The costs of head and neck oncology: primary tumours, recurrent tumours and long-term follow-up

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Abstract

We retrospectively calculated the costs of head and neck oncology for reimbursement purposes. This analysis was based on 854 head and neck cancer patients treated between 1994 and 1996 in two major Dutch university hospitals. To anticipate future care costs, costs of required improvements in the quality of care were added. Costs of diagnosis, treatment and 2 years of follow-up of patients with a primary tumour were €21 858. For patients with a recurrent tumour, this amount was €27 629. The costs of 10 years of follow-up were €423 after discounting and correction for survival. In total, average costs per new patient were €31 829, which covered discounted costs of treating the primary tumour, costs of treating recurrent tumours in 40% of all patients and the costs of 10 years of follow-up. Costs of improving the quality of care were estimated to be €1598 per new patient. © 2001 Elsevier Science Ltd. All rights reserved.

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1. Introduction

In Europe, head and neck cancers are the fourth most common cancer in men, after cancer of the lung, colorectum and prostate [1]. In The Netherlands, 2100 new head and neck cancer patients are diagnosed each year [2]. This number is expected to increase in the near future because of the progressive ageing of the population and an increase in exposure to carcinogens over the past decades [3]. Of all head and neck cancer patients, the vast majority consists of patients with a tumour in the larynx, oral cavity or oropharynx, with an average male to female ratio of 3:1. The approximate 5-year survival rates for all stages combined, are 70% for laryngeal tumours, 55% for oral cavity tumours and 40% for oropharyngeal tumours [4]. It was recently suggested that the survival rates of head and neck cancer patients in Western Europe, particularly in Sweden

and The Netherlands, are fairly good as a consequence of the centralisation of the treatment since the 1980s [5].

Head and neck oncology is characterised by a high degree of multidisciplinarity [6], in which head and neck surgery, oral surgery, reconstructive surgery, radiotherapy and internal medicine are involved. Treatment mainly consists of surgery and radiotherapy. The application of chemotherapy is historically limited to the palliative setting, although its role in combination treatment modalities is growing, e.g. as part of a larynx preservation approach in patients requiring total laryngectomy [7].

In The Netherlands, specific hospital budgets are determined for advanced, complex and high technology care (like head and neck oncology) which is restricted to licensed hospitals. The Dutch reimbursement system covers all inputs the hospitals need, irrespective of patient outcomes. On behalf of an adequate revision of the hospital reimbursement for head and neck oncology, we calculated full hospital costs [8] of this care process in this retrospective study. A problem in the case of head and neck oncology is that the organisation of the

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care process (in terms of e.g. number of specialised nursing and administrative staff, registrars and physicians) is still subjected to a development process. This implies that the costs would be determined on the basis of data from a care process in which shortcomings are implicitly incorporated. To anticipate future care costs, we therefore added an estimation of 'quality costs' to our cost analysis. These costs contain the total costs of all measures necessary to overcome the current shortcomings. These shortcomings are particularly related to high workloads and the multidisciplinarity of the care process, which places high demands on the logistics. Another characteristic is the high degree of personal care in the relationship between the patient and the head and neck specialist, which increases the importance of an estimation of the specialist's costs. We aimed to take notice of these features in this cost analysis in which we determined the costs per new patient, including costs of diagnosis, treatment (of primary tumours and recurrent or second primary tumours) and 10 years of follow-up.

2. Patients and methods

2.1. Patients

In the University Hospital Rotterdam and the University Hospital Vrije Universiteit Amsterdam, a selection of 854 study subjects was made from a consecutive number of patients in whom the diagnosis 'cancer in the oral cavity, larynx or oropharynx' was confirmed between 1994 and 1996. We assumed that assessing these sites would yield a representative view of the costs of head and neck tumour patients, since they constitute the majority of all annual head and neck cancer patients [4,5].

Patients treated for a primary tumour and diagnosed between 1994 and 1996 were easily tracked in the databases of both hospitals. In total, 306 patients with an oral cavity tumour, 358 with a laryngeal tumour and 121 with an oropharyngeal tumour were found to be eligible. In contrast, it was relatively difficult to find if a patient had been treated for a recurrent or second primary tumour. Due to this lack of information, only a small subgroup of patients with a recurrent or second primary tumour was selected manually by investigating notes in patient files: 21 oral cavity tumours, 34 laryngeal tumours and 14 oropharyngeal tumours. From the costing viewpoint, second primary tumours and recurrent tumours were considered to be the same and they were therefore assessed as one group (they will only be mentioned as 'recurrent' tumours in the remainder of this article).

From each of the 854 patients in the sample, the records in both hospital information systems were used to determine the total medical consumption, consisting of outpatient visits, consultations, hospital days, surgery (diagnostic and therapeutic), radiotherapy, chemotherapy, radiodiagnostic tests, pathological tests, laboratory services, cardiographic tests, nuclear tests and microbiological tests. The course of the disease and the applied therapeutic option(s) were derived from patient files. Patients were assessed for one group only: patients on whose data the costs of recurrent tumours were calculated were not assessed for the costs of primary tumours, for which they had been treated earlier. Given the aim of the analysis (budget revision for head and neck oncology), only medical consumption relating to the treatment of the head and neck tumour was recorded.

For all patients, the majority of the medical consumption was found in the mentioned sources. A difficulty in this study was that the information had to be collected from different databases. For example, the structure of the database in which hospital days were stored was different (and from another operating system) than the database with outpatient visits. Since this study was primarily interested in average costs per patient, no attempt was made to incorporate the different databases into a statistical program. The major implication for the analysis is that it was basically only possible to determine average values. For a few patients, some data in specific categories (e.g. laboratory services) were missing. In those cases, average values for these categories were only determined on the basis of the data from patients from whom the values on these categories were known. No procedures replacing missing values could be performed, due to the different origins of the data.

2.2. Costs

In principle, four cost categories can be distinguished within economic evaluations [9]: direct costs within healthcare (e.g. medical therapy costs), direct costs outside healthcare (patient costs, like travelling costs), indirect costs within health care (medical costs of diseases not related to the therapy under study which arise as a consequences of life years gained), and indirect costs outside healthcare (like costs of lost production due to absence from work). As this study was designed to create a basis for a revision of the hospital budget, it only considers the first category and was therefore performed from the institutional perspective [10].

The cost analysis was based on the total medical consumption of all patients. In contrast to charges, unit costs are the best estimators of the theoretically proper opportunity costs [9]. Therefore, and to facilitate comparison with costs in other countries, we determined average unit costs for the most important items within the medical consumption, reflecting full hospital costs,

including overhead costs [8,9]. To determine these unit costs, we followed the micro-costing method, which is based on a detailed inventory and measurement of resources consumed [11], e.g. materials and disposables used and time spent by nursing staff. The valuation of the resources and overhead costs was based on financial data from both hospitals (1996 level, €1 = 2.20371 Dutch guilders). All costs made after the first year of treatment were discounted at a recommended rate of 4% [12].

One-hour costs of the head and neck specialist were estimated to be €82. The specialist's activities were divided into direct time and indirect time [13]. Direct time, defined as time in which both the specialist and the patient are present (e.g. outpatient visits) was estimated to take 50% of the specialist's weekly worktime. The time spent by the specialist on the patient where the patient is not present was called indirect time (e.g. multidisciplinary discussions in which the patient is the subject). Indirect time also took 50% of the weekly worktime. Therefore, direct times (outpatient visits, consultations and operation times) were multiplied by 2 to allow for costs of indirect time.

The first outpatient visit to the head and neck department was estimated to last 60 min on average and all following visits 10 min. The first visit amounted to €228 (of which €163 were specialist costs). The costs of all following visits were €69 (specialist costs: €27).

Similar to the costs of outpatient visits, the costs of hospital days were specifically calculated using financial data from the head and neck surgery department. This financial registration enabled us to make an adequate aggravation to all resource use spent on head and neck oncology patients. The costs of a hospital day on the head and neck surgery ward were €363 including €27 specialist costs (for one visit a day during hospitalisation). Half of the costs of a hospital day can be ascribed to other personnel. An account was given for a relative high nursing workload for the patients concerned. Other costs that were higher than in a regular hospital day were the costs of parenteral nutrition and equipment costs (mainly infusion equipment). The hospital day unit cost also included costs of the administered drugs.

In the results, 'therapy costs' will be the sum of the costs of surgery, radiotherapy and chemotherapy. Surgery costs (consisting of costs of all specialists, operating room personnel and utilisation of the surgery room and its equipment) are driven by the durations of operations. Specialist costs of operations relate to the head and neck surgeon, oral surgeon, plastic surgeon and the anaesthesiologist.

Radiotherapy costs covered the entire process of a radiotherapy series including preparation. These costs were mainly driven by the costs of the radiotherapist and the physicist, the costs of the radiation equipment and overhead costs. In particular, total costs of tele-

therapy are determined by the numbers of sessions, while total costs of brachytherapy are constituted by the surgical implantation of the loops and the brachytherapy equipment.

Chemotherapy costs only contain the costs of the cytostatics. The equipment costs are already included in the equipment costs of hospital days.

Retrospective analyses like this study automatically incorporate costs of shortcomings experienced in the time that the assessed care was delivered. As this analysis was meant to be a basis for a future budget, we decided that the costs per patient to overcome these shortcomings should also be added. Therefore, an inventory of these current bottlenecks was made. Measures necessary to overcome these bottlenecks were translated into costs [14]. The additional costs were added to the spreadsheet model that was used for the cost calculation.

2.3. Modelling approach

All components of an entire 10-year disease course were modelled to clarify which costs were calculated (Fig. 1). The model specifies the state of affairs after the second year, after the fourth year and after the fifth and tenth year, calculated from the date of the primary diagnosis. The survival rates in the model are approxi-
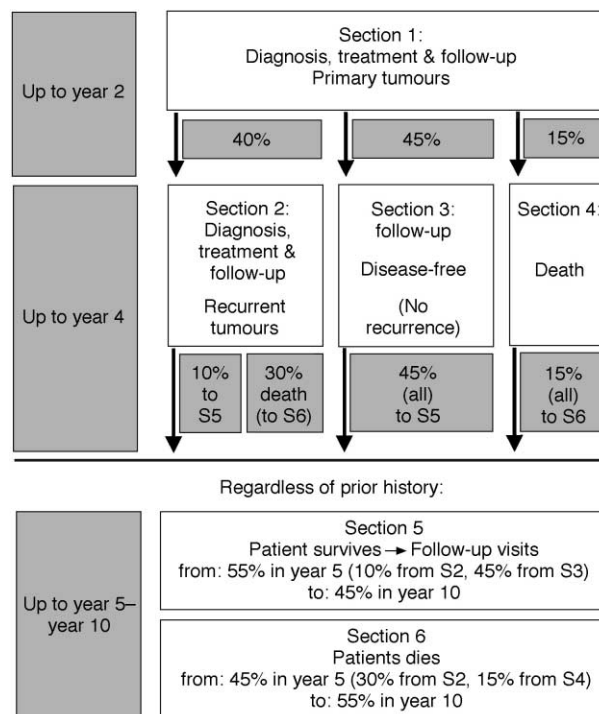

Fig. 1. Modelling approach. The model presents the *states of affairs* after year 2, after year 4 and after years 5–10. After Section (S) 2: Of the 40% of the patients who initially enter Section 2, 10% continue to Section 5 (long-term survivors) and 30% die within Section 2 (which is given account for in Section 6, together with the 15% of the initial group that already died within Section 4).

mate numbers extracted from The Netherlands Cancer Registry [4]. The percentages in Sections 2 and 3 below are approximations from both institutions in which the study was performed.

- Section 1. Costs of diagnosis, treatment and follow-up of patients with a primary tumour were calculated up to a maximum of 2 years after the diagnosis. Patients were censored at 2 years or, if earlier, when a recurrence was suspected to ensure that only costs belonging to the primary tumour were recorded.
- After the first 2 years, 40% of the initial group will have a recurrence of the tumour, 45% will remain tumour-free and 15% will die (from any cause). Three possible outcomes therefore constitute years 3 and 4 of the model.
- Section 2. Patients in whom the tumour recurs (40%). A separate cost analysis of patients with recurrent tumours was performed assessing a maximum of 2 years.
- Section 3. Patients who remain tumour-free and are regularly seen in the outpatient clinic (probability set at 45%). These costs of routine visits were calculated on the basis of protocol schedules.
- Section 4. Patients who died (probability set at 15%). These are patients in Section 1 who do not survive years 1 and 2.

Of the 40% of patients who have entered Section 2, 25% (10% of the initial group) will still be alive after the end of this phase (years 3 and 4), while 75% (30% of the initial group) will be deceased after year 4. Therefore, the total percentage of patients who are deceased after year 4 is 45% (30% of the initial group who died within Section 2 and 15% who had already died within Section 4). The complement of this percentage (55%) reveals the total percentage of initial patients who enter Section 5 (long-term survivors).

- Sections 5/6. The years 5 to 10 constitute two options which are assumed to be the same for all patients, regardless of prior history: patients die (Section 6) or patients survive (55% in year 5 to 45% in year 10, Section 5). For the latter patients, the costs of routine follow-up visits were calculated (based on protocol schedules).

3. Results

3.1. Costs of diagnosis, treatment and follow-up of primary tumours (Section 1)

The costs of Section 1 (Table 1) were mainly determined by outpatient visits, consultations, hospital days and therapies.

All groups had on average approximately 19 head and neck surgery outpatient visits. Approximate numbers of consultations with other specialists were 27 in the oral cavity and oropharynx groups and seven in the larynx group. These visits mainly concerned speech therapy consultations (after the therapy) and internal medicine consultations. Although numbers of 'other' visits were almost equal between the oral cavity and the oropharynx groups, the costs were somewhat higher in the former group, due to a higher number of expensive oral surgery consultations.

The patients were hospitalised for 31 days on average (oral cavity and oropharynx) and 19 days (larynx).

In Table 2, the therapy costs are divided into the three main treatment modalities, of which combinations were often used. The separation of costs for the two hospitals demonstrates that total therapy costs did not differ much, although the distribution of patients over the three treatment modalities differed. For laryngeal tumours and particularly oropharyngeal tumours, hospital 1 had a distinct preference for primary radiotherapy with surgery being reserved for salvage treatment, whereas hospital 2 mainly preferred primary surgery for early-staged lesions and combined treatment for advanced-staged tumours. There was no obvious difference in treatment for oral cavity primaries among the two hospitals.

The average total costs of Section 1 were €25 425 and €25 679 for oral cavity or oropharynx tumours, respectively and €17 072 for laryngeal tumours (Table 1). The costs of primary laryngeal tumours were the lowest of the three groups, as this group was mainly treated with radiotherapy (as a single treatment modality or as part of a combined treatment modality), which results in less hospitalisation of the patients.

The average total weighted costs for the entire group (€21 858, of which €2578 were specialist costs) were determined by the proportions of oral cavity, larynx and oropharynx tumours in the entire population, which are 40.0, 43.2 and 16.8%, respectively [4]. These proportions are comparable to other Western European countries, particularly to the United Kingdom, Sweden and Germany [5]. If account is given for the fact that a part of the costs have to be discounted as they are made in the second year of the disease course, the total costs amount to €21 581, of which €2529 are specialist costs.

3.2. Costs of diagnosis, treatment and follow-up of patients with a recurrent tumour (Section 2)

In this section, patients with a recurrent tumour made on average eight (oral cavity), 17 (larynx) and seven (oropharynx) visits to the head and neck surgery outpatient clinic. Oral cavity patients had an average of 10 consultations with other specialists, oropharynx patients had 20 other consultations. Both were primarily related

to the oral surgery department. Patients with a recurrent laryngeal tumour had on average 27 consultations with other specialists, mainly in the speech therapy department (for speech rehabilitation after surgery).

Patients were hospitalised for 36 days (oral cavity and oropharynx) or 46 days (larynx) on average.

Costs of the individual treatment modalities are presented in Table 2. In contrast to the treatment of the primary tumours, hospital 1 preferred surgical therapies, whereas hospital 2 had a preference for radiotherapy. These preferences resulted from the preferred therapies in treating the primary tumours, which were the other way around. The differences in therapy costs for recurrent tumours between the hospitals were greater than in the treatment of the primary tumours, caused by the fact that surgical interventions were in themselves more expensive in patients with recurrent tumours, due to the higher possibilities of complications. In both hospitals, larynx extirpation was the preferred option for patients with a recurrent laryngeal tumour (with post-operative radiotherapy in hospital 2).

In total, diagnosis, treatment and 2 years follow-up of recurrent tumours cost €27 629 (Table 1) on average: €25 543 and €25 145 for recurrent oral cavity or oropharynx tumours, respectively, and €31 353 for recurrent laryngeal tumours. The latter costs are higher than in the other groups due to the longer durations of hospitalisation after the larynx extirpation.

The mentioned costs only apply to 40% of the initial patient group in which the tumour recurs and were

Table 1
Average total undiscounted costs (Euros) per patient of diagnosis, treatment and follow-up (max. 2 years) of primary tumours and recurrent tumours[a]

	Primary tumours				Recurrent tumours			
	Oral cavity	Larynx	Oropharynx	Weighted average	Oral cavity	Larynx	Oropharynx	Weighted average
H&N outpatient visits	1595	1426	1472	1501	556	1146	497	764
Other consultations	1533	442	1279	1019	445	1708	991	1016
H&N hospital days	10 539	6447	10 216	8717	12 513	15 948	12 027	13 699
ICU hospital days	358	184	307	274	766	644	163	609
Hospital days other specialisms	288	116	599	266	199	309	404	278
Therapies	7997	5775	8409	7106	8362	8596	8293	8436
Radiodiagnostics	837	701	1069	817	553	703	812	657
Other diagnostics	2278	1981	2328	2158	2148	2300	1959	2169
Total costs	25 425	17 072	25 679	21 858	25 543	31 353	25 145	27 629
of which specialist	3446	1704	2760	2578	2464	3181	2150	2672
Share in total (%)	40.0	43.2	16.8	100	44.2	37.2	18.6	100

H&N, head and neck department; ICU, intensive care unit.

[a] The weighted average costs were determined by the proportions of oral cavity, larynx and oropharynx tumours in the entire population ('Share in total'). The proportion of patients with recurrent tumours resulted from these proportions of patients with primary tumours, multiplied by the fraction of patients that have recurred after 2 years (oral cavity and oropharynx: 45%; larynx: 35%). 'Other consultations' comprise consultations in all other departments other than the head and neck department. 'Therapies' comprise surgery, radiotherapy and chemotherapy. 'Other diagnostics' contained costs of laboratory services and pathological, cardiographic, nuclear and microbiological tests.

Table 2
Average total undiscounted costs (Euros) per patient of therapies, for the two hospitals and the different treatment modalities[a]

	Oral cavity		Larynx		Oropharynx	
Primary tumours	Hospital 1	Hospital 2	Hospital 1	Hospital 2	Hospital 1	Hospital 2
Surgery (diagnosis/therapeutic)	4347	5699	1343	2550	2027	6101
Radiotherapy	3186	2597	4691	2896	4841	3381
Chemotherapy	38	128	28	43	424	43
Total therapy costs	7571	8424	6062	5489	7292	9525
Recurrent tumours						
Surgery (diagnosis/therapy)	8679	2086	6523	5296	n.d.	3563
Radiotherapy	1664	3510	351	4533	n.d.	3923
Chemotherapy	212	573	0	488	n.d.	806
Total therapy costs	10 555	6169	6874	10 317	n.d.	8292

[a] In each diagnosis group, the arithmetic mean of the total costs in both hospitals is used for calculating the overall (hospital-independent) therapy costs. Note: therapy costs of patients with a recurrent oropharyngeal tumour have not been determined in hospital 1 (=n.d.), since data for the therapy of these patients were incomplete.

therefore multiplied by 0.4 for the final calculation (€11 268 of which €1069 were specialist costs). Subsequently, they were discounted as these costs relate to the third and fourth year of the model (€9825, of which €932 were specialist costs).

3.3. Costs of routine long-term follow-up visits (Sections 3 and 5)

During the years 3 and 4 (Section 3), the patients were seen 3.5 times a year on average. As this applied to 45% of all patients, the average number of routine follow-up visits was 3.15 (€190).

During the years 5 to 10 (Section 5), patients were seen 1.5 times a year on average. This applied to 55% of all patients in year 5 (the surviving patients) to 45% in year 10. Correcting the mentioned 1.5 visits in each of the years for the fraction of surviving patients yielded an average number of 4.5 visits (€233).

The total costs of routine long-term follow-up visits were therefore determined by the costs of 7.65 visits to the outpatient clinic (€423, of which €165 were specialist costs; if undiscounted, €528 and €207).

3.4. Total costs

The sum of Sections 1, 2, 3 and 5 of the model (Fig. 1) constituted the total costs per new patient. Diagnosis, treatment and follow-up of primary tumours (Section 1) amounted to €21 581 (if undiscounted, €21 858). Section 2 of the model referred to the costs of diagnosis, treatment and follow-up of recurrent tumours (€27 629). As this part of the model refers to approximately 40% of the initial group and are related to the third and fourth year of the model, these costs were multiplied by 0.4 (€9825 or, if undiscounted, €11 268). The costs of Sections 3 and 5 (long-term follow-up: €423 or, if undiscounted, €528) had already been corrected for survival. The addition sum yielded the total average weighted 10-year costs for each *new* patient with a head or neck tumour (€31 829 of which €3626 were specialist costs; or, if undiscounted, €33 654 and €3854), which includes costs of diagnosis, treatment and follow-up of a primary tumour and in which account is given for the possibility that the patient needs to be treated for a recurrence of the tumour and in which costs of long-term routine follow-up visits are included (Table 3).

3.5. Quality-enhancing activities

During the assessed time interval, some bottlenecks were experienced in the organisation of the care process. Determining costs on the basis of a care process which is not yet felt to be optimal would imply that short-comings are incorporated in the calculation. This would give an underestimation of the future care costs. At the time the current analysis was started, the involved specialists had already inventoried which bottlenecks had to be eliminated. The solutions for the inventoried bottlenecks were divided into three groups. They are assumed to enhance the quality of the care process as experienced by patients, since they all involve measures which increase time and attention spent on patients.

First, the time spent on outpatient visits and consultations should be increased. Times spent on outpatient visits and hospitalisation consultations were 10 min (except for the first visit). It was estimated that these times should be increased to 20 min and 15 min, to reserve time for psychosocial care. The consequence of this would be a rise of €1271 in the average total weighted costs: €832 for both Sections 1 (discounted) and 2 (discounted and applied to 40% of patients) and €165 for Sections 3 and 5 together.

Secondly, many quality demands related to the logistic organisation of the multidisciplinary care and to the additional supportive care of patients. Based on the number of new patients per hospital per year, the number of additional tasks and the time taken for each of these tasks, it was calculated that 2.5 oncology nurses and two additional secretary employees should be appointed. Dividing the accompanying costs over the number of new patients per hospital per year yielded an additional €227 per new patient.

The final quality demand is a post-treatment daycare programme for laryngectomised patients. This consists of 10 days in which patients are given psychosocial guidance and in which they are taught to manage their new handicap. As this programme only refers to a limited fraction of all patients, the estimated costs per new patient are relatively low: approximately €100.

The additional amount of the above mentioned quality-enhancing activities per new patient is €1598. This implies that a rise of the calculated average total weighted 10-year costs of 5% from €31 829 to €33 427 is necessary to reflect the future care costs.

4. Discussion

In this retrospective study, we analysed the costs of head and neck oncology. The average total weighted costs per new patient, including diagnosis and treatment of a primary tumour, a possible treatment of a recurrent (or second primary) tumour and a maximal 10 years follow-up amounted to €31 829. We assumed this amount to be representative for the head and neck cancer patient in general, since the assessed sites (oral cavity, larynx and oropharynx) constitute the great majority of all annual head and neck cancer patients [4,5].

A cost analysis like this should incorporate a sensitivity analysis to account for uncertainty in the calculated

Table 3
Average total discounted costs (Euros) per new head and neck patient[a]

	Oral cavity	Larynx	Oropharynx	Weighted
Primary tumour (Section 1)	25 096	16 860	25 353	21 581
Recurrent tumour (Section 2)	10 022	9568	9866	9825
Long-term follow-up (Sections 3 and 5)	423	423	423	423
Total costs per new patient	35 541	26 851	35 642	31 829

[a] Costs of Section 2 of the model (recurrent tumours) have been multiplied by the fraction of patients in whom the tumour recurred.

average costs [9], and the lack of this is definitely the main drawback of our study. The reason for this omission was the difference in sources used to calculate the medical consumption of the patients. For the purpose of this analysis, it was not considered necessary to invest time in merging those different sources into one statistical database. In our analysis, there are two components which are sensitive to uncertainties: specialist costs and hospitalisation costs. Specialist costs are an uncertain cost component, particularly when one tries to compare our results to those of other countries. Specialist costs may vary between settings. In our spreadsheet model that was used to calculate the total specialist costs, we could easily alter the costs per hour. A change of the specialist costs of 10% resulted in a change of the total weighted costs of 1% only, from which we conclude that the uncertainty in specialist costs is of minor importance in this particular analysis. In contrast, the uncertainty in the average number of hospital days may exert an important influence on the final results due to the relative high unit cost of a hospital day (notice that hospitalisation costs already account for approximately 40 and 50% of the total costs of treating primary and recurrent carcinomas, respectively). The availability of a database with hospital days enabled us to provide some 95% confidence intervals illustrating the possible variation in hospital costs. For the primary tumours, the average number of hospital days were 31 (oral cavity, oropharynx) and 19 (larynx). The 95% confidence intervals are 24–41 and 13–24 which result in approximate uncertainties of €3500 and €2000, respectively, around the calculated average total costs. For recurrent tumours, the uncertainty is higher as the numbers of patients were smaller. The intervals are 11–61 (oral cavity, oropharynx) and 28–64 (larynx) around the average numbers of 36 and 46, respectively, which result in uncertainties of €8000 and €6000. However, given the aim of our analysis, it was most suitable to determine average costs per patient and we assume to have calculated these adequately by assessing a large total number of patients. Although the mentioned 95% confidence intervals may be wide, notice that they are nicely distributed around the mean values, particularly for the recurrent tumours, which indicates that the average numbers have not been greatly influenced by outliers.

In the literature, most articles on the costs of head and neck oncology focus on specific treatment modalities in specific subgroups, instead of the financial burden of the entire patient group. For example, Cragle and Brandenburg [15] compared costs of CO_2-laser chordectomy and radiation therapy in patients with T1 glottic larynx cancer. We only found two articles by one US research group which also focused on the financial burden of entire patient groups in which different treatment modalities are carried out [16,17], but they both used charges instead of unit costs and the price level used was from 1983. Funk and colleagues [16] calculated average total costs of diagnosis, treatment and 1-year follow-up of US$32 500 on the basis of 73 patients with a primary oral cavity tumour. According to Arnold and colleagues [17], total costs of diagnosis, treatment and 2 years of follow-up were US$23 964 on average in 57 patients with a primary laryngeal tumour. It is difficult to compare these results with ours which are from another healthcare system and based on unit costs from 1996. A similarity is the observation that patients with a primary oral cavity tumour induce higher costs than patients with a primary laryngeal tumour.

The importance of our results to other head and neck centres is that a quick estimation of the total costs per new patient can be made with our cost data in which account can be given to the specific patient mix. It should be noted that there is a similarity in the costs of the primary and recurrent tumours for cancers of the oral cavity and oropharynx. From a medical point of view, this is understandable as the treatments for both sites have many similarities. So, if the annual number of patients with an oral cavity or oropharynx tumour on the one hand and the number of patients with a laryngeal tumour on the other hand for a specific hospital are known, an estimation of the total financial burden of these patients can be made.

Furthermore, we demonstrated that enhancing the quality of the care process brings about relatively low costs. Although the costs of employing additional personnel may seem high from the perspective of a head and neck department manager, the costs per new patient increased by 5% only in our analysis. These additional costs enable measures that improve the psychosocial

elements of the care process, particularly seen from the patient's view. Moreover, the reported measures, like increasing the doctor's time and increasing the manpower are relatively easy to implement, once financed.

To conclude, our analysis based on the average costs and numbers from two hospitals adequately estimates the costs of the 'average' head and neck cancer patient. This data was primarily meant to be used as a basis for determining reimbursements for head and neck centres, but can be applied in any hospital if the numbers of patients with oral cavity or oropharynx tumours and with laryngeal tumours are known.[1]

Acknowledgements

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[1] Editor's note: On a relative theme, please see the 'Economics of Cancer' Special Issue. *Eur J Cancer* 2001, **37**(14).