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A Prospective Survey of Radiotherapy Practice 2001 in Sweden

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A prospective survey of radiotherapy practice in Sweden was conducted during 12 weeks in the autumn of 2001. All hospitals that provided radiotherapy participated, and all patients who started radiotherapy during the study period were included. The final patient sample comprised 5 105 treatments given to 4 171 patients. The results were compared with those of a similar survey conducted in 1992, and the following conclusions were drawn:

- A substantial increase in the use of radiotherapy was noted;
- The estimated proportion of cancer cases receiving radiotherapy (compared to the incident number of cases) had increased from 32% in 1992 to 47%;
- The proportion of cancer patients receiving radiotherapy was estimated at between 37 and 46%;
- 54% of treatments were given with curative intent, a small increase since 1992;
- The difference between regional and county departments for proportion of treatments with curative intent had diminished;
- Treatments with curative intent used a higher proportion of resources measured in terms of fractions;
- The proportion of palliative treatment was slightly lower than in 1992, but the absolute number of treatments had increased by more than 20%;
- No improvement in participation in clinical trials was noted;
- Treatments given with curative intent were more complex with more fields;
- Hyperfractionation was used, mainly in treatments of cancers of the head and neck, lung, and bladder;
- The use of brachytherapy for non-gynaecological malignancies had increased dramatically;
- Treatment of bone metastases with a single or few fractions was used much more frequently;
- Dose planning and patient set-up showed a high standard but quality control of dosimetry of given treatment did not fully comply with Swedish and European recommendations;
- The treatment devices seem to be used more efficiently.

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PURPOSE AND DESIGN

The aim of the project was to assess the actual use of radiotherapy in Sweden, to compare the results with those of the previous survey in 1992, and to create a database for further studies of, e.g., survival, patterns of care, and utilization of radiotherapy resources. A prospective survey was conducted during 12 consecutive weeks in the autumn of 2001 (17 September–9 December), viz. the same time period as the previous study (1, 2). All patients who began radiotherapy were included. The data therefore include not only patients who received primary treatment but also those who received treatment later in the course of disease. The registration of the personal ID number permits long-term follow-up of the present cohort.

All 16 departments of oncology and 7 departments of gynaecologic oncology participated in the survey (see Fig. 1

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in (3), this issue). Data were also collected on patients treated at St Erik's Hospital for Eye Diseases and, to a small extent, the Department of Neurosurgery, Karolinska Hospital, Stockholm, and at the nuclear research plant in Studsvik, thus making the survey national in scope. No selection for diagnosis was made, and the survey thus included all patients with cancer who had started radiotherapy during the study period, as well as treatments for benign and non-neoplastic disease. The study did not encompass treatments with radiopharmaceutical methods or bucky radiation at the dermatological departments.

The study was approved by the Research Ethics Committee of Lund University as a national multicentre study, and permission to erect a register with personal identification was also given.

MATERIAL AND METHODS

Data collection and monitoring

A special form was used to gather information on each of the patients surveyed, and a comprehensive guideline for filling out the form was provided. If, during the study period, the same individual began multiple courses of radiotherapy that were independent of each other and directed towards different targets, each course of radiotherapy was registered on a separate form. The results of the analyses are presented in terms of both 'treatments' (= forms) and 'patients' (= individuals).

The forms were pre-printed with a unique code for department and a consecutive serial number and recorded the following information for each treatment:

- Personal ID number (from which sex and age can be derived)
- Diagnosis (ICD-10) and date of diagnosis
- TNM and Stage
- Morphology (SNOMED)
- Previous radiotherapy: no/yes; same target: no/yes
- Intent: curative/palliative/other

Treatment according to:

- National or local care programmes
- Trial protocol (radiotherapy trial/other trial)
- Local clinical guidelines
- Individualized treatment

Target volume:

- Primary tumour
- Locoregional recurrence
- Distant metastases: lymph nodes/bone/brain/lung/other
- Lymphoma manifestation
- Other target

Combined therapy:

- Radiotherapy as the only treatment
- Radiotherapy combined with surgery (preop./postop.)
- Radiotherapy combined with chemotherapy
- Radiotherapy combined with hormonal therapy

External beam treatment plan and implementation:

- Dose calculation: point dose/2-D/3-D
- Beam shaping: none/standard blocks/individual blocks/multileaf collimator
- Fixation: standard fixation/individual fixation
- Verification: film; no./electronic; no.
- In vivo dosimetry: portal measurements; no./other site; no.
- Date treatment started (several series possible)
- Date treatment concluded
- Number of beams
- Number of fractions
- Number of fractions per day
- Target dose, Gy: target I/target II
- Treatment fulfilled according to plan/re-planning/interrupted

Brachytherapy:

- Radiation source
- Dose rate: HDR/MDR/LDR/PDR; dose rate Gy/h
- Duration: temporary/permanent
- Technique of application: remote afterloading/manual afterloading/manual application
- Type of application: intracavitary/interstitial/surface application
- Dose planning based on: geometry/x-rays/CT/other
- Date treatment started (several series possible)
- Date treatment concluded
- Number of fractions
- Target dose, Gy: target I/target II
- Treatment fulfilled according to plan/re-planning/interrupted

A site visit was carried out by the study monitor and an oncologist to all departments 1–3 weeks before the start of the study period. At each therapy unit—external beam unit as well as brachytherapy unit—a special logbook was activated, and all patients that were referred to the unit for treatment were registered in this logbook. At the same time, the patients' informed consent was sought. A specific person was designated at each department to be responsible for collecting the data. After completion of the form, it was sent, together with a copy of the treatment record form, to the Oncological Centre in Lund and reviewed by the study monitor (research oncology nurse Jeanette Ceberg). Correc-

tions and complementary information were required for at least 25% of forms before the data could be entered into the database.

Double data entry to the database was not used, but the data were checked by extensive descriptive statistics, and errors and missing values were corrected based on source data. Extreme values were also checked specifically, and for some key variables random samples of treatments were compared with the source data. The close monitoring by one very experienced person who also had direct contact with all departments resulted in high-quality data.

Calculation of annual figures

The study period covered 12 weeks. To obtain annual figures for the number of treatments, fractions and fields, the actual numbers derived from the study were multiplied by 50/12. This was considered to be a reasonable factor, taking into account that there were no holidays during the study period and that the level of activity at the departments was high. This factor was checked against treatment statistics for the same period from Lund, showing exactly the same percentage. The factor is also very close to the one used in the previous report, 100/23, based on the estimation that the proportion of treatments given during the study period comprised 23% of the annual number of treatments of a specified subgroup of patients at the Radiumhemmet in Stockholm.

However, since the same patient may be treated on other occasions during the year outside the study period, the annual number of patients will most probably be overestimated using an extrapolation factor of 50/12. In the other direction, a conservative estimate of the annual number of patients can readily be derived from the proportion (p) of patients treated with radiotherapy for the first time during the study period. Thus, for this estimate, a factor of $p \times 50/12$ is used instead in the extrapolation of number of patients.

In addition, the extrapolation to annual figures involves an element of variability due to random fluctuations in the number of treatments given during 12-week periods. However, it is possible to get a rough idea of the precision in the extrapolation procedure by construction of approximate 95% predictions intervals (PI) using reasonable assumptions for the standard deviation of the number of treatments.

To this end, let n_{obs} be the observed number of treatments during the study period. Using the aforementioned extrapolation factor of $k = 50/12$, the predicted annual number is simply $k \times n_{obs}$. Assume that the standard deviation, s, for the number of treatments during a study period of 12 weeks is p% of the average number of treatments, m, during such a period. (In other words, the coefficient of variance equals p%.) Further, assuming that the number of treatments in a period is approximately normally distributed, the probability of observing a deviation from m in n_{obs} with at most $2 \times$ p% of m is then approximately 95%. Since it is impossible to estimate s from data alone, we apply a couple of different, but reasonable, values of p (2.5%, 5%, and 7.5%) and use $p \times n_{obs}/100$ as the corresponding value of s. Hence, given the value of p, an approximate 95% prediction interval for the annual number of treatments is given by

$$k \times n_{obs} \pm 2 \times (k(k-1))^{1/2} \times p \times n_{obs}/100$$

Approximate 95% PIs for the annual proportion of incident cancer cases treated with radiotherapy are calculated by simply dividing the lower and upper limits of the corresponding prediction interval for the number of treatments of malignancies by the number of incident cases during 2000.

RESULTS

Patient material

During the course of the study, a total of 5 858 treatments were reported to the log. Out of these, 492 (8.4%) were later cancelled owing to a change in treatment decision or deteriorating condition or death of the patient. The number of patients who declined to participate was 250 (4.3%), with a range of 0–8% between the clinics. Eleven (0.2%) forms could not be retrieved from five departments. Thus, the final material consisted of 5 105 treatments given to 4 171 patients. Of these patients, 3 853 received external radiotherapy only, 169 received external radiotherapy and brachytherapy, and the remaining 149 received brachytherapy only. A total of 3 416 patients had one treatment, 639 two treatments, 71 three treatments, and 45 patients had four treatments or more. This means that 18% of all patients had multiple treatments during the study period. It should be noted that in some of these patients (especially those with both external beam therapy and brachytherapy) treatments were given to the same target. Forty-six patients were treated for more than one diagnosis, and 34 patients were treated at more than one department.

During the study period, 84 patients were treated with the gamma knife and 10 patients with BNCT.

For an extrapolation to annual figures we assume that the 11 forms that could not be retrieved correspond to 11 unique patients not included in the study material. Further, we assume that the 250 patients who declined participation actually did start therapy and together would have generated 250 forms had they been included in the study material. Finally, for the extrapolation we also include 94 patients treated with the gamma knife or BNCT and assume that each of them corresponds to a single treatment/form. Thus a prediction of an annual number of treatments is given by $5\,460 \times 50/12$, i.e. 22 750 treatments. Using the same extrapolation factor and the above assumptions leads to a predicted annual number of treated patients equal to $4\,526 \times 50/12 = 18\,858$. However, this is most likely an

overestimation since the same patient may be treated on several occasions during the year, and outside the study period. An alternative and conservative figure can be derived by considering only the proportion of patients treated with radiotherapy for the first time ever during the year. Since this proportion was approximately 80% as estimated from the study material, we arrive at $0.80 \times 18 = 15\,087$ as an estimate of a lower limit to the total number of annual patients.

The extrapolation to annual figures involves an element of variability owing to random fluctuations in the number of treatments given during 12-week periods. In the Methods section we show how a rough impression of the impact of this chance variation can be gained in terms of approximate 95% prediction intervals. The calculations are reliant on specification of the size of the coefficient of variance for the number of treatments during a 12-week period, p. With respect to the total number of treatments given annually, approximate 95% prediction intervals are (21 800–23 700) for $p = 2.5\%$, (20 800–24 700) for $p = 5\%$ and (19 800–25 700) for $p = 7.5\%$.

In 1992, it was estimated that approximately 13 000 treatments were given annually. Thus the present figure indicates a substantial increase on an annual basis. Compared to the total number of treatments of 19 156 (17 915 external beam and 1 241 brachytherapy) given during the year 2000 as reported by the departments, the actual figure seems reasonable, taking into account the increase in cancer incidence and that a new department of oncology was opened during 2000. Furthermore, the definition of 'treatment' probably differs between annual reports and the more stringent concept as used in the survey.

The distribution of age and gender appears in Fig. 1; of the subjects, 1 981 (47.5%) were men and 2 190 (52.5%) women. The median age was 68 years (range 3–97) for men and 61 (range 0–102) for women. Thus, a higher proportion of women are found in the lower age groups, explained mainly by a different age distribution in the two most common diagnoses, breast cancer and prostate cancer. The proportion of patients below 65 years of age was 37.5% for males and 60.0% for females. The corresponding figures for all patients diagnosed with cancer in Sweden in 2000 were 28.9% and 41.1%, respectively. Patients receiving radiotherapy constitute a younger population than incident cancer cases (Fig. 2).

The distribution of age and gender among those patients who declined to participate did differ from that of the final material. Fifty-seven percent were women, and the median age for each gender was 70 years. Thus, proportionately more elderly women declined to participate. The reason for this selection is unclear. The majority of these patients were treated at a few regional hospitals, indicating local logistic problems.

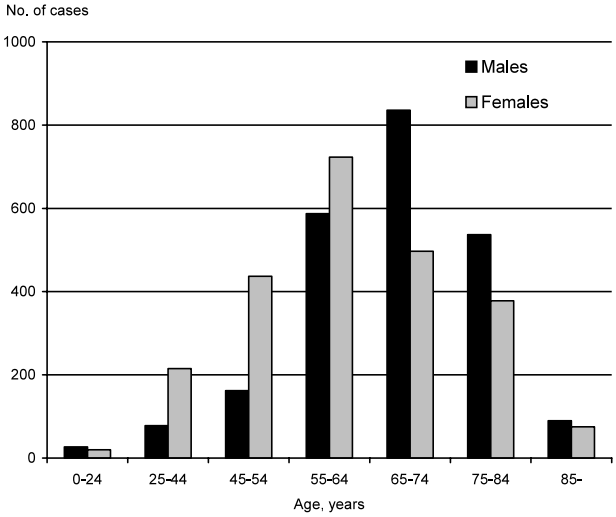

Fig. 1. Distribution of age and gender in the study cohort of 4 168 individuals.

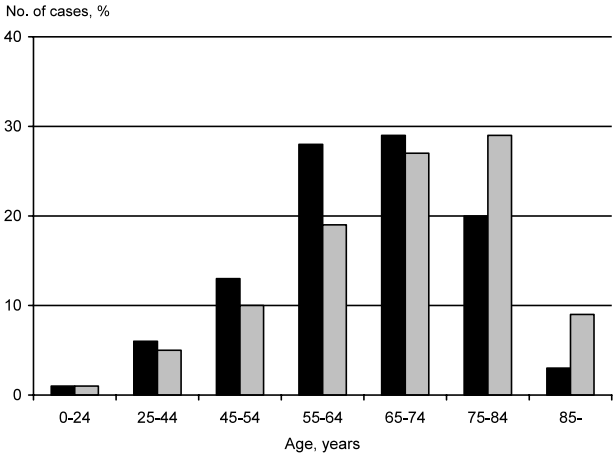

Fig. 2. Distribution of age in the study cohort (black) in relation to age of incident cancers in Sweden 2000 (grey).

Diagnoses for which radiotherapy was given and proportion of patients treated

The complete spectrum of tumour types for which radiotherapy was given is listed in Table 1. This table also gives the corresponding national incidence figures for 2000, the most recent year for which national cancer incidence data were available. The most common diagnoses in the survey were cancer of the breast (24%), prostate (18%), lung (10%), rectum (5%) and uterine corpus (4%). The tumour types included in the previous survey (marked in bold in the table) constitute 81% of all treatments recorded in the present survey. The absolute number of treatments to these diagnoses is 38% larger in the present survey than in the previous one. The relative distribution of diagnoses is essentially the same but the proportion of patients with

Table 1

Overview of all treatments included in the survey distributed by tumour type and related to number of new cases of that particular diagnosis in Sweden 2000. Tumour types included in the survey 1992 are marked in bold. The table also gives, for each tumour type, the estimated proportion of cases receiving radiotherapy on an annual basis

Diagnosis		Treatments included in the survey of 2001		New cancer cases in Sweden 2000		Estimated proportion receiving radiotherapy[a]
ICD-10	Tumour site	No. of treatments	%	No. of cases	%	%
C 00	Lip	8	0.2	150	0.3	22
C 01—06	**Oral cavity**	75	1.5	332	0.7	94
C 07–08	Salivary glands	13	0.3	90	0.2	60
C 09–10	**Oropharynx**	37	0.7	139	0.3	100
C 11	**Nasopharynx**	12	0.2	39	0.1	100
C 12–13	**Hypopharynx**	6	0.1	64	0.1	39
C 15	**Oesophagus**	66	1.3	378	0.8	73
C 16	Stomach	17	0.3	1 037	2.3	7
C 18	Colon	44	0.9	3 275	7.2	6
C 19–20	**Rectum**	244	4.8	1 817	4.0	56
C 21	Anus	25	0.5	112	0.2	93
C 22–24	Liver, gallbladder, biliary tract	17	0.3	752	1.7	9
C 25	Pancreas	12	0.2	852	1.9	6
C 30–31	Nasal cavity, accessory sinuses	15	0.3	53	0.1	100
C 32	**Larynx**	53	1.0	179	0.4	100
C 34	**Lung**	485	9.5	2 846	6.3	71
C 40–41	Sarcoma of bone and cartilage	11	0.2	84	0.2	55
C 43	**Malignant melanoma of skin**	89	1.7	1 616	3.6	23
C 44	**Non-melanoma skin cancer**	60	1.2	2 934	6.5	9
C 45–49	**Soft tissue sarcoma**	81	1.6	290	0.6	100
C 50	**Breast**	1 231	24.1	6 383	14.0	81
C 51–52	**Vulva, vagina**	42	0.8	163	0.4	100
C 53	**Cervix uteri**	89	1.7	448	1.0	83
C 54	**Corpus uteri**	198	3.9	1 292	2.8	64
C 56	**Ovary**	30	0.6	826	1.8	15
C 60	**Penis**	8	0.2	68	0.2	49
C 61	**Prostate**	940	18.4	7 611	16.7	51
C 62	**Testis**	28	0.5	244	0.5	48
C 64	Kidney	119	2.3	783	1.7	63
C 65–66	Renal pelvis, ureter	12	0.2	184	0.4	27
C 67	**Urinary bladder**	86	1.7	2 086	4.4	17
C 69	Eye	12	0.2	107	0.2	47
C 70–72	**Central nervous system**	109	2.1	1 217	2.7	37
C 73	Thyroid gland	19	0.4	293	0.6	27
C 77–80	Secondary tumour and tumour NOS	118	2.3	1 776	3.9	28
C 81	**Mb Hodgkin**	20	0.4	176	0.4	47
C 82–88	**Non-Hodgkin's lymphoma**	125	2.4	1 342	3.0	39
C 90	Myeloma	106	2.1	538	1.2	82
C 91–95	Leukaemias	21	0.4	1 049	2.2	8
	Other tumours	30	0.6	1 857	4.2	7
Total		4 713		45 482	100	43
D 05	**Breast cancer in situ**	36	0.7	637		24
D 10–36	Benign tumours	14	0.3			
	Non-neoplastic conditions	342	6.7			
Grand total		5 105	100			

[a]Values > 100 are given as 100.

prostate cancer is higher, corresponding to a doubling of the number of treatments.

For each tumour type, the estimated proportion of cases receiving radiotherapy on an annual basis is also given in Table 1. These estimates use the extrapolation factor of 50/12 and rely solely on the number of treatment forms actually included in the study material (n = 5 105). The highest proportion of cases receiving radiotherapy was seen for

cancers of the head and neck, soft tissue sarcoma, breast cancer and some gynaecological cancers, while very few patients with gastrointestinal cancers (with the exception of rectal cancer), urological cancers and skin tumours receive radiotherapy.

In the survey, a total of 4 713 treatments were given to 3 953 patients with a malignant diagnosis (defined as ICD-10 C00–C95). For an extrapolation to annual figures, we make the same assumptions as before concerning the number of treatments/patients for patients or forms not included in the study material for various reasons (non-retrieved forms, patients declining to participate, etc.). In addition, we assume that the 11 non-retrieved forms all concerned malignancies and, likewise, that the 250 patients who declined participation all had malignant diagnoses. For the 94 patients treated with the gamma knife or BNCT it is known that 77 had a malignant diagnosis. Thus, on an annual basis, it could be estimated that 21 046 treatments were given to between 14 063 and 17 579 patients with cancer. Approximate 95% prediction intervals for the annual number of treatments of malignancies were (20 100–22 000) for $p = 2.5\%$, (19 –22 900) for $p = 5\%$, and (18 300–23 800) for $p = 7.5\%$.

In 2000, 45 482 new cancers were reported of which as first tumour in 38 907 individuals. If incidental autopsy findings are excluded, these figures are 44 497 and 38 156, respectively. When relating the number of treatments to number of cancers excluding autopsy findings, it has been found that 47% of incident cancers receive radiotherapy at some time during the course of the disease. Approximate 95% prediction intervals for the proportion of cases treated with radiotherapy are (45%, 49%) for $p = 2.5\%$, (43%, 51%) for $p = 5\%$, and (41%, 53%) for $p = 7.5\%$. Compared with the estimate of 32% in the previous report, the actual figures suggest a considerable increase in the proportion of cancer patients being treated with radiotherapy. The corresponding figure for the relation based on patients was between 37% and 46%.

The 14 benign tumours comprised tumours of the parotid gland and bone not reportable to the cancer registry. The 342 non-neoplastic diseases for which radiotherapy was given included prophylactic treatment to the mammary glands in patients with prostate cancer ($n = 311$), endovascular brachytherapy of the coronary arteries ($n = 10$), stereotactic radiotherapy of cerebral vascular malformations ($n = 6$), keloids ($n = 6$), hyperfunctioning of the salivary and lachrymal glands ($n = 3$), prostatic hyperplasia ($n = 2$), arthrosis ($n = 2$), endocrine ophthalmopathy ($n = 1$), and splenic irradiation in haemolytic anaemia ($n = 1$). These conditions and treatments are only partly included in the further analyses.

Eighty-four patients were given treatment with the gamma knife: 34 primary intracranial tumours, 33 brain metastases and 17 vascular malformations. On an experimental basis, BNCT was given to 10 patients with brain tumours. These are not included in the further analyses, owing to lack of adequate data.

Treatment intent

Treatments were classified as given with either curative or palliative intent. However, the concept of curative versus palliative treatment caused some confusion since no clear, universally accepted definition exists. A common perception is that curative treatment refers to therapy that is planned to provide definitive cure for the patient, locally and/or generally. In some cases, curative treatment is planned where experience shows that only a few patients can actually be cured. In this study, the definition of curative treatment suggested above was applied. However, one should be aware that definitions of curative/palliative may vary among the departments and even between oncologists in the same department.

In order to evaluate this uncertainty, treatment intent as reported was correlated to type of target. It was found that therapy directed towards the primary tumour was given with curative intent in 84% of cases, the remaining 16% mostly made up of very advanced (T4) tumours of the lung, prostate and urinary bladder, a high proportion of the malignant gliomas, malignant lymphomas, and the majority of myelomas. Treatment for locoregional recurrence was given with curative intent in 59% of cases, while only 3% of metastatic disease was treated with curative intent, and most of these cases also included the primary tumour in the target volume. Obviously, the definition of curative and palliative intent seemed to be operational, at least for non-lymphoma tumours. This concept is also valid in a broader sense for the non-neoplastic disorders treated with radiation; e.g. alleviating pain, obstruction or disturbing secretions, or preventing events such as restenosis of the coronary arteries or rupture of cranial vessels.

Table 2a presents the number of treatments and proportion of treatments given with curative intent by type of department, classified into departments of oncology at regional and county hospitals, and departments of gynaecologic oncology.

Fifty-four percent of all treatments were given with curative intent, with only a minor difference between oncological departments at county and regional hospitals (49 vs. 53%), but with a higher proportion at the gynaecological departments (87%). The difference between regional and county hospitals was less than that in 1992, but there was still a variation from 38% to 100% between individual departments, independent of care level. Even between individual departments of gynaecologic oncology a wide variation of 72–100% was seen. It is difficult fully to explain this variation. One explanation may be, as suggested above, a somewhat different definition of concepts.

Table 2a

Overview of patients and treatments included in the survey distributed by type of department, and given both as total and divided according to type of treatment and treatment intent. All treatments for cancer including breast cancer in situ, n = 4 749

	Oncology		Gynaecologic oncology	Total[d]
	County hospital	Regional hospital[a]		
Total				
No. of patients	921	2 824	265	3 989
Treatments				
No.	1 039	3 371	339	4 749
Curative intent, %	49	53	87	54
Range[b]	38–62	42–100	72–100	38–100
External beam therapy				
No. of patients	907	2 746	198	3 850
Treatments				
No.	1 024	3 205	211	4 440
Curative intent, %	48	51	80	51
Range[b]	38–58	37–59	67–100	37–100
Fractions				
No.	15 642	49 024	4 611	69 277
Curative intent, %	73	79	92	78
Range[b]	56–82	74–84	86–100	56–100
Fields[c]				
No.	44 035	147 235	16 584	207 854
Curative intent, %	81	85	95	85
Range[b]	66–89	78–88	89–100	66–100
Brachytherapy				
No. of patients	15	166	127	308
Treatments				
No.	15	166	128	309
Curative intent, %	100	91	98	95
Range[b]	–	47–100	60–100	47–100
Fractions				
No.	15	953	461	1 429
Curative intent, %	100	96	97	97
Range[b]		50–100	54–100	50–100

[a]St Erik's Hospital for eye diseases included as a regional hospital.
[b]Variation between individual departments.
[c]Information on number of fields missing for 133 treatments at regional hospitals and 11 treatments at departments of gynaecologic oncology.
[d]The sum of patients over type of department is not necessarily identical to total number of patients, since an individual patient may have visited more than one hospital.

Palliative treatments often use fewer fractions and fewer fields than treatments with curative intent. Consequently, the proportion of fractions and treated fields with curative intent was substantially higher, 78% and 85%, respectively. Generally, a higher proportion of fractions and fields with curative intent was given at the regional oncological departments, which might be explained by a different case mix.

Limiting the analysis to the same tumour diagnoses as in the survey of 1992, the proportion of treatments with curative intent was 56%, which is higher than in the previous study, 50% (Table 2b). The number of such treatments increased by 52% from 1 419 in 1992 to 2 150. In addition, the proportion of fractions and treated fields with curative intent was higher than in 1992, 81% of fractions vs. 68%, and 87% of treated fields vs. 72%. This is explained by an increasing level of sophistication of treatments with curative intent.

A total of 1 711 treatments with non-curative intent were given compared with 1 419 in 1992, an increase of 21%. The number of treated fields with non-curative intent decreased by 22% and the number of fractions decreased by 23%, indicating fewer fractions per treatment.

In Table 3 it is shown that the proportion of treatments given with curative intent varied considerably by type of cancer. The lowest proportion of such treatments ($< 25\%$) was observed in malignant melanoma and cancers of the penis, ovary and lung. By contrast, a high ($> 75\%$)

Table 2b

Same analysis as in Table 2a, but the material is limited to external radiotherapy for those diagnoses included in the survey 1992 and presented according to type of department as defined at that time

	Oncology		Gynaecologic oncology	Total[c]
	County hospital	Regional hospital		
Patients				
No.	1 001	2 196	196	3 391
Treatments				
No.	1 112	2 540	209	3 861
Curative intent, %	53	55	80	56
Range[b]	44–60	39–66	66–100	39–100
Fractions				
No.	17 337	41 246	4 556	63 139
Curative intent, %	78	82	92	81
Range[b]	60–85	76–87	86–100	60–100
Fields[a]				
No.	49 500	126 191	16 396	192 087
Curative intent, %	85	87	95	87
Range[b]	70–91	79–90	89–100	70–100

[a]Information on number of fields missing for 107 treatments at regional hospitals and 11 treatments at departments of gynaecologic oncology.
[b]Variation between individual departments.
[c]The sum of patients over type of department is not necessarily identical to total number of patients, since an individual patient may have visited more than one hospital.

proportion was noted for cancers of the head and neck, rectum, skin, vulva-vagina, cervix, corpus and testis. The distribution of percentages is similar to that in 1992 with two major exceptions: prostate cancer and brain tumours.

Table 3

Number of treatments and proportion (%) given with curative intent, by diagnosis, divided according to type of department. All treatments for cancer including breast cancer in situ, n = 4 749

Diagnosis/tumour site	Oncology				Gynaecologic oncology		Total	
	County hospital		Regional hospital					
	No.	%	No.	%	No.	%	No.	%
Head and neck	19	84	164	91			183	90
Oesophagus	5	20	61	41			66	39
Rectum	69	80	175	80			244	80
Lung	108	18	377	27			485	25
Sarcoma of bone	1	0	10	50			11	45
Melanoma of skin	13	15	76	13			89	13
Non-melanoma skin cancer	12	100	48	88			60	90
Soft tissue sarcoma	5	60	76	53			81	53
Breast	354	72	913	67			1 267	68
Vulva, vagina	4	75	2	100	36	92	42	90
Cervix uteri	2	50	2	0	85	92	89	89
Corpus uteri	10	80	1	0	187	94	198	93
Ovary	0	0	1	0	29	24	30	23
Penis	0	0	8	13			8	13
Prostate	235	29	705	51			940	45
Testis	5	100	23	91			28	93
Urinary bladder	24	42	62	35			86	37
Brain	16	38	93	56			109	53
Malignant lymphoma	29	62	116	64			145	63
Other tumours	128	20	458	26	2	50	588	24
Total	1 039	49	3 371	53	339	87	4 749	54

In prostate cancer, the proportion of treatment with curative intent increased from 17% to 45%, while for brain tumours it decreased from 71% to 53%.

The proportion of patients treated with curative intent also varied with age and sex. In males, curative treatments were given to 77% of patients in the youngest age group (< 25 years) gradually decreasing to 25% in the oldest age group (85 years or older). In females, the corresponding values were 74% and 44%, respectively. Thus, considerably fewer older male patients receive radiotherapy with curative intent, which might be explained by the high frequency of skeletal metastases from prostate cancer at higher ages.

Targets irradiated

The numbers for treatments to different targets by tumour type are listed in Table 4. As expected, the most common target was the site of the primary tumour, being the aim of irradiation in 59% of treatments. Locally recurrent disease was treated in 5% of cases, while treatment for metastatic disease was given in 35%.

The highest proportion of treatment to the primary tumour was seen for testicular cancer with 93% and brain tumours with 91%, not unexpectedly since the latter tumours do not metastasize. High proportions were also seen in the gynaecological cancers with the exception of ovarian (88–85%), head and neck (86%) and rectal cancer (83%). The lowest proportions were noted for cancer of the penis (0%), malignant melanoma (4%) and cancer of the ovary (7%).

Skeletal metastases were the target in 62% of treatments for recurrent or metastatic disease, virtually the same proportion as in 1992 (60%). They were seen mainly in patients with cancer of the lung, breast, prostate and bladder. Annually, more than 4 800 treatments for skeletal metastases are given in Sweden, equivalent to 11% of incident cancers (less incidental autopsy findings). It might be of interest to notice that the median time from diagnosis of the disease to treatment of bone metastases was 7 months (p90 23 months) for lung cancer, 3.5 years (p90 10.4 years) for prostate cancer, and 5.8 years (p90 14.4 years) for breast cancer.

Brain metastases are also most common in lung and breast cancer. Approximately 1 000 treatments for brain metastases are given annually, double the figure for 1992.

Targets classified as 'Others' comprised radiocastration in breast cancer (n = 8), total body irradiation (n = 7) and splenic irradiation (n = 5) in lymphoma and leukaemia and prophylactic irradiation of the cranial cavity and spinal meninges in lung cancer (n = 5).

Table 4

Number of treatments distributed by target. All treatments for cancer including breast cancer in situ, n = 4 749

Diagnosis/tumour site	Primary tumour[a]	Locoregional relapse	Distant metastases						Other target
				Specific sites					
			Total	Lymph nodes	Lung	Brain	Bone	Other	
Head and neck	158	14	11	2	2	0	7	0	0
Oesophagus	50	2	14	4	1	4	3	2	0
Rectum	203	13	28	2	3	5	14	4	0
Lung	224	16	240	10	6	71	134	19	5
Sarcoma of bone	4	1	6	0	3	0	2	1	0
Malignant melanoma	4	16	69	12	1	17	26	13	0
Non-melanoma skin	44	12	4	3	0	1	0	0	0
Soft tissue sarcoma	46	6	29	1	7	1	10	10	0
Breast	822	54	383	17	9	42	299	16	8
Vulva, vagina	37	3	2	0	0	0	0	2	0
Cervix uteri	78	2	9	3	2	2	2	0	0
Corpus uteri	169	16	13	2	0	2	6	3	0
Ovary	2	5	23	10	2	5	3	3	0
Penis	0	1	7	2	0	0	4	1	0
Prostate	469	12	459	4	0	0	449	6	0
Testis	26	0	2	2	0	0	0	0	0
Urinary bladder	50	10	26	2	1	1	20	2	0
Brain	99	10	0	0	0	0	0	0	0
Malignant lymphoma	113	18	12	1	0	3	6	2	2
Other tumours	227	25	326	34	15	41	195	41	10
Total	2 825	236	1 663	111	52	195	1 180	125	25

[a]Treatment of tumour bed including regional lymph nodes after surgical resection of tumour as well as manifestations of malignant lympoma are classified in this and subsequent tables as treatment of primary tumour.

Table 5

Number of treatments given according to type of programme, by type of department. All treatments for cancer including breast cancer in situ, n = 4 749[a]

Type of programme	Oncology				Gynaecologic oncology		Total	
	County hospital		Regional hospital					
	No.	%	No.	%	No.	%	No.	%
Radiotherapy trial	7	0.7	75	2.2	14	4.1	96	2.0
Other randomized study	10	1.0	48	1.4	8	2.4	66	1.4
National/regional care programme	416	40.0	1 211	36.0	156	46.1	1 783	37.6
Local PM/Procedure manual	224	21.6	589	17.5	71	21.0	884	18.7
Individualized treatment	382	36.8	1 437	42.8	89	26.3	1 908	40.3
Total	1	100	3	100	338	100	4 737	100

[a]Information on type of programme missing for 12 treatments.

Care programmes and clinical trials

In Table 5 it is shown that 38% of all treatments were given according to national or regional care programmes (clinical guidelines). The proportion was lower for oncology departments at regional hospitals compared with county hospitals, 36% vs. 40%. Departments of gynaecologic oncology showed a higher figure of 46%. An additional 19% of treatments were given according to a local memorandum or procedure manual. Only 162 patients (3%) participated in a clinical trial, 96 in a radiotherapy trial and 66 in other trials.

These data are similar to the results obtained in the previous study. It is a sad fact that the proportion of radiotherapy patients participating in clinical trials has not increased.

The proportion of patients treated according to clinical guidelines varied considerably by diagnosis (Table 6). Testicular tumours (at 86%) represent the diagnostic group most commonly treated according to national/regional care programmes; cancer of the vulva–vagina (at 33%) represents the most frequently treated group according to a local

Table 6

Number of treatments given according to type of programme, by diagnosis. All treatments for cancer including breast cancer in situ, n = 4 749[a]

Diagnosis/tumour site	Type of programme					Total number of treatments
	Radiotherapy trial	Other randomized study	National/regional care programme	Lokal PM/ procedure manual	Individualized treatment	
Head and neck	24	3	65	48	43	183
Oesophagus	5	4	11	12	34	66
Rectum	20	5	131	41	47	244
Lung	5	10	72	114	280	481
Sarcoma of bone	0	0	3	2	6	11
Malignant melanoma	0	0	9	10	70	89
Non-melanoma skin cancer	0	0	1	15	44	60
Soft tissue sarcoma	1	3	12	20	45	81
Breast	0	16	798	147	305	1 266
Vulva, vagina	0	0	13	14	15	42
Cervix uteri	3	3	40	16	26	88
Corpus uteri	12	4	112	37	33	198
Ovary	0	1	3	3	23	30
Penis	0	0	1	0	7	8
Prostate	17	2	262	267	388	936
Testis	0	1	24	2	1	28
Urinary bladder	0	0	20	16	50	86
Brain	5	2	50	18	34	109
Malignant lymphoma	0	1	68	6	70	145
Other tumours	4	11	88	96	387	586
Total	96	66	1 783	884	1 908	4 737

[a]Information on type of programme missing for 12 treatments.

memorandum or procedure manual; and cancers of the head and neck (at 15%) and oesophagus (at 14%) represent the group most frequently treated according to clinical trials. For cancers of the oesophagus, lungs, bone and soft tissue sarcoma, melanoma and other skin tumours, ovary, penis and urinary bladder, treatment was usually individualized.

Classifying the patients according to curative or palliative treatment shows that 64% of curative treatment was delivered according to some form of guideline (59% based on national or regional guidelines and 5% based on controlled studies).

Radiotherapy in combination with other treatment modalities

Out of 2 765 treatments of the primary tumour, radiotherapy as the only modality was given in 20% of the cases (Table 7). Radiotherapy in combination with surgery was employed in 1 532 (55%) with or without the addition of chemotherapy and/or hormonal therapy. Radiotherapy plus systemic treatment was given in 25%.

The highest proportions of radiotherapy alone were seen in oesophageal cancer, skin cancer and bladder cancer, while cancer of the rectum, corpus uteri and testicular tumours usually were treated with a combination of radiotherapy and surgery. Systemic therapy combined with radiotherapy was seen chiefly in lung cancer, prostate cancer and malignant lymphoma. The combination of all three treatment modalities was seen almost exclusively in breast cancer and, in addition, a few prostate cancers.

In combination therapy with radiation and surgery, preoperative radiotherapy was mainly given for rectal cancers and a few head and neck cancers, while postoperative radiotherapy was given in most other cases.

Table 7

Number of treatments for primary tumour by treatment modality: radiotherapy alone or in combination with other treatment. All primary treatments of patients with cancer including breast cancer in situ, n = 2 825[a]

Diagnosis/ tumour site	Total number of treatments	Treatment modality					
		Radiotherapy alone	Radiotherapy combined with surgery	Radiotherapy combined with surgery and chemotherapy ± hormonal therapy[b]	Radiotherapy combined with surgery and hormonal therapy	Radiotherapy combined with chemotherapy ± hormonal therapy[c]	Radiotherapy combined with hormonal therapy
Head and neck	156	71	60	6	0	19	0
Oesophagus	50	32	2	7	0	9	0
Rectum	202	7	184	9	0	2	0
Lung	212	69	9	7	0	127	0
Sarcoma of bone	4	1	0	2	0	1	0
Malignant melanoma	3	1	1	0	0	1	0
Non-melanoma skin cancer	44	28	15	0	0	1	0
Soft tissue sarcoma	42	12	18	5	0	7	0
Breast	820	17	218	301	267	4	13
Vulva, vagina	37	10	19	4	0	4	0
Cervix uteri	73	31	16	9	0	17	0
Corpus uteri	167	12	126	24	2	3	0
Ovary	2	0	0	2	0	0	0
Penis	0	0	0	0	0	0	0
Prostate	449	71	18	1	31	1	327
Testis	26	3	23	0	0	0	0
Urinary bladder	48	29	10	1	0	8	0
Brain	98	28	49	13	0	7	1
Malignant lymphoma	113	35	5	11	0	62	0
Other tumours	219	85	38	17	2	76	1
Total	2 765	542	811	419	302	349	342

[a]Information on treatment modality (radiotherapy alone or in combination with other treatment) missing for 60 treatments.
[b]Number of patients with hormonal therapy: 165.
[c]Number of patients with hormonal therapy: 3.

Chemotherapy in combination with radiotherapy was given as induction therapy in some head and neck cancers (10%) and the majority of lung cancers (60%). In a few of these cases chemotherapy was also given concomitantly with radiotherapy. Chemotherapy also preceded radiotherapy in malignant lymphomas (40%).

External radiotherapy—dose and fractionation patterns

Table 8 gives the average number of fractions, fields and total target dose for non-interrupted treatment of the primary tumour of different tumour types. On average, the primary tumour was treated with 47 Gy in 22 fractions with 3.7 fields. The variation between individual tumour types was considerable. The highest radiation dose and most fractions were given for head and neck cancer (63.5 Gy/34 fractions) and prostate cancer (57 Gy/28 fractions). Since these diagnoses also used many fields, they represent some of the most resource-demanding treatments. The lowest radiation dose was used for testicular tumours (27 Gy/15 fractions) and malignant lymphoma (32 Gy/15 fractions), which is explained by the high radiosensitivity of these tumours, and consequently they can be cured by lower radiation doses. Rectal cancer also received a fairly low dose (29 Gy/8 fractions) because most of the treatments were given as 5×5 Gy preoperatively.

Hyperfractionated radiotherapy to the primary tumour was administered in 113 treatments, mainly for head and neck cancer (n = 42), lung cancer (n = 16), breast cancer (n = 12), bladder cancer (n = 8) and oesophageal cancer (n = 7).

The same information on treatment for local recurrence and various metastatic sites is given in Table 9. The average dose for locoregional recurrence was 44.5 Gy in 20 fractions with 3.5 fields, which is only slightly less than the average dose to the primary tumour. This can be explained by the fact that 60% of these treatments were given with curative intent, and that only 17% had been irradiated previously to the same target, thus permitting a higher, tumoricidal dose to be given in most cases.

On average, metastatic disease was given 21 Gy in 6 fractions with 1.8 fields. Skeletal metastases, the most common metastatic site to be irradiated, were given an average of 18 Gy/4.4 fractions with 1.6 fields, compared with an average of 27 Gy in 8.4 fractions with 1.7 fields as found in the previous survey. Thus, the principle of irradiation of skeletal metastases with a single or few fractions has been widely adopted in clinical practice.

Figs. 3 and 4 illustrate the dose-fraction patterns employed in treatments with curative and palliative intent, respectively. Data on interrupted treatments are excluded. As can be seen, most treatments with curative intent used

Table 8

External radiotherapy for primary tumour. Number of treatments, number of fractions per treatment, number of fields per fraction, and target dose (Gy), by tumour type. All non-interrupted primary treatments of patients with cancer including breast cancer in situ, n = 2 446[a]

Diagnosis/tumour site	No. of treatments	Fractions		Fields[b]		Target dose, Gy	
		Mean/median	Min-max	Mean/median	Min-max	Mean/median	Min-max
Head and neck	139	33.8/34.8	15–66	5.9/6.0	2–18	63.5/66.0	41–74
Oesophagus	36	20.0/20.0	5–38	4.6/3.0	2–13	43.5/40.8	20–65
Rectum	199	8.3/5.0	5–32	3.9/4.0	2–20	29.2/25.0	20–86
Lung	202	19.0/20.0	1–65	3.7/3.0	1–12	44.2/44.0	10–65
Sarcoma of bone	4	26.0/32.0	4–36	6.3/7.0	1–10	40.5/48.0	12–54
Malignant melanoma	4	6.3/5.0	5–10	2.8/2.5	1–5	36.3/35.0	30–45
Non-melanoma skin cancer	39	14.9/10.0	4–38	1.5/1.0	1–12	45.9/45.0	30–68
Soft tissue sarcoma	45	17.5/23.0	3–36	3.2/2.0	1–10	41.5/45.0	18–68
Breast	809	24.3/25.0	5–39	3.4/3.0	1–14	49.5/50.0	20–70
Vulva, vagina	32	26.0/25.0	5–35	3.4/3.0	1–8	52.2/50.0	30–70
Cervix uteri	45	27.4/26.0	5–37	5.9/6.0	2–15	53.3/50.0	25–70
Corpus uteri	79	23.5/23.0	19–32	4.3/4.0	3–12	45.5/46.0	38–60
Ovary	2	25.0/25.0	23–27	4.5/4.5	4–5	50.0/50.0	46–54
Penis	0	–	–	–	–	–	–
Prostate	341	27.6/30.0	1–39	4.7/4.0	1–10	57.1/60.0	8–80
Testis	26	14.9/14.0	14–34	2.0/2.0	1–2	26.9/25.2	22–68
Urinary bladder	43	28.5/32.0	2–66	3.9/4.0	2–10	52.6/62.0	17–80
Brain	92	23.8/28.0	3–39	3.2/2.5	1–12	48.6/54.0	20–66
Malignant lymphoma	110	15.4/17.0	1–25	2.5/2.0	1–7	32.4/30.6	8–44
Other tumours	199	15.4/10.0	1–40	3.0/2.0	1–11	36.6/30.0	2–80
Total	2 446	22.1/25.0	1–66	3.7/3.0	1–20	46.9/50.0	2–86

[a]Number of interrupted treatments: 88.
[b]Information on number of fields missing for 33 treatments.

Table 9

External radiotherapy for local recurrence or metastasis. Number of non-interrupted treatments distributed by site of relapse. All secondary treatments of patients with cancer including breast cancer in situ, n = 1 809[a]

Site of relapse	No. of treatments	Fractions		Fields		Target dose, Gy	
		Mean/median	Min-max	Mean/median	Min-max	Mean/median	Min-max
Locoregional relapse	209	19.8/23.0	1–40	3.5/3.0	1–25	44.5/46.0	8–90
Curative intent	125	24.2/25.2	1–40	4.2/4.0	1–25	50.8/50.0	12–90
Palliative intent	84	13.3/10.0	1–33	2.5/2.0	1–11	35.2/30.0	8–66
All distant metastases	1 600	5.7/5.0	1–40	1.8/2.0	1–15	21.1/20.0	2–85
Specific sites							
Lymph nodes	103	12.2/10.0	1–32	2.4/2.0	1–12	34.5/30.0	2–85
Lung	51	8.1/5.0	1–31	3.5/2.0	1–9	30.7/30.0	8–62
Brain	179	8.4/8.0	1–40	2.1/2.0	2–6	27.5/30.0	20–60
Bone	1 144	4.4/5.0	1–25	1.6/2.0	1–9	17.9/20.0	6–58
Other sites	123	7.6/5.0	1–29	2.3/1.0	1–15	26.9/30.0	2–57
Total	1 809						

[a]Number of interrupted treatments: 73.

50–60 Gy in 25–30 fractions. The highest peaks represent postoperative treatment in breast cancer and radiotherapy of head and neck and prostate cancers. The smaller peak at 20–25 Gy in a few fractions represents preoperative treatment in rectal cancer and treatment of malignant lymphomas. A small 'hill' at low dose and few fractions represent mainly total body irradiation. In treatments with palliative intent, three distinct peaks can be discerned, representing 6–8 Gy in one fraction, 20–24 Gy in 4 or 5 fractions and 30 Gy in 10 fractions, respectively. This graph illustrates the now widespread use of single or few fractions in irradiation of bone metastases.

An attempt was made to identify the most common dose-fraction patterns employed in different clinical situations. The result is given in Table 10, organized according to tumour type and treatment schedule. Obviously, this table can only give a rough view of radiotherapy practice since there are always deviations from an identifiable standard practice.

External beam therapy—dose planning, beam shaping, and patient fixation

For treatment of the primary tumour, CT-based, 3-D dose planning was used in 75% of cases (Table 11). Almost all

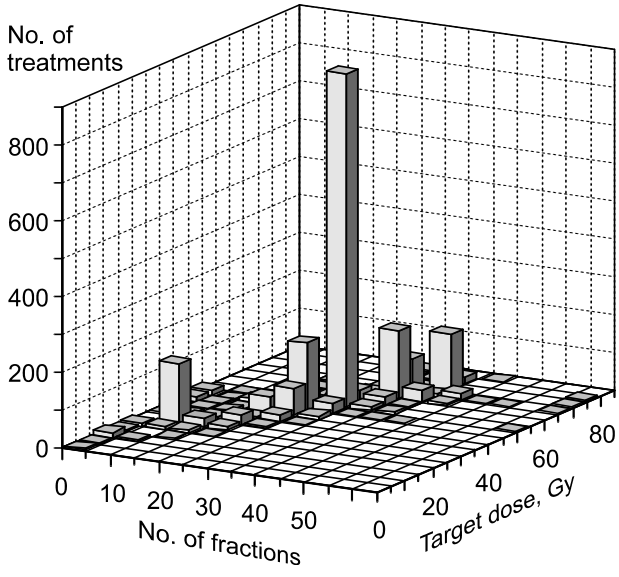

Fig. 3. Three-dimensional graph of number of treatments with curative intent using different dose-fractionations. Several distinct peaks are easily discernible, the highest corresponding to 50 Gy/25 fractions.

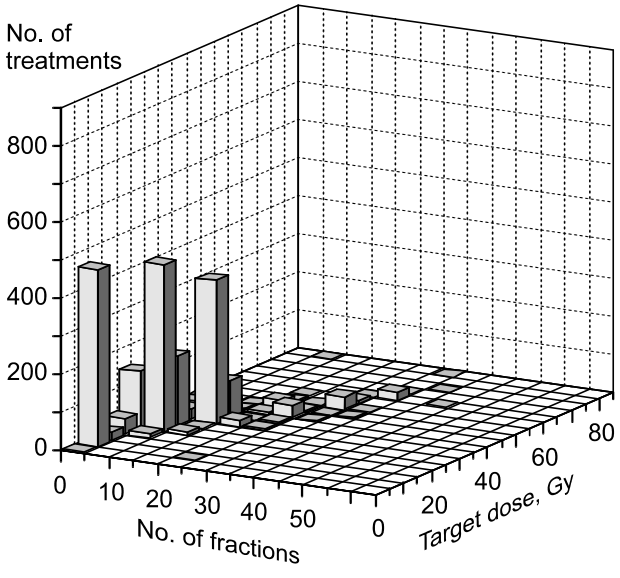

Fig. 4. The same type of presentation of dose-fractionation patterns in treatments with palliative intent. Three distinct peaks can be seen, representing treatments with single fractions, 5 fractions and 10 fractions, respectively.

Table 10

Target dose and fractionation in treatments of the primary tumour in selected diagnoses and specific metastatic sites, distributed by treatment schedule. Interrupted treatments are excluded. Patterns of fractionation are given mainly according to the size of the fraction dose

Diagnosis/tumour site	Treatment schedule	Dose and fractionation		Frequency
Head and neck				
Oral cavity	RT alone	a)	60.8–68 Gy/34–43 fractions[a]	3/17
		b)	64–68 Gy/32–34 fractions[e]	10/17
		c)	8–25/1 fraction brachy. LDR or 35 Gy/42 fractions brachy. PDR	3/17
	RT+surgery		44–64 Gy/22–32 fractions[e]	4/7
	Surgery+RT	a)	57.8 Gy/34 fractions	5/24
		b)	60–68 Gy/30–34 fractions[e]	9/24
		c)	30 Gy/1 fraction. brachy. LDR or 50 Gy/60 fractions. brachy. PDR	3/24
Oropharynx	RT alone		66–70 Gy/33–34 fractions[e]	10/12
	Chemo+RT		64.6 Gy/38 fractions	4/5
	Surgery+RT	a)	64.6–68/38–43 fractions[a]	3/4
		b)	64 Gy/32 fractions	1/4
	RT+surgery	a)	68 Gy/43 fractions	2/7
		b)	66–68 Gy/33–34 fractions[e]	5/7
Hypopharynx	RT alone	a)	68 Gy/34 fractions	2/3
	Surgery+RT	a)	68 Gy/34 fractions	1/2
	RT+surgery	a)	68 Gy/34 fractions	1/1
Nasopharynx	Chemo+RT	a)	64.6–68 Gy/38–40 fractions[a]	2/4
		b)	60–66 Gy/30–33 fractions[e]	2/4
Larynx	RT alone	a)	64–70 Gy/32–35 fractions[e]	25/38
		b)	62.5 Gy/25 fractions	5/38
	Surgery+RT	a)	54–68.8/30–43 fractions[a]	5/8
	RT+surgery	a)	64.6/38 fractions[a]	2/4
		b)	68/34 fractions	2/4
Oesophagus	RT alone	a)	40–64 Gy/20–32 fractions[e]	4/23
		b)	30–45 Gy/10–15 fractions[f]	8/23
		c)	20–25 Gy/5 fraction	4/23
		d)	16–21 Gy/2–3 fractions HDR brachy.	3/23
		e)	30 Gy/10 fractions+12 Gy/3 fractions HDR brachy.	2/23
		f)	40.8/24 fractions+20 Gy/4 fractions HDR brachy.	1/23
	Chemo+RT	a)	50–64 Gy/25–32 fractions[e]	5/8
	Chemo+RT+surgery		40.8–64.6 Gy/24–38 fractions[a]	5/6
Rectum				
	RT alone	a)	50–64 Gy/25–32 fractions[e]	2/6
		b)	30–39 Gy/10–3 fractions[f]	2/6
		c)	25 Gy/5 fractions	2/6
	RT+surgery	a)	46-52 Gy/23–26 fractions[e]	16/175
		b)	25 Gy/5 fractions	154/175
	Surgery+RT	a)	50–60 Gy/25–30 fractions[e]	3/4
Anus	RT (±surgery±	a)	60–66 Gy/30–33 fractions[e]	14/21
	Chemo)	b)	46–50 Gy/23–25 fractions[e]	4/21
Lung				
SCLC	Chemo+RT	a)	59.4 Gy/33 fractions	4/25
		b)	40–50 Gy/20–25 fractions[e]	13/25
		c)	30–39 Gy/10–13 fractions[f]	3/25
NSCLC	RT alone	a)	40–64 Gy/20–34 fractions[e]	12/61
		b)	30–45 Gy/10–15 fractions[f]	22/61
		c)	20 Gy/5 fractions	4/61
		d)	45 Gy/3 fractions	11/61
	Chemo+RT	a)	61.2–64.6 Gy/34–38 fractions[a]	7/87
		b)	40–44Gy/20–22 fractions[e]	10/87
		c)	60–64 Gy/30–32 fractions[e]	28/87
		d)	30–45 Gy/10–15 fractions[f]	26/87
		e)	20 Gy/5 fractions	4/87

Table 10 (*Continued*)

Diagnosis/tumour site	Treatment schedule	Dose and fractionation		Frequency
	Surgery + RT	a)	64.2 Gy/38 fractions	2/14
	(±chemo)	b)	44 Gy/22 fractions	3/14
		c)	50–60 Gy/25–30 fractions[e]	7/14
Breast				
Cancer in situ	Surgery + RT	a)	50 Gy/25 fractions	29/36
	(±systemic)	b)	42.5 Gy/16 fractions	4/36
Stage I	RT alone (±systemic)	a)	50 Gy/25 fractions	12/16
		b)	47 Gy/20 fractions	2/16
	Surgery + RT	a)	50–54 Gy/25–27 fractions[e]	273/316
	(±systemic)	b)	42.5 Gy/16 fractions	21/316
		c)	47 Gy/20 fractions	8/316
Stage IIA + B	RT alone (±systemic)	a)	50 Gy/25 fractions	6/10
		b)	47 Gy/20 fractions	2/10
		c)	39 Gy/13 fractions	2/10
Stage IIA	Surgery + RT	a)	50 Gy/25 fractions	51/62
	(±systemic)	b)	47 Gy/20 fractions	3/62
		c)	42.5 Gy/16 fractions	2/62
Stage IIB	Surgery + RT	a)	50–54 Gy/25–27 fractions[e]	194/284
	(±systemic)	b)	54–60 Gy/26–30 fractions[e]	21/284
		c)	46 Gy/23 fractions	22/284
		d)	45 Gy/20 fractions	16/284
		e)	42.5 Gy/16 fractions	4/284
		f)	47 Gy/20 fractions	5/284
Stage III	Surgery + RT	a)	50 Gy/25 fractions	29/43
	(±systemic)	b)	46 Gy/23 fractions	5/43
		c)	45 Gy/20 fractions	3/43
Stage IV	RT alone (±systemic)	a)	20 Gy/5 fractions	1/5
		b)	20 Gy/6 fractions	1/5
		c)	25 Gy/5 fractions	1/5
		d)	45 Gy/15 fractions	1/5
		e)	50 Gy/25 fractions	1/5
	Surgery + RT (±systemic)	a)	50 Gy/25 fractions	12/15
Cervix uteri	RT alone	a)	46.8–67 Gy/26–37 fractions[a]	6/19
		b)	50–66 Gy/25–33 fractions[e]	4/19
		c)	46–60 Gy/23–30 fractions + 13–15 Gy/3 fractions brachy. HDR	3/19
		d)	42 Gy/21 fractions + 72 Gy/2 fractions brachy. LDR	1/19
		e)	46.8 Gy/26 fractions + 22.5 Gy/1 fraction brachy. LDR	1/19
		f)	55.8 Gy/31 fractions + 15 Gy/1 fraction brachy. LDR	1/19
		g)	46 Gy/23 fractions + 28 Gy/2 fraction brachy. LDR	1/19
	Chemo + RT	a)	50–70 Gy/25–35 fractions[e]	6/12
		b)	10 Gy/1 fraction brachy. LDR or 15 Gy/5 fractions brachy. HDR	3/12
		c)	50 Gy/25 fractions + 10–30 Gy/1–3 fractions brachy. LDR	2/12
		d)	60 Gy/30 fractions + 18 Gy/1 fraction brachy. HDR	1/12
	Surgery + RT	a)	46–50 Gy/23–25 fractions[e]	3/11
		b)	5–17.7 Gy/2–3 fractions brachy. HDR	2/11
		c)	46–50 Gy /23–26 fractions + 10–12 Gy/2–3 fractions brachy. HDR	4/11
	Surgery + chemo + RT	a)	45–61.2 Gy/25–34 fractions[a]	3/6
		b)	46 Gy/23 fractions + 12 Gy/3 fractions brachy. HDR	2/6
		c)	60 Gy/30 fractions + 15 Gy/1 fraction brachy. LDR	1/6
Corpus uteri	RT alone	a)	21–30 Gy/3–5 fractions brachy. HDR	3/9
		b)	45 Gy/3 fractions brachy. LDR	2/9
	Surgery + RT	a)	45–50 Gy/23–25 fractions[e]	22/94
		b)	45 Gy/25 fractions	4/94
		c)	18 Gy/6 fractions brachy. HDR	10/94
		d)	11.25 Gy/3 fractions brachy. HDR	11/94

Table 10 (*Continued*)

Diagnosis/tumour site	Treatment schedule	Dose and fractionation		Frequency
		e)	10 Gy/2–4 fractions brachy. HDR	8/94
		f)	17.7 Gy/3 fractions brachy. HDR	3/94
		g)	20 Gy/5 fractions brachy. HDR	3/94
		h)	46 Gy/23 fractions + 10–12. 5 Gy/3–4 fractions brachy. HDR	13/94
		i)	39.6–46.8 Gy/22–26 fractions + 8–10 Gy/2–4 fractions brachy. HDR	8/94
	Surgery + chemo + RT	a)	46 Gy/23 fractions	5/17
		b)	10 Gy/2–4 fractions brachy. HDR	2/17
		c)	11.25–12.5 Gy/3–5 fractions brachy. HDR	4/17
		d)	46 Gy/23 fractions + 12.5 Gy/5 fractions	3/17
Prostate	RT alone	a)	70 Gy/35 fractions	32/65
		b)	74–78 Gy/37–39 fractions[e]	12/65
		c)	21 Gy/3 fractions	2/65
		d)	125 Gy/1 fraction LDR brachy. permanent	11/65
	Hörmones + RT	a)	70 Gy/35 fractions	66/317
		b)	50 Gy/25 fractions	18/317
		c)	72–78 Gy/36–39 fractions[e]	28/317
		d)	21 Gy/3 fractions	6/317
		e)	30–45/10–15 fractions[f]	5/317
		f)	20 Gy/2 fractions	19/317
		g)	50 Gy/25 fractions + 20 Gy/2 fractions brachy. HDR	62/317
	Surgery + RT ± hormones	a)	60–70 Gy/30–35 fractions[e]	34/44
		b)	21 Gy/3 fractions	4/44
Testis	Surgery + RT	a)	25.2 Gy/14 fractions	20/23
Urinary bladder	RT alone (±chemo)	a)	79.2–79.6 Gy/65–66 fractions[b]	4/31
		b)	60–74 Gy/30–37 fractions[e]	15/31
		c)	21 Gy/3 fractions	2/31
	Surgery + RT	a)	46–50 Gy/23–25 fractions[e]	2/8
		b)	21 Gy/3 fractions	1/8
Brain		c)	30 Gy/10 fractions	2/8
Low-grade glioma	RT alone	a)	50.4–54 Gy/28–30 fractions[d]	3/5
		b)	56 Gy/28 fractions	1/5
		c)	39 Gy/13 fractions	1/5
	Surgery + RT	a)	50.4 Gy/28 fractions	2/6
		b)	54–60 Gy/27–30 fractions[e]	3/6
High-grade glioma	RT alone	a)	50.4–59.4 Gy/28–33 fractions[d]	4/14
		b)	54–60 Gy/27–30 fractions[e]	4/14
		c)	34 Gy/10 fractions	3/14
	Surgery + RT	a)	56–66 Gy/28–33 fractions[e]	13/24
		b)	34 Gy/10 fractions	4/24
Medulloblastoma	Surgery + RT (±chemo)		34.2–55.8 Gy/19–31 fractions[d]	8/10
Meningeoma	Surgery + RT	a)	50.4–55.8 Gy/27–31 fractions[d]	3/9
		b)	54–60 Gy/27–30 fractions[e]	3/9
Hodgkin's lymphoma	Chemo + RT	a)	29.75–35.9 Gy/17–21 fractions[c]	10/13
		b)	30–40 Gy/15–20 fractions[e]	3/13
Non-Hodgkin lymphoma	RT alone	a)	24–30 Gy/12–15 fractions[e]	9/34
		b)	40–44 Gy/20–22 fractions[e]	8/34
		c)	30–39 Gy/10–13 fractions[f]	7/34
	Chemo + RT	a)	40–44 Gy/20–22 fractions[e]	19/46
		b)	30–36 Gy/15–18 fractions[e]	5/46
		c)	21–36 Gy/7–12 fractions[f]	8/46
		d)	20 Gy/5 fractions	3/46
	Surgery + RT (±Chemo)	a)	30–40 Gy/15–20 fractions[e]	11/14
Myeloma	RT alone	a)	44–52 Gy/22–26 fractions[e]	4/20
		b)	30–42 Gy/10—14 fractions[f]	9/20
		c)	20–28 Gy/5–7 fractions[g]	3/20

Table 10 (*Continued*)

Diagnosis/tumour site	Treatment schedule	Dose and fractionation		Frequency
		d)	20–25 Gy/4—5 fractions[h]	2/20
		e)	8 Gy/1 fraction	1/20
	RT+chemo	a)	30–36 Gy/10–12 fractions[f]	12/53
		b)	20 Gy/5 fractions	18/53
		c)	8 Gy/1 fraction	6/53
		d)	20–25 Gy/4–5 fractions[h]	7/53
Skeletal metastases		a)	8 Gy/1 fraction	424/1144
		b)	20 Gy/5 fractions	239/1144
		c)	24–28 Gy/6–7 fractions[g]	73/1144
		d)	20–y/4–5 fractions[h]	109/1144
		e)	30 Gy/10 fractions	150/1144
Brain metastases		a)	20 Gy/5 fractions	47/179
		b)	30 Gy/10 fractions	71/179
		c)	29.6 Gy/8 fractions	24/179
Lung metastases		a)	30–39 Gy/10–13 fractions[f]	15/51
		b)	20 Gy/5 fractions	8/51
		c)	20–40 Gy/2–4 fractions[i]	6/51
		d)	30–45 Gy/2–3 fractions[j]	8/51

Abbreviations: RT = radiotherapy; chemo = chemotherapy; systemic = xhaemotherapy and/or hormonal therapy.
[a]1.6–1.8 Gy/fraction. Hyperfractionated treatment; [b]1.2 Gy/fraction. Hyperfractionated treatment; [c]1.75 Gy/fraction; [d]1.8 Gy/fraction; [e]2.0 Gy/fraction; [f]3.0 Gy/fraction; [g]4.0 Gy/fraction; [h]5.0 Gy/fraction; [i]10.0 Gy/fraction; [j]15.0 Gy/fraction.

treatments for head and neck tumours and gynaecological malignancies had a 3-D dose plan. In contrast, for most treatments for melanoma and other tumours of the skin only a point dose calculation was made.

In two-thirds of treatments of the primary tumour, beam shaping was performed by means of a multileaf collimator. Individual blocks were used in 14% of cases, and standard blocks were almost abandoned. It should be noticed that the multileaf collimator had to be supplemented with additional blocks in 7% of treatments. A third of the treatments were given without any specific patient fixation, and for the rest standard and individual fixation devices and methods were used equally often.

External beam therapy—quality control

Quality control of external beam therapy includes checking of beam geometry and delivered dose (Table 12). The position of the individual beams is checked in relation to well-defined anatomical structures, internally most often to skeletal parts, and externally to distinct points of the integumentary system. The most common method for checking beam position is by means of special films, exposed by the treatment unit during irradiation. This method was employed in 60% of treatments, on average 2.8 times during each treatment to the primary tumour. Electronic portal vision was performed in 35% of treatments, on average 3.1 times per treatment. In a few cases, the two methods were combined. No such checks were carried out for the majority of treatments of skin cancer, but also a high proportion of patients with rectal cancer, most probably due to this treatment being highly standardized.

Measurement of entrance dose is a means to ascertain that the patient receives the correct dose to that particular radiation field. Such measurements are required for each field at least at the start of the treatment according to recent Swedish regulations (5). This standard procedure was employed for the majority of treatments. A wide variation in dose measurement practice was observed between departments, from one measurement to 24 per treatment on average.

Measurement of dose at other locations, e.g. in the oesophagus, rectum, or at beam exit, is a means of checking the correctness of the dose plan, and repeated measurements can reveal changes in the patient's body (such as accumulation of body fluids, weight loss, etc.) that can have a clear influence on the final dose to the target. Such checks were carried out to a limited extent only.

Brachytherapy

In this survey, 318 patients were treated with brachytherapy, 149 patients received brachytherapy alone and 169 received brachytherapy and external beam radiotherapy in combination. A total of 319 treatments were given, and in Table 13 a summary is given of brachytherapy treatment techniques by diagnosis.

Gynaecologic brachytherapy was less used than in 1992 (128 treatments vs. 211) but the relative distribution between diagnoses was the same. In the previous report, only one treatment was given for a non-gynaecological

Table 11

External radiotherapy of primary tumour. Type of dose planning, beam shaping and patient fixation. Proportion (%) of primary treatments of patients with cancer including breast cancer in situ, n = 2 534

Diagnosis/ tumour site	Dose planning[a]			Beam shaping[b]				Patient fixation[c]	
	Point dose calculation	Calculation in a plane	Full 3-D (CT based)	Individual blocks	Standard blocks	MLC	Combination MLC+other	Individual fixation	Standard fixation
Head and neck	1.4	0.7	97.9	31.7	0.7	55.4	7.9	95.7	0.7
Oesophagus	31.7	0.0	68.3	12.2	0.0	61.0	7.3	39.0	34.2
Rectum	33.0	22.7	44.3	8.7	11.8	74.9	0.0	6.2	25.6
Lung	30.3	2.3	67.4	14.4	1.0	67.0	2.4	52.2	24.4
Sarcoma of bone	25.0	0.0	75.0	0.0	0.0	75.0	0.0	25.0	25.0
Malignant melanoma	75.0	0.0	25.0	0.0	0.0	33.3	0.0	66.7	0.0
Non-melanoma skin cancer	79.1	0.0	20.9	69.8	2.3	16.3	0.0	27.9	4.7
Soft tissue sarcoma	41.3	0.0	58.7	23.8	0.0	47.6	4.8	31.0	14.3
Breast	12.2	3.9	83.9	9.6	2.3	47.2	15.2	31.6	57.4
Vulva, vagina	44.1	0.0	55.9	8.8	11.8	64.7	2.9	11.8	29.4
Cervix uteri	2.1	0.0	97.9	2.3	0.0	95.4	0.0	0.0	34.9
Corpus uteri	3.7	3.7	92.6	11.4	1.3	84.8	1.3	8.9	25.3
Ovary	0.0	0.0	100	0.0	0.0	100	0.0	0.0	0.0
Penis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prostate	8.1	0.6	91.3	4.3	0.3	86.2	1.8	16.9	32.5
Testis	53.9	3.9	42.3	11.5	0.0	80.8	3.9	11.5	38.5
Urinary bladder	20.0	2.0	78.0	4.2	2.1	68.8	2.1	18.8	41.7
Brain	15.2	1.01	83.8	28.6	6.1	56.1	0.0	91.8	4.1
Malignant lymphoma	43.4	1.8	54.9	26.6	4.4	46.9	1.8	49.6	22.1
Other tumours	50.2	0.5	49.3	16.9	3.0	37.3	2.5	34.8	18.9
Total	21.6	3.8	74.7	13.8	2.8	59.0	6.6	34.5	34.2

[a]Information on dose planning missing for 2 cases.
[b]Information on beam shaping missing for 68 cases.
[c]Information on patient fixation missing for 68 cases.

diagnosis. In the present survey, the majority of treatments were given to non-gynaecological tumours: 25 of the head and neck, 15 of the gastrointestinal tract, 124 prostate, 7 melanoma of the eye, and 10 other sites. It is of interest to notice that endovascular therapy was given to 10 patients. Of the prostate treatments, 15 patients received permanent implants and the other high-dose rate temporary interstitial brachytherapy.

Brachytherapy was combined with external beam therapy to the same target in 160 patients with cancer of the prostate (54%), uterine corpus (25%), cervix (13%) and head and neck + oesophagus (6%) (Table 14).

Departmental workload, production and productivity

During the study period, external beam therapy was given with a total of 69 806 fractions (Table 15). Assuming three fields per fraction for n = 144 forms with missing data on the number of fields, an approximate figure of the total number of fields used during the study period is 211 000. On an annual basis, these figures correspond to 290 858 fractions and 879 167 treated fields. These figures are in reality somewhat higher, taking into consideration that patients who declined to participate in the study most probably also were treated. Compared with data from 1992 in the previous report, the actual figures imply an increase by a quarter in the number of fractions and nearly a doubling of the number of fields. The reasons for this increase are increasing incidence of cancer, a higher proportion of patients being treated and more complex treatments (on average 3.0 fields per fraction vs. 2.3).

In Table 15 we show the number of treatments, fractions and treated fields produced at the different departments. If these figures are related to the number of high-voltage treatment units (disregarding orthovoltage and contact therapy units) in Sweden at the time of the study (n = 59, Fig. 1 in the paper on Radiotherapy and Cancer Care in Sweden, this issue (2)), an average annual patient load per unit of 338 with a variation from 248 to 442 between individual departments is found. On average, the number of

Table 12

External radiotherapy of primary tumour. Quality control of beam geometry (verification film or electronic) and dose (in vivo dosimetry). Primary treatment of patients with cancer including breast cancer in situ, n = 2 534

Diagnosis/tumour site	Verification[a]			In vivo dosimetry[b]		
	None	Film	Electronic (EPID)	None	Entrance dose	Other site
Head and neck	0	93	57	0	138	17
Oesophagus	2	20	20	0	41	7
Rectum	36	107	56	2	192	13
Lung	24	117	77	13	196	18
Sarcoma of bone	0	3	2	1	3	1
Malignant melanoma	2	1	0	1	1	1
Non-melanoma skin cancer	34	5	4	25	17	2
Soft tissue sarcoma	10	26	7	7	35	0
Breast	21	536	281	17	799	59
Vulva, vagina	9	12	14	1	33	0
Cervix uteri	2	27	15	0	44	1
Corpus uteri	5	43	31	0	79	0
Ovary	1	0	1	0	2	0
Prostate	18	195	122	6	319	20
Penis	–	–	–	–	–	–
Testis	2	17	8	0	26	8
Urinary bladder	6	24	19	1	47	6
Brain	13	60	28	6	92	25
Malignant lymphoma	20	58	38	10	102	9
Other tumours	34	99	75	8	191	22
Total	239	1 443	855	98	2 357	209

[a]Information on verification missing for 68 cases
[b]Information on in vivo dosimetry missing for 67 cases.

fractions per device was 4 930 with a variation from 3 338 to 7 047 and number of treated fields per unit 14 740, with a variation from 9 433 to 20 026. In the previous report, a load of 300 patients (= treatments) and 12 000 fields per treatment unit per year was considered a standard. The current figures might thus indicate a more efficient use of devices. However, modern treatment units are usually equipped with multileaf collimators and a computerized set-up that permits the rapid application of many fields sequentially and makes the concept of treated fields as a measure of production and workload questionable.

In Table 14 we present the same information divided by diagnostic group. It is readily seen that breast cancer constitutes the largest diagnostic group, using a third of all radiotherapy resources in terms of fractions and fields, prostate cancer being the second largest group, using 18% of resources, and cancers of the head and neck the third largest, using 8%.

DISCUSSION

One of the key issues in the present study is to determine the proportion of cancer cases being treated with radiotherapy. Ideally, a prospective, long-term follow-up of one year's cohort of patients throughout their entire disease episode would be desirable. However, surveying all patients commencing radiotherapy during a defined period of time, which is the method used here, can give a reasonable estimate. Since this estimate is based on a chain of approximations, it is important to evaluate the strength of the individual links in this chain.

Firstly, the factor of 50/12 used to extrapolate figures of the study period to a full calendar year was chosen on experience of the variation in patient load over the year due to holidays and reduced capacity during vacation periods. The essential assumption being used is stability in the expected number of treatments during 12-week periods over a (hypothetical) treatment year consisting of 50 weeks. This assumption has been roughly checked against actual numbers for the last three years from Lund, indicating no severe departures from a uniform patient load over the year. The present factor should not be expected to overestimate the annual numbers of treatments, fractions, and fields. However, the annual number of patients will most probably be overestimated since the same patient may be treated on other occasions during the year outside the study period. A conservative estimate of the annual number of patients can readily be derived from an estimate of the proportion of patients treated with radiotherapy for the first time during the study period. This proportion was found to be 80% and

Table 13

Brachytherapy. Number of treatments/fractions by diagnosis, technique, and radiation source

Diagnosis/ tumour site	Total no. of treatments	Technique and radionuclide									
		Intra-cavitary HDR ^{192}Ir	Intra-cavitary MDR/ LDR ^{137}Cs	Endo-vascular ^{32}P	Interstitial HDR ^{192}Ir	Interstitial LDR ^{192}Ir	Interstitial PDR[a] ^{192}Ir	Interstitial LDR permanent ^{103}Pd	Surface application HDR ^{192}Ir	Surface application LDR ^{192}Ir	Surface application MDR/ LDR ^{106}Ru
Lip	2						2/144				
Tongue	6				1/3	3/3	2/102				
Base of tongue	3					1/1	2/84				
Floor of mouth	4					2/2	2/96				
Gum	1						1/60				
Gingiva	1									1/1	
Nasopharynx	1	1/2									
Oropharynx	3					1/1	2/80				
Oesophagus	9	9/24									
Stomach	2	2/4									
Colon	1	1/2									
Rectum	1	1/3									
Anus	2				1/6	1/1					
Accessory sinus	4				1/6	3/3					
Bronchus	5	3/11				1/1	1/8				
Skin	2					1/1	1/75				
Breast	1	1/3									
Vulva, vagina	4	4/16									
Cervix uteri	30	14/43	15/24		1/6						
Corpus uteri	93	85/350	7/12						1/5		
Ovary	1	1/5									
Penis	1					1/1					
Prostate	124	3/6			105/206	1/2		15/15			
Kidney	1	1/4									
Eye	7										7/7
Coronary artery	10			10/10							
Total	319										

[a]Indicates number of pulses.

thus, a factor of $0.8 \times 50/12$ can be used instead in the extrapolation of number of patients.

Secondly, the data from the survey of 2001 are compared with cancer incidence of the year 2000, less incidental autopsy findings. The total number of incident cases by the year 2001 would probably be 1% higher, reducing the proportion slightly.

Thirdly, even if the survey was intended to be complete for patients starting radiotherapy, there is a deficit of 4–5% in the total number of treatments. All of these aspects being taken into account, the figure of 47% can be regarded as a reasonable point estimate. The precision of this estimate, which also depends on the magnitude of random fluctuations in the number of treatments of malignancies during a 12-week study period, has been discussed in the Results section.

To estimate the proportion of cases receiving radiotherapy for the individual diagnoses, national incidence

Table 14

Number of treatments, fractions and fields, by diagnosis and distributed on external beam therapy and brachytherapy, respectively. All treatments included in the survey, n = 5 105

Diagnosis/tumour site	External beam therapy			Brachytherapy		No. of patients with comb. ext + brachy.
	No. of treatments	No. of fractions	No. of fields[a]	No. of treatments	No. of fractions	
Head and neck	164	5 137	17 413	19	435	5
Oesophagus	57	991	3 159	9	24	4
Rectum	243	2 007	7 039	1	3	
Lung	481	5 637	16 123	4	13	
Sarcoma of bone	11	183	651			
Malignant melanoma	89	500	930			
Non-melanoma skin cancer	58	909	1 579	2	76	
Soft tissue sarcoma	81	1 188	3 705			
Breast	1 266	23 222	68 895	1	3	
Vulva, vagina	38	933	2 398	4	16	2
Cervix uteri	59	1 420	5 695	30	73	21
Corpus uteri	105	2 327	9 008	93	367	40
Ovary	29	281	680	1	5	
Penis	7	47	55	1	1	
Prostate	816	11	37 274	124	229	87
Testis	28	419	806			
Urinary bladder	86	1 642	5 492			
Brain	109	2 479	6 763			
Malignant lymphoma	145	2 127	5 073			
Other tumours	568	5 955	15 116	20	184	1
Benign tumours and non-neoplastic conditions	346	529	862	10	10	
Total	4 786	69 806	208 716	319	1 439	160

[a]Information on number of fields missing for 144 treatments.

data for the year 2000 are used, but without correction for incidental autopsy findings. The size of that proportion is 2% of all incident cancer cases, but less and even zero for most tumour types where radiotherapy is important. The only noticeable exceptions are lung cancer with 6% and tumours of the central nervous system with 4%. Furthermore, treatments with the gamma knife and BNCT are not included in these estimates. Since the diagnoses for which treatments were given in patients declining to participate and those for the missing forms are not known, these treatments could not be included. The combined effect of these facts is a minor underestimation, varying between diagnoses.

In the year 1992, a total of 39 617 new malignancies were diagnosed. In the previous report it was estimated that the cancer incidence would increase by 1% annually. In the year 2000, a total of 45 482 new cases were diagnosed, an increase of 10%, which is slightly higher than the prediction. Based on the present survey it can be concluded that the number of treatments per year has increased by approximately 60% and the proportion of cancer cases treated with radiotherapy from 32% to 47%, despite the concurrent increase in cancer incidence. The number of radiotherapy departments increased by one to 23 and the number of megavoltage treatment units has increased from 50 (7 cobalt units and 43 linear accelerators) to 59. This indicates a more intensive use of the devices.

The study of 1992 and the present study have great similarities but also differences. Both surveys collected essentially the same data during the same calendar period. Since no patient identification was recorded in 1992, a 'patient' was defined as a treatment of an independent target, while in the present study it was possible to make a distinction between 'patients' (= individuals) and 'treatments'. It might be of interest to notcee that 18% of the patients treated with external beams had more than one such treatment during the study period, a figure much higher than the one discussed in the previous report. The previous survey collected data on defined tumour types, while the present one had no such restrictions. The difference amounts to 19%. Furthermore, no data were collected on radiation therapy being delivered at non-oncological departments. On the other hand, none of the patients declined to participate in the previous study since there was no need to obtain the patient's informed consent, but the magnitude of missing forms is not known.

Fifty-four percent of all treatments for cancer were given with a curative intent. Compared to palliative treatments, the curative treatments are more complex, with a higher number of fractions and more fields given. Thus, 78% of the

Table 15

Total number of treatments, fractions and fields by department and distributed on external radiotherapy and brachytherapy, respectively. All treatments included in the survey, n = 5 105

Department (gyn = Department of Gynaecologic Oncology)	External beam therapy			Brachytherapy		Total no. of patients
	No. of treatments	No. of fractions	No. of fields	No. of treatments	No. of fractions	
Borås	180	2 464	6 385			148
Eskilstuna	161	1 713	4 528			131
Gävle	202	2 857	7 742			184
Göteborg	594	9 161	25 279	52	94	564
Göteborg gyn.	43	986	3 558	35	105	65
Jönköping	153	2 558	7 054	15	15	144
Karlstad	128	2 094	6 586			115
Linköping	335	4 978	13 486	15	36	289
Linköping gyn.	20	447	1 639	5	28	23
Lund	473	8 433	27 134	2	10	411
Lund gyn.	25	548	2 018	17	83	32
Malmö	239	3 317	9 552			197
Radiumhemmet	716	6 775	25 211[a]	54	112	512
Radiumhemmet gyn.	63	1 139	4 324[a]	39	115	72
Södersjukhuset	268	3 419	9 390			237
S:t Erik				7	7	7
Uppsala	233	3 695	9 632	20	39	219
Uppsala gyn.	21	510	1 602	15	39	30
Umeå	428	6 719	19 821			366
Umeå gyn.	18	482	1 741	3	4	18
Västerås	177	2 459	6 509			140
Växjö	119	1 602	5 358			107
Örebro	169	2 951	8 465	26	665	169
Örebro gyn.	21	499	1 702	14	87	25
Total	4 786	69 806	208 716	319	1 439	4 205

[a]Information on number of fields missing for 144 treatments.

fractions and 85% of the fields were used for curative treatments. The survey in 1992 encompassed approximately 87% of cancer patients. If the present material is selected according to the same criteria, the curative proportion of treatments, fractions and fields is 56%, 81% and 87%, respectively. The corresponding figures in the 1992 survey were 50%, 68% and 72%, respectively. Thus, the proportion used for curative purposes had increased over the nine years. The increase was most pronounced in county and regional departments of oncology, but less so in departments of gynaecologic oncology.

The technical development during the past decade has increased the number of devices with multileaf collimators. A multileaf collimator allows the use of many fields within the frame of an automatic set-up and without substantially adding to the treatment time for an individual patient. In treatments with curative intent, the number of fields has increased from 2.6 per fraction in 1992 to 3.2 in 2001. The corresponding figures for palliative treatment were 2.0 and 1.9, respectively. This explains why the proportion of curative fields has increased more than the figures for treatments and fractions.

The proportion of treatments with curative intent for individual diagnoses showed some interesting changes. The increase from 17% to 45% for prostate cancer is explained by more primary tumours being treated as a consequence of the widespread opportunistic screening with prostate-specific antigen (PSA). The treatment is also more aggressive. The explanation for the decrease from 71% to 53% in brain tumours is not so obvious—perhaps this more realistic figure is a result of the conclusions of the previous SBU report?

The primary tumour is the target in approximately 60% of all treatments, which is in good agreement with almost the same figure reported for treatments with curative intent. The proportion of treatments to different metastatic sites is the same as that in 1992, although the absolute numbers are substantially higher.

About 60% of the treatments were delivered according to a guideline or protocol. The corresponding figure in 1992 was 33%. The increase should be interpreted with caution since there was some uncertainty in the definition of guidelines in the previous survey. The figures nevertheless indicate an increased conformity in how radiotherapy is

utilized in Sweden, especially in the county hospitals. Care programmes, however, do not necessarily contain a detailed description of the more technical aspects of various treatment forms, especially not concerning radiotherapy, since this is often judged to be of limited informational value to anyone other than an oncologist. The focus of many care programmes tends to be on describing the medical investigations, referral paths, treatment principles, etc., and procedures that are relevant for the diagnosis and primary treatment of the patient.

In the previous survey approximately 3% of the patients participated in controlled clinical studies. It is sad to find the figure equally low in the present study. So many questions still remain unanswered in clinical oncology and substantially more patients should be recruited to clinical trials. A low proportion (approximately 10%) of patients participating in clinical studies was also seen when SBU in 1997 surveyed the use of chemotherapy in treatment of cancer (4).

As already pointed out in the previous report, malignant disease therapy is a multimodality treatment in most cases. Only 20% of the treatments of the primary tumour were given with radiotherapy alone. Thus, in the vast majority of treatments, radiotherapy was a part of a combination treatment schedule.

The number of fractions and mean target dose in curative treatments are similar in 1992 and 2001. No substantial dose escalation can be detected. Furthermore, in the case of palliative treatment the number of fractions and doses are similar between the two surveys except for bone metastases. In 1992 a mean of 27 Gy in 8 fractions was used. It was stated that based on the knowledge at that date, fewer fractions could be used and a conservative estimate of 5.65 fractions per patient was suggested. In the present study the corresponding figures were 17.9 Gy in 4.4 fractions, indicating a much more radical change in treatment policy than was envisaged.

In 1992 brachytherapy was used almost exclusively for gynaecological malignancies, with uterine cancer as the most common indication. At that time, brachytherapy was under-utilized in non-gynaecological cancers compared to the literature, which was also pointed out in the previous report. This situation has changed radically over the past nine years. In 2001 treatment of gynaecological cancers now represents only 40% of the treatments. This change is also partly explained by the declining use of brachytherapy in uterine cancer. Traditionally, the standard therapy was brachytherapy followed by surgery. Today, most patients are treated with surgery first and brachytherapy to the vulva is utilized only in the advanced cases.

At present, prostatic cancer is the most common indication for brachytherapy. In some centres curative treatment is given as a combination of external radiotherapy and two fractions of brachytherapy. Head and neck cancer was the indication for 19 treatments. Historically, head and neck cancer was one of the most important indications for brachytherapy. During the 1950s the technique was abandoned in favour of the new external high-voltage radiotherapy. In some patients brachytherapy has a definite advantage over external radiotherapy. The number of patients treated with brachytherapy on this indication can be expected to increase further. However, if intensity-modulated radiotherapy (IMRT) is implemented widely in the clinical routine, this technique may replace brachytherapy in some situations.

Dose planning, field shaping and patient fixation were not studied in 1992, so no comparisons can be made. Eighty-three percent of curative treatments are based on three-dimensional CT dose planning, with preoperative radiotherapy for rectal cancer as the most significant exception, where a standard beam arrangement is used.

As regards quality control procedures, checking of beam position and delivered dose are performed to varying extents. Dose measurements are nowadays regarded as an essential part of the QA procedure, and it is noteworthy that such checks at other locations than beam entrance were carried out to a much lesser degree than what is regarded as an acceptable standard (5–8), see also (9, 10). Experience gained during the monitoring process indicates that the form and completeness of documentation of a given therapy vary considerably between departments, and standardization is therefore desirable.

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