3
Radioactive iodine therapy for prostate											
Treatment facilities	50	71.4	16	22.9	29	10.4	1	0.4	96	13.7	
Cases	1842		360		856		22		3080		14.5
Total body RT											
Treatment facilities	63	90.0	31	44.3	65	23.2	21	7.5	180	25.7	
Cases	798		235		620		137		1790		4.9
Intraoperative RT											
Treatment facilities	15	21.4	6	8.6	4	1.4	3	1.1	28	4.0	
Cases	135		21		9		8		173		–31.1
Stereotactic brain RT											
Treatment facilities	43	61.4	26	37.1	94	33.6	39	13.9	202	25.8	
Cases	1660		658		9671		1866		13 855		10.4
Stereotactic body RT											
Treatment facilities	51	72.9	26	37.1	71	25.4	17	6.1	165	23.6	
Cases	1087		185		1125		140		2537		1.9
IMRT											
Treatment facilities	47	67.1	10	14.3	36	12.9	8	2.9	101	14.4	
Cases	1855		94		1961		386		4296		34.8
Thermoradiotherapy											
Treatment facilities	7	10.0	5	7.1	4	1.4	4	1.4	20	2.9	
Cases	185		38		137		31		391		15.0

PCS = Patterns of Care Study; RT = radiotherapy; IMRT = intensity-modulated radiotherapy.

[a]Rate of increase compared with the data of 2007. Calculating formula: $\frac{\textit{data of } 2009\ (n) - \textit{data of } 2007\ (n)}{\textit{data of } 2007\ (n)} \times 100\ (\%)$

compared with 2007 [6]. In other words, nearly half the institutions in Japan still rely on part-time radiation oncologists. There are two reasons for this. First, although the number of FTE radiation oncologists grew by 13.7 % over the last 2 years, the number of cancer patients who require radiation has also increased by 10% over the same period. Second, specialist fees for radiation oncologists in academic institutions are not covered by the Japanese medical care insurance system, which is strictly controlled by the government. Therefore, most radiation or other oncologists at academic institutions must work part-time at affiliated hospitals in the B1 and B2 groups to earn a living. To reduce the number of institutions that rely on part-time radiation oncologists and thus may encounter problems with their quality of care, a reform of Japan's current medical care system based on treatment outcome is required, especially as it applies to staff at academic institutions. However, great care is needed to ensure that the long-term success of radiation oncology in Japan and patient benefits are well balanced with costs. For this reason, personal identification of ROs in both A and B institutions was included and recorded in the 2007 and 2009 surveys for further detailed analysis of patient load and real cost [7]. There were significant differences in the average practice index for patients between ROs working mainly in main university hospitals and in affiliated hospitals (1.07 vs 0.71: $P <$ 0.0001). Under the current Japanese national medical system, patterns of work by ROs at academic facilities appear to be problematic for fostering true specialization of ROs. On the other hand, according to the increase in the number of cancer patients who require RT, B1 institutions are gradually offering full-time positions for ROs. However, the speed of offers for second or third positions are slow in individual institutions due to tight budgets in most B1 institutions. Therefore, monitoring these structural data is necessary to convince local government to improve working environments for ROs. Even under these conditions, however, the number of FTE ROs increased by 2.57 times compared with 1990 [3], and by 13.7% over 2007 [6]. On the other hand, patient load per FTE RO also increased by 1.35 times to 231.9 during the same period 1990–2009, but registered a –0.67% decrease compared

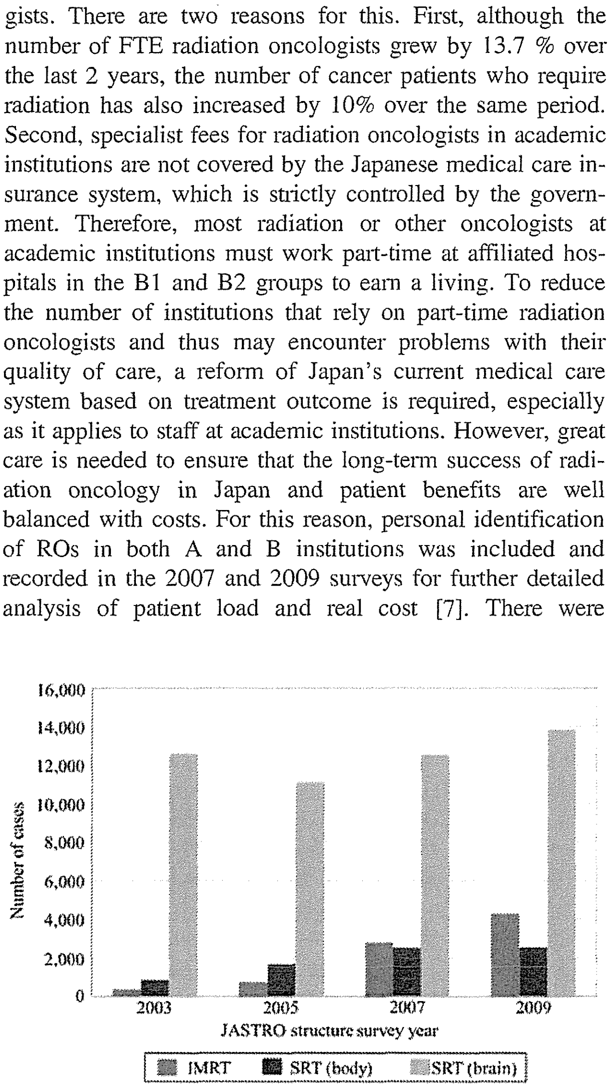

Fig. 2. Trends in numbers of patients treated with SRT for brain, SRT for body and IMRT by survey year

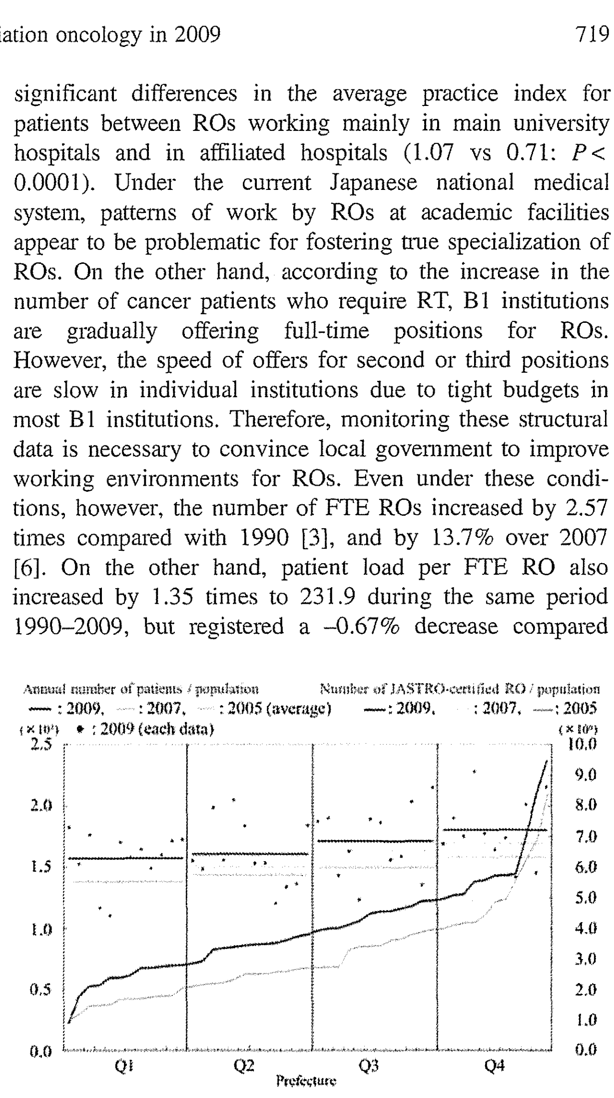

Fig. 3. Geographic distribution for 47 prefectures of annual numbers of patients (new plus repeat) per 1000 population in increasing order for JASTRO-certified radiation oncologists (RO)/ 1 000 000 population by prefecture Q1, 0–25%; Q2, 26–50%; Q3, 51–75%; and Q4, 76–100%. Horizontal lines show average annual number of patients (new plus repeat) per 1000 prefectural population per quarter.

Table 7: brain metastasis or bone metastasis patients treated with RT in 2007 by PCS institutional stratification

Metastasis	Patients										
	A1 ($n = 70$)		A2 ($n = 70$)		B1 ($n = 280$)		B2 ($n = 280$)		Total ($n = 700$)		Comparison with data of 2007[a] (%)
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	
Brain	3534	5.2	1363	6.0	12 394	12.2	3043	9.7	20 334	9.3	–4.3
Bone	6948	11.2	2419	10.6	12 618	12.4	4921	15.7	26 906	12.4	–3.8

Data presented as number of patients, with percentages in parentheses.
[a]Rate of increase compared with the data of 2007. Calculating formula: $\frac{data\ of\ 2009\ (n) - data\ of\ 2007\ (n)}{data\ of\ 2007\ (n)} \times 100\ (\%)$

with 2007 [6]. This may reflect the growing popularity of RT due to an increase in the elderly population and recent advances in technology and improvement in clinical results. The caseload ratio in Japan has therefore already exceeded the limit of the Blue Book guidelines of 200 patients per radiation oncologist and improved only slightly in 2009 [21, 22]. The percentage distribution of institutions by patient load per RO showed a slightly high percentage for smaller patient load/RO than that in the USA in 1989 [3], but also showed a major shift to a larger size in 2009 compared with 1990. In Japan, the patterns are now becoming similar to those of the USA in 1989 [3], indicating that Japanese radiation oncology is catching up quickly with western systems and growing steadily in spite of limited resources. Furthermore, additional recruiting and education of ROs continue to be top priorities for JASTRO. The distribution of patient load per RT technologist shows that only 17.3% of institutions met the narrow guideline range (100–120 patient per RT technologist) and the rest showed a dense distribution around the peak level. Compared with the distribution in the USA in 1989, nearly 18% of institutions in Japan had a relatively low caseload of 10–60, because there are still a large number of smaller B2-type institutions, which account for nearly 40% of institutions that do not attain the range specified by the guidelines. As for medical physicists, an analysis of patient load for FTE staff similar to that for RT technologists remains difficult, because the number of the former was very small and they were working mainly in metropolitan areas. However, RT technologists in Japan have been acting partly as medical physicists. Their training duration has changed from 3 to 4 years over the last decade, and graduate and postgraduate courses have been introduced. Currently, RT technologists who have obtained a master's degree or those with enough clinical experience can take the examination for qualification as a medical physicist, as can those with a master's degree in science or engineering like in the USA or Europe. A unique, hybrid education system for medical physicists has thus been developed in Japan since the Cancer Control Act actively started to support improvement in quality assurance and quality control (QA/QC) specialization for RT. However, the validity of this education and training system remains to be proven, not only for QA/QC but also for unique research and developmental activities. The discrepancy between FTE medical physicists and the number of registered medical physicists in Japan reflects the fact that their role in the clinic is not recognized as a full-time position only for medical physics services.

Analysis of the distribution of primary sites for RT showed that the number of lung cancer patients at A1-type institutions increased by 8% compared with 2007. On the other hand, more head and neck cancer patients were treated at A1-, A2- or B1-type institutions, but the rates of increase compared with 2007 were high for A2 and B1 institutions. The increase in the number of lung cancer patients at A1 institutions in 2009 was noteworthy and the same goes for that of prostate cancer patients or breast cancer patients at A1-, A2-, B1- and B2-type institutions. This suggests that stereotactic body RT (SBRT) for lung cancer at A1 and 3DCRT for prostate cancer or breast-conserving therapy for breast cancer (BCT) at A1, A2, B1 and B2 were used more frequently in 2009. Especially in B2-type institutions, breast cancer patients (18.8%) and prostate cancer patients (20.3%) increased at two of the highest rates. This indicates that treatments such as 3DCRT and BCT were disseminated widely to B2-type institutions as a standard. The number of patients with brain or bone metastasis did not increase compared with 2007 [6]. The use of specific treatments and the number of patients treated with these modalities were significantly affected by institutional stratification, with more specific treatments being performed at academic institutions. These findings indicate that significant differences in patterns of care, as reflected in structure, process and possibly outcome for cancer patients continued to be prevalent in Japan in 2009. However, these differences point to opportunities for improvement. The Japanese PCS group published structural guidelines based on PCS data [22] and we are using the structural data obtained in 2009 to revise the Japanese structural guidelines for radiation oncology in the near future. The use of intraoperative RT decreased significantly from 2005 to 2007 and showed a similar rate of decrease (35%) between 2007 and 2009, while that of thermoradiotherapy increased slightly by 15% compared with 2007 [6]. These two modalities are thus not considered mainstay treatments in Japan. The numbers of patients with bone metastasis or brain metastasis in 2009 decreased, compared with those in 2007. Within the limited resources of departments of radiation oncology, more efforts may be made, focusing on radical treatment than palliative ones. Also general treatments such as bisphosphonates or narcotic drugs such as opioids for bone metastasis may relatively reduce the candidates for RT. The reason for the reduction in use of RT for brain metastasis is unknown.

Geographic patterns showed that there were significant differences among prefectures in the use of RT, and the number of JASTRO-certified physicians per population was associated with the utilization of RT in 2005 [5], 2007 [6] and 2009, so that a shortage of radiation oncologists or medical physicists on a regional basis will remain a major concern in Japan. Compared with 2005 [5] and 2007 [6], however, the utilization rate of radiation for new cancer patients in 2009 showed further increase. JASTRO has been making every effort to recruit and educate radiation oncologists and medical physicists through public relations, to establish and conduct training courses at academic institutions, to become involved in the national examination for physicians and to seek an increase in the coverage of fees for ROs by the government-controlled insurance scheme.

In conclusion, the Japanese structure of radiation oncology has clearly and steadily improved over the past 19 years in terms of installation and use of equipment and its functions, but shortages of man power and differences in maturity depending on type of institution and caseload remain. Structural immaturity is an immediate target for improvement, while for improvements in process and outcome, the PCS or National Cancer Database (NCDB), which are currently operational and the subject of close examination, can be expected to perform an important function in the future of radiation oncology in Japan.

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SPECIAL ARTICLE

Comprehensive Registry of Esophageal Cancer in Japan, 2004

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Preface

Japan was struck by the Great East Japan Earthquake, which resulted in almost twenty thousand deaths and missing persons, 1 year ago. We would like to express our heartfelt condolences and sympathies to all the people who have been affected by this disaster. We pray that the regions affected will recover as soon as possible and that the physicians working diligently in the affected areas remain in good health and spirits.

We deeply appreciate the cooperation of many physicians with the registry of esophageal cancer cases; nevertheless, the recovery from the Great East Japan Earthquake is ongoing. The Comprehensive Registry of Esophageal Cancer in Japan, 2004, was finally published here, despite some delay.

The registry of esophageal cancer cases has required some adjustments to comply with the Act for the Protection of Personal Information, which was promulgated in 2003 and began to be enforced in 2005. The most important point was "anonymity in an unlinkable fashion" using encryption with a hash function. The new registration

These data were first made available on June 1, 2004, as the Comprehensive Registry of Esophageal Cancer in Japan, 2004. Not all the pages are reprinted here; however, the original table and figure numbers have been maintained.

The authors were members of the Registration Committee for Esophageal Cancer, the Japan Esophageal Society, and made great contributions to the preparation of this material.

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system was completed in 2008, and the registry itself resumed the registry of cases of esophageal cancer that had been treated in 2001. This was the fourth time that the new registration system was used to prepare a Comprehensive Registry of Esophageal Cancer in Japan. The physicians in charge of the registration seem to have become accustomed to the new system.

Here, we have briefly summarized the Comprehensive Registry of Esophageal Cancer in Japan, 2004. A total of 5,066 cases were registered from 214 institutions in Japan. Comparing the Comprehensive Registry in 2004 to the Comprehensive Registry in 2003, the number of registered cases, surgical cases, and registered institutions increased by 407, 159, and 15, respectively. As for the histologic type of cancer according to biopsy specimens, squamous cell carcinoma and adenocarcinoma accounted for 88.7 and 2.9 %, respectively. Regarding clinical results, the 5-year survival rates of patients treated using endoscopic mucosal resection, concurrent chemoradiotherapy, radiotherapy alone, chemotherapy alone, or esophagectomy were 83.7, 26.4, 15.5, 8.6, and 50.2 %, respectively. Concerning the approach used to perform an esophagectomy, 18.0 % of the cases were treated endoscopically, that is, thoracoscopically, laparoscopically, or mediastinoscopically. Regarding the reconstruction route, the retrosternal, the posterior mediastinal, and the intrathoracic route were used in 36.0, 35.5 and 16.4 % of the cases, respectively. The operative mortality was 1.3 % (35 out of 2,669 cases).

We hope that this Comprehensive Registry of Esophageal Cancer in Japan for 2004 will help to improve all aspects of the diagnosis and treatment of esophageal cancer.

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I. Clinical factors of esophageal cancer patients treated in 2004

Institution-registered cases in 2004

Institution
Aichi Cancer Center
Aizawa Hospital
Akita University Hospital
Asahikawa Medical College Hospital
The Cancer Institute Hospital of JFCR
Chiba Cancer Center
Chibaken Saiseikai Narashino Hospital
Chiba University Hospital
Dokkyo Medical University Hospital
Fuchu Hospital
Fujioka General Hospital
Fujita Health University
Fukui Red Cross Hospital
Fukui University Hospital
Fukuoka Saiseikai General Hospital
Fukuyama Hospital
Foundation for Detection of Early Gastric Carcinoma
Genwakai Himawari A Clinic
Gifu Prefectural General Medical Center
Gunma Central General Hospital
Gunma University Hospital
Hachioji Digestive Disease Hospital
Hakodate Goryokaku Hospital
Hamamatsu University School of Medicine, University Hospital
Health Insurance Naruto Hospital
Hiratsuka City Hospital
Hiratsuka Kyosai Hospital
Hiroshima City Asa Hospital
Hiroshima University Research Institute for Radiation Biology Medicine
Hitachi General Hospital
Hokkaido kin-ikyo chuo Hospital
Hokkaido University Hospital
Hokusatsu-byouin
Hyogo Cancer Center
Hyogo College of Medicine
Hyogo Prefectural Nishinomiya Hospital
Ibaraki Prefectural Central Hospital.
Ida Municipal Hospital
Iizuka Hospital
Inazawa City Hospital
International University of Health and Welfare Mita Hospital
Ishinomaki Red Cross Hospital
Iwakuni Medical Center
Iwate Medical University Hospital
Japanese Red Cross Shizuoka Hospital
Japanese Red Cross Society Onoda Hospital
Jichi Medical University Hospital
Jikei University Hospital
Juntendo University Hospital
Junwakai Memorial Hospital
Kagawa Prefectural Central Hospital
Kagawa University Hospital
Kagoshima University Hospital
Kanazawa University Hospital
Kansai Medical University Hirakata Hospital
Kansai Rosai Hospital
Kashiwa Kousei General Hospital

continued

Institution
Kawasaki Medical School Hospital
Keio University Hospital
Keiyukai Sapporo Hospital
Kikuna Memorial Hospital
Kinki Central Hospital
Kinki University Hospital
Kinki University Nara Hospital
Kinki University Sakai Hospital
Kiryu Kosei General Hospital
Kitakyushu Municipal Medical Center
Kitano Hospital
Kitasato Institute Hospital
Kitasato University Hospital
Kobe City Medical Center General Hospital
Kobe University Hospital
Kochi University Hospital
Kumamoto University Hospital
Kurashiki Central Hospital
Kurume University Hospital
Kuwana City Hospital
Kyorin University Hospital
Kyosai Tachikawa Hospital
Kyoto University Hospital
Kyushu Central Hospital of the Mutual Aid Association of Public School Teachers
Kyushu University Hospital
Matsuda Hospital
Matsudo City Hospital
Matsushita Memorial Hospital
Matsuyama Red Cross Hospital
Mie University Hospital
Minoh City Hospital
Mito Red Cross Hoapital
Murakami General Hospital
Nagahama City Hospital
Nagano Red Cross Hospital
Nagaoka Chuo General Hospital
Nagoya City University Hospital
Nagoya Daiichi Red Cross Hospital
Nanpuh Hospital
Nara Medical University Hospital
National Cancer Center Hospital
National Cancer Center Hospital East
National Defense Medical College Hospital
National Hospital Organization Chiba Medical Center
National Hospital Organization Kure Medical Center
National Hospital Organization Kyushu Cancer Center
National Hospital Organization Matsumoto National Hospital
National Hospital Organization Nagasaki Medical Center

continued

Institution
National Hospital Organization Nagoya Medical Center
National Hospital Organization Osaka National Hospital
National Institute of Radiological Sciences
Nihon University Itabashi Hospital
Niigata Cancer Center Hospital
Niigata City General Hospital
Niigata Prefectural Shibata Hospital
Niigata University Medical and Dental Hospital
Nippon Medical School Musashi Kosugi Hospital
Nippon Medical School Tama Nagayama Hospital
Nishi-Kobe Medical Center
Nomura Hospital
NTT West Osaka Hospital
Numazu City Hospital
Ohta General Hospital Foundation Ohta Nishinouchi Hospital
Oita Red Cross Hospital
Oita University Hospital
Okayama Saiseikai General Hospital
Okayama University Hospital
Osaka City University Hospital
Osaka General Medical Center
Osaka Koseinenkin Hospital
Osaka Medical Center for Cancer and Cardiovascular Diseases
Osaka Prefectural Hospital Organization Osaka General Medical Center
Osaka University Hospital
Otsu Red Cross Hospital
Rinku General Medical Center
Ryukyu University Hospital
Saga University Hospital
Saiseikai General Hospital
Saiseikai Kyoto Hospital
Saiseikai Gose Hospital
Saitama City Hospital
Saitama Medical Center Jichi Medical University
Saitama Medical University Hospital
Saitama Medical University International Medical Center
Saitama Red Cross Hospital
Saitama Social Insurance Hospital
Saku Central Hospital
Sano Kousei General Hospital
Sato Clinic
Sapporo Medical University
Sawara Hospital
Seikei-kai Chiba Medical Center
Sendai City Hospital
Sendai Medical Center
Shiga Medical Center for Adults
Shiga University of Medical Science Hospital

continued

Institution
Shikoku Cancer Center
Shimane University Hospital
Shimizu Welfare Hospital
Shinbeppu Hospital
Shinshiro Municipal Hospital
Shinshu University Hospital
Shizuoka Cancer Center
Shizuoka City Shimizu Hospital
Shizuoka City Shizuoka Hospital
Shouzankai-Saiki Hospital
Showa Inan General Hospital
Showa University Hospital
Showa University Northern Yokohama Hospital
Social Insurance Omuta Tenryo Hospital
Social Insurance Tagawa Hospital
Social Insurance Yokohama Central Hospital
Sonoda Daiichi Hospital
St. Luke's International Hospital
Sugita Genpaku Memorial Obama Municipal Hospital
Suita Municipal Hospital
Takasago Municipal Hospital
Tenri Hospital
Tochigi Cancer Center
Toho University Omori Medical Center
Toho University Hospital
Tohoku Kosai Hospital
Tohoku University Hospital
Tokai University Hospital
Tokushima Red Cross Hospital
Tokushima University Hospital
Tokyo Dental College Ichikawa General Hospital
Tokyo Medical and Dental University Hospital

continued

Institution
Tokyo Medical University Hospital
Tokyo Metropolitan Cancer and Infectious Center Komagome Hospital
Tokyo Metropolitan Health and Medical Corporation Toshima Hospital
Tokyo University Hospital
Tokyo Women's Medical University Hospital
Tonan Hospital
Toranomon Hospital
Tottori Prefectural Central Hospital
Tottori University Hospital
Toyama Prefectural Central Hospital
Toyama University Hospital
Tsuchiura Kyodo Hospital
Tsukuba University Hospital
Tsuruoka Municipal Shonai Hospital
University Hospital, Kyoto Prefectural University of Medicine
University of Miyazaki Hospital
University of Occupational and Environmental Health
Wakayama Kenritsu University Hospital
Yamagata Prefectural and Sakata Municipal Hospital Organization
Yamagata Prefectural Central Hospital
Yamagata University Hospital
Yamaguchi University Hospital
Yamanashi University Hospital
Yamaguchi-ken Saiseikai Shimonoseki General Hospital
Yao Municipal Hospital
Yatsu Hoken Hospital
Yokohama City University Hospital
Yokohama City University Medical Center
Yokohama Rosai Hospital

(Total 214 institutions)

Patient Background

Table 1 Age and gender

* **Excluding 49 missing cases of gender**

Age	Male	Female	Unknown	Cases (%)	
~29	6	0	0	6	(0.1%)
30~39	9	6	0	15	(0.3%)
40~49	148	27	0	175	(3.5%)
50~59	975	150	0	1125	(22.8%)
60~69	1758	236	0	1994	(40.3%)
70~79	1200	183	0	1383	(28.0%)
80~89	174	53	0	227	(4.6%)
90~	12	7	0	19	(0.4%)
Total	4282	662	0	4944	
Missing	57	16	0	73	

Table 12 Tumor location

* **Excluding 178 treatment unknown, missing cases of treatment types**

Location of tumor	Endoscopic treatment (%)		Chemotherapy and/or radiotherapy (%)		Surgery				Total (%)	
					Palliative operation (%)		Esophagectomy (%)			
Cervical	13	(2.4%)	112	(7.3%)	3	(2.5%)	101	(3.8%)	229	(4.7%)
Upper thoracic	55	(10.2%)	198	(12.9%)	20	(16.7%)	298	(11.2%)	571	(11.8%)
Middle thoracic	296	(55.0%)	680	(44.2%)	55	(45.8%)	1242	(46.9%)	2273	(46.9%)
Lower thoracic	142	(26.4%)	314	(20.4%)	32	(26.7%)	799	(30.2%)	1287	(26.6%)
Abdominal	13	(2.4%)	26	(1.7%)	9	(7.5%)	148	(5.6%)	196	(4.0%)
EG	4	(0.7%)	2	(0.1%)	0		24	(0.9%)	30	(0.6%)
EG-Junction(E=G)	0		1	(0.1%)	0		20	(0.8%)	21	(0.4%)
Cardia (G)	0		1	(0.1%)	0		2	(0.1%)	3	(0.1%)
Others	0		0		0		0		0	
Unknown	15	(2.8%)	205	(13.3%)	1	(0.8%)	15	(0.6%)	236	(4.9%)
Total	538		1539		120		2649		4846	
Missing	9		5		1		7		22	

EG: esophago-gastric

Table 15 Histologic types of cancer according to biopsy specimens

*** Excluding 178 treatment unknown, missing cases of treatment types**

Histologic types	Endoscopic treatment (%)		Chemotherapy and/or radiotherapy (%)		Surgery: Palliative operation (%)		Surgery: Esophagectomy (%)		Total (%)	
Not examined	36	(6.8%)	5	(0.3%)	2	(1.7%)	5	(0.2%)	48	(1.0%)
SCC	456	(86.0%)	1263	(82.4%)	111	(92.5%)	2446	(92.7%)	4276	(88.7%)
SCC	355	(67.0%)	801	(52.3%)	79	(65.8%)	1380	(52.3%)	2615	(54.3%)
Well diff.	16	(3.0%)	73	(4.8%)	4	(5.0%)	252	(9.6%)	345	(7.2%)
Moderately diff.	65	(12.3%)	250	(16.3%)	20	(16.7%)	575	(21.8%)	910	(18.9%)
Poorly diff.	20	(3.8%)	139	(9.1%)	8	(6.7%)	239	(9.1%)	406	(8.4%)
Adenocarcinoma	18	(3.4%)	16	(1.0%)	2	(1.7%)	105	(4.0%)	141	(2.9%)
Undifferentiated	0		15	(1.0%)	1	(0.8%)	6	(0.2%)	22	(0.5%)
Carcinosarcoma	0		1	(0.1%)	2	(1.7%)	8	(0.3%)	11	(0.2%)
Malignant melanoma	1	(0.2%)	2	(0.1%)	0		10	(0.4%)	13	(0.3%)
Other tumors	3	(0.6%)	19	(1.2%)	0		14	(0.5%)	36	(0.7%)
Dysplasia	0		0		0		0		0	
Unknown	16	(3.0%)	211	(13.8%)	2	(1.7%)	44	(1.7%)	273	(5.7%)
Total	530		1532		120		2638		4820	
Missing	18		18		1		31		68	

SCC: squamous cell carcinoma

Table 19 Organs with metastasis in cM1 case (UICC-cTNM 5th)

*** Excluding 178 treatment unknown, missing cases of treatment types**

Metastatic organs	Endoscopic treatment (%)		Chemotherapy and/or radiotherapy (%)		Surgery: Palliative operation (%)		Surgery: Esophagectomy (%)		Total (%)	
PUL	10	(27.8%)	86	(17.1%)	5	(45.5%)	11	(5.9%)	112	(15.3%)
OSS	0		14	(2.8%)	0		1	(0.5%)	15	(2.0%)
HEP	6	(16.7%)	94	(18.7%)	3	(27.3%)	16	(8.6%)	119	(16.2%)
BRA	1	(2.8%)	5	(1.0%)	0		1	(0.5%)	7	(1.0%)
LYM	15	(41.7%)	255	(50.8%)	3	(27.3%)	140	(75.7%)	413	(56.3%)
MAR	0		1	(0.2%)	0		0		1	(0.1%)
PLE	1	(2.8%)	5	(1.0%)	0		1	(0.5%)	7	(1.0%)
PER	0		0		0		3	(1.6%)	3	(0.4%)
SKI	0		3	(0.6%)	0		1	(0.5%)	4	(0.5%)
OTH	3	(8.3%)	21	(4.2%)	0		5	(2.7%)	29	(4.0%)
Unknown	0		18	(3.6%)	0		6	(3.2%)	24	(3.3%)
Lesions	36		502		11		185		734	
Missing	1		5		0		6		12	
One organ	18	(69.2%)	369	(85.4%)	7	(77.8%)	172	(96.6%)	566	(87.8%)
Two organs	6	(23.1%)	58	(13.4%)	2	(22.2%)	5	(2.8%)	71	(11.0%)
Three organs	2	(7.7%)	3	(0.7%)	0		1	(0.6%)	6	(0.9%)
Four organs~	0		2	(0.5%)	0		0		2	(0.3%)
Unknown	0		0		0		0		0	
Total cases	26		432		9		178		645	
Missing	1		5		0		6		12	

PUL: pulmones, OSS: ossis, HEP: hepar, BRA: brain, LYM: lymph node, MAR: marrow,

PLE: pleural membrane, PER:peritoneal membrane, SKI: skin, OTH: others