Direct medical cost of radiation therapy for cancer patients in Taiwan

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ABSTRACT

Background and purpose: The rising cost of health care is of concern worldwide, in particular, for cancer care. The costs of treatment, including chemotherapeutic drugs and radiotherapy, are no exceptions. The purpose of this study is to explore the direct medical cost of radiotherapy and the annual increasing trend of expenditures in Taiwan. Methods: This study utilized data retrieving from the original claim data of the reimbursement of the Health Insurance Research Database (HIRD) derived from Taiwan's Health Insurance (HI) program. Detailed data on the direct medical cost within the radiotherapy process for beneficences were extracted from inpatient expenditures by admissions (DD) and ambulatory care expenditures by visits (CD) database according to the reimbursed expenditure code of radiotherapy from January 1, 2000 to December 31, 2005. Prescriptions for radiotherapy were retrieved and the direct medical costs for radiotherapy were collected based on the NHI reimbursement price list of 2005. The annual increasing trend of expenditures was also explored according to the perspective of Bureau Health Insurance of Taiwan. Results: The total direct medical costs of radiotherapy for cancer patients were increasing from 2000 to 2005, which were estimated to US $7.80 million, US $8.09 million, US $7.58 million, US $10.7 million, US $12.2 million and US $15.9 million in 2000, 2001, 2002, 2003, 2004 and 2005, respectively. The increased percentage corresponded to the total healthcare expenditures claimed was increased substantially from 0.82% in 2000 to 1.22% in 2005. The total direct medical costs within the radiotherapy process were also in-creased gradually if identified by different types of radiotherapy and teaching hospital levels. The direct medical costs attribute to radiotherapy, compared to total health care expenditures in Taiwan, were similar to the costs of anticancer drugs for cancer patients annually. Conclusions: The direct medical costs of radiation therapy increased substantially each year. Further cost analysis on radiation therapy is needed in years beyond 2005.

Keywords: Direct Medical Cost; Radiotherapy; Cancer Patient

1. INTRODUCTION

The rising cost of health care is a major concern of decision makers of health insurance in many countries. The aging population, innovative medical technologies, widespread health insurance and many other factors may influence the health care expenditures. Medical costs continue to soar and have become an increasing part of the gross domestic product (GDP) in Western and Asia countries. It is estimated 16% of the GDP in United States and 6% of GDP in Taiwan in 2008 [1,2]. Similarly, health care expenditures for the treatment of cancer have been rising as the increasing number of cancer patients. The global cost associated with new cancer cases in 2009 to be at US $286 billion [3]. The assessment of the cost and benefits of cancer treatment has become an important issue.

Although the allocation of medical resources of cancer treatment appears to be an interesting topic, little is known about either the total costs of cancer treatment, or the relative costs of different treatment techniques such as varying combinations of radiotherapy, chemotherapy and surgery. The assessment of the resource allocation is made particularly difficult as the new technologies or

medicines emerge. To make a choice between allocating scarce health care resources to cancer treatment or to the treatment of other illness is an endless controversy. The selection of regimens for the use of surgery, radiotherapy, chemotherapy or combinations of these as the primary form of treatment or as adjuvant treatments will depend on the types and size of cancer, age of the patient, overall health of the patient, spreading of the cancer and staging, such as colorectal cancer, cervical cancer etc. [4]. In order to make these choices in an efficient way, data regarding the effectiveness and cost of different treatment of cancer are indispensable. According to the Surveillance, Epidemiology and End Results (SEER)-Medicare data, Medicare billing for radiation therapy e.g. IMRT increased from 0.9% of patients diagnosed in 2001 to 11.2% of women whose breast cancer were diagnosed in 2005. [5]. Despite no updated data were reported, the absolute costs attributable to radiation oncology are increasing substantially. Therefore, interest in performing economic analysis on the magnitude of the costs attributable to oncology and to other forms of cancer treatment is growing.

A number of strategies to reduce health care expenditure have been proposed continuously. The global budget caps for health care have already been performed in many regions which have a Health Insurance Program, such as Taiwan. The Medicare in United States has also proposed to reduce payment for radiation oncology services overall by 19% [6]. Payers have already contracted with providers to enter into risk-sharing arrangements such as capitation [7]. These trends appear an inevitable future that healthcare resources will be increasingly limited. More studies are required to provide an accurate and comprehensive knowledge of costs of treatments of cancer in order to allocate scarce resources between and within cancer therapies and produce maximum benefits for patients.

This is the first study in Taiwan to explore the direct medical cost of radiotherapy for cancer patients from the claim database of the health insurance.

2. METHODS

This study utilized data retrieving from the original claim data of the reimbursement of the Health Insurance Research Database (HIRD) derived from Taiwan's Health Insurance (HI) program. Detailed data on the direct medical cost of radiotherapy for beneficences were extracted from inpatient expenditures by admissions (DD) and ambulatory care expenditures by visits (CD) database from January 1, 2000 to December 31, 2005. The study has been approved by the Hospital Committee for Medical and Health Research Ethics.

Prescriptions for radiotherapy were retrieved and the costs were identified by using the reimbursement codes

for radiotherapy for all cancer patients, which included 36xxxB, 37xxxB during the studied period. The direct medical costs within a radiotherapy process, which are calculated based on the NHI reimbursement unit price of 2005 for each patients' prescription, included some specific material costs, such as the costs of fixation masks, X-ray films, simulation and portal films and materials to produce shielding blocks; dosimetry and computerized treatment planning. The annual increasing trend of expenditures was analyzed for total costs expense, types of radiotherapy, the proportion of expense claimed by outpatient clinics/in-patient units and types of hospital from the perspective of Bureau Health Insurance of Taiwan. The annual direct medical costs of radiotherapy were also compared to the annual costs of anticancer drugs based on data of NHI. All data were analyzed by descriptive analysis.

3. RESULTS

The total direct medical costs of radiotherapy for cancer patients were increasing from 2000 to 2005, which were estimated to US $7.80 million, US $8.09 million, US $7.58 million, US $10.7 million, US $12.2 million and US $15.9 million in 2000, 2001, 2002, 2003, 2004 and 2005, respectively (**Table 1**). The increased percentage corresponded to the total healthcare expenditures claimed (total direct medical cost claimed/total healthcare expenditures claimed) was 0.82% in 2000, 0.87% in 2001, 0.77% in 2002, 1.05% in 2003, 1.00% in 2004 and 1.22% in 2005. If we identified the cost by different types of radiotherapy reimbursed by NHI program, the total direct medical costs were estimated to US $6.8 million in 2000, US $7.04 million in 2001, US $6.59 million in 2002, US $9.53 million in 2003, US $10.1 million in 2004 and US $12.9 million in 2005, respectively (**Table 2**). If the total direct medical cost identified by different levels of teaching hospital, there were about 79.01% reimbursed for medical centers, 20.5% for regional teaching hospitals and 0.46% for district teaching hospitals (**Table 3**). As we measured the Consumer Price Index (CPI) in the calculation formula, the results showed that the direct medical cost of radiotherapy was still increased steadily. The percentage of annual direct medical costs of total health care expenditure for radiotherapy process and anticancer drugs for cancer patients was similar.

4. DISCUSSION

This is the first study in Taiwan to analyze the direct medical cost within the radiotherapy process by using the claim database of NHI. Our findings showed that the direct medical cost of radiotherapy paid by the Bureau of Health Insurance is increasing gradually, but the percentage of external radiotherapy corresponded to

Table 1. Total direct costs of radiotherapy.

Cost category \ Years	2000	2001	2002	2003	2004	2005
Planning	75,812,000 (3.11%)	96,580,000 (3.53%)	77,396,000 (2.95%)	112,208,000 (3.02%)	372,139,700 (9.11%)	576,108,140 (11.25%)
Material costs	209,460,680 (8.60%)	256,991,680 (9.39%)	266,411,640 (10.15%)	318,163,120 (8.57%)	330,728,880 (8.09%)	388,847,660 (7.59%)
ADE treatment	0 (0%)	0 (0%)	0 (0%)	390,000 (0.01%)	1,643,000 (0.04%)	4,767,760 (0.09%)
Radiotherapy(RT)	2,150,081,000 (88.29%)	2,382,891,880 (87.08%)	2,280,394,360 (86.90%)	3,281,284,280 (88.40%)	3,381,481,380 (82.76%)	4,152,011,540 (81.07%)
Total RT cost (NT $) (x CPI each year)	2,435,353,680 (2,294,103,167)	2,736,463,560 (257,774,864)	2,624,202,000 (2,466,749,880)	3,712,045,400 (3,478,186,540)	4,085,992,960 (3,889,865,298)	5,121,735,100 (4,988,569,987)
Total RT cost, US $	78,056,208	80,960,460	75,843,988	107,908,297	122,335,119	159,060,096
Total RT cost, (million, NT)	2435.4	2736.5	2624.2	3712.0	4085.9	5121.7
*Total HCE (million, NT)	296,839	311,500	339,704	353,286	407,265	419,916
*Total anti-cancer drug cost (million, NT)	2137.5	2584.7	3124.9	3778.0	4567.6	5522.6
Percentage of HCE, anti-cancer drugs (million)	0.72	0.83	0.92	1.06	1.12	1.32
Percentage of HCE, RT (million)	0.82	0.87	0.77	1.05	1.00	1.22
***Total HCE for long term cancer(million, NT)**	18,047	20,137	23,615	25,421	31,400	34,030
% of Radiotherapy	13.4	13.5	11.1	14.6	13.0	15.1
% of anti-cancer-drugs	11.8	12.8	13.2	14.8	14.6	16.2

Data source: http://www.nhi.gov.tw/English/webdata/webdata.aspx?menu=11&menu_id=296&webdata_id=1942&WD_ID=296
http://www.doh.gov.tw/CHT2006/DisplayStatisticFile.aspx?d=58226 (2000, Inpatient), http://www.doh.gov.tw/CHT2006/DisplayStatisticFile.aspx?d=58227
(2000, OPD), ADE = adverse drug event, HCE = Health care expenditure.

Table 2. Total costs of different types of radiotherapy.

Category \ Years	2000	2001	2002	2003	2004	2005
External therapy	2,067,176,200 (96.14%)	2,341,857,480 (98.28%)	2,199,110,960 (96.44%)	3,205,568,440 (97.69%)	3,179,548,860 (94.03%)	3,929,096,300 (94.63%)
Brachytherapy	82,904,800 (3.86%)	41,034,400 (1.72%)	81,283,400 (3.56%)	71,126,000 (2.17%)	97,837,320 (2.89%)	10,500,520 (2.53%)
Radiosurgery	0 (0%)	0 (0%)	0 (0%)	4,589,840 (0%)	104,095,200 (3.08%)	117,864,720 (2.84%)
Total cost (NT $)	2,150,081,000	2,382,891,880	2,280,394,360	3,281,284,280	3,381,481,380	4,152,011,540
Total cost (US $)	68,912,853	70,499,760	65,907,351	95,386,171	101,241,957	128,944,458

the total healthcare expenditure or total healthcare cost for cancer is slightly lower than the percentage of anti-cancer drugs used for cancer patients in Taiwan. This is likely inconsistent with the findings reported in Sweden, in which they reported that the percentage of the estimated total costs of external radiotherapy for cancer is lower than the percentage of costs of chemotherapy for cancer corresponded to the total healthcare cost [8].

There is an indication that the cost of radiation treatment has increased steadily reported by eleven studies over the past decade [9-19], however, Ploquin et al. reported that the correlation between cost and time is weak because the effect of inflation as measured by the consumer price index has been removed in the eleven studies. However, our findings still indicated that the direct medical cost of radiation treatment has also increased

Table 3. Total costs of radiotherapy identified by hospital levels.

Years Hosp levels	2000	2001	2002	2003	2004	2005
Medical center	1,924,061,760 (79.01%)	1,913,693,120 (69.93%)	1,905,614,320 (72.62%)	1,998,348,800 (53.83%)	2,050,455,920 (50.18%)	2,918,487,720 (56.98%)
Regional hospital	500,183,000 (20.54%)	738,450,560 (26.99%)	649,347,080 (24.74%)	1,576,512,320 (42.47%)	1,931,577,360 (47.27%)	2,182,738,940 (42.62%)
District hospitals	11,108,920 (0.46%)	84,319,880 (3.08%)	69,240,600 (2.64%)	137,184,280 (3.70%)	41,513,680 (1.02%)	20,508,440 (0.4%)
Physician clinics & dental clinics	0 (0%)	0 (0%)	0 (0%)	0 (0%)	62,446,000 (1.53%)	0 (0%)
Total cost (NT $)	2,435,353,680	2,736,463,560	2,624,202,000	3,712,045,400	4,085,992,960	5,121,735,100

gradually even we measure the Consumer Price Index (CPI) in the calculation. It is probably due to the small variation of CPI in Taiwan.

There were many published literatures explored the cost of radiotherapy, but the variation in the estimates is huge. The possible explanations for the variability in cost estimation are likely to be the different definition of costs. For example, some of the studies published do not cost the auxiliary equipment used (such as planning computer and simulator) or the support staff required (such as technicians, porters and administrative staff), it is absolutely due to different definitions of costs which is depending on the perspective of the researchers [20]. If the study is done on the perspective of insurance payer, who may only concern how much they should pay for the radiotherapy, the costs identified in the study may only include direct medical costs within the radio-therapy process, which are some specific material costs, such as the costs of fixation masks, X-ray films, simulation and portal films and materials to produce shielding blocks; dosimetry and computerized treatment planning [21]. If the study is conducted in the healthcare providers' perspective, they may interest in the return on investment, therefore, the direct medical costs and indirect costs, such as manpower, infrastructure which overhead administrative costs, maintenance costs of the building, facilities, equipment should be included [22,23]. The second reason to explain for the variability in cost estimates in the previous studies may be the differences in patient throughput on a treatment machine, but the possibility of the relationship between cost and throughput is weak [24].

In conclusion, although many published literatures focu on the analysis of the cost of radiotherapy, no study so far has analyzed the direct medical cost within the radiotherapy process from the payer's perspective. We need to analyze the cost of radiotherapy beyond the year of 2005 in order to provide the decision makers with cost reference in the distribution of scarce medical resource.

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