

**ORIGINAL PAPER****Economic and Biological Cost of Computed Tomography Exams in Cyprus****Despena Andrioti BSc, PhD**

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**Correspondence :** Nicolas Nicolaou, 60 Omerou str. Aglantzia 2121, Nicosia Email : Nikolaou.nikolas@hotmail.com**Abstract****Background:** Economic and biological costs are very important in health services. In a time of economic crisis, health services must be more effective**Aim:** The aim of this study is to determine the biological and economic costs of Computed Tomography (CT) examinations at Nicosia General Hospital (NGH), in the year 2011**Methodology:** The data we present in this work are taken from all the patients that visited the Nicosia General Hospital for a CT examination during 2011. We include all the direct costs of the CT Department as to create a complete study of the annual costs**Results:** The total number of scans conducted in the CT Department of the General Hospital of Nicosia for the year 2011 was 29.439 for all the 9216 patients that were accounted for. The direct cost of operating the CT department is estimated to be €657.035, 46 for the same year, with a breakdown of consumables €165.108, 20, salaries 381,020.16 and miscellaneous €110.907,29. The average cost perpatient amounted at €71.29**Conclusions:** The average cost per patient was not very high compared with this of other countries and it is almost the same as the price paid by the insurance funds for such examinations in our country. However one should consider the biological effects for the patient as well. CT examinations constitute very popular means to diagnosis among doctors. They choose the CT scan as an immediate action that will provide them with fast results without taking into consideration the future effects on the patient's health. It is estimated that 9 out of the total 9216 patients may develop cancer at some point in their lives. This study draws on data from one hospital in our country. We envisage its expansion to include all the relevant settings may help physicians and policy makers by providing evidence informed practice tools**Keywords:** Cost- effectiveness of ct exams, economic cost of ct, biological cost of ct**Introduction**

Imaging technology and in particular, the discovery of x-rays, by Wilhen Rontgen has made an invaluable contribution to many medical advances. The discovery of Computed Tomography (CT) is considered to be the biggest breakthrough in the area of radiology after the discovery of x-rays. It is the imaging technique of a cross section that is provided to diagnostic radiology (UNESCEAR 2006, WHO 2009, WHO 2012).

However, the reckless exposure of the human body to x-rays, in most cases, leads to undesirable effects

on the patient's health. The biological cost that the patient is subjected to refers to the amount of x-ray dosage absorbed by his body (US National Academies 2003, US EPA.2012).

The economic cost of imaging technology is also an important attribute. The health sector is of the highest importance in every community but it is also one of the most expensive. In situations, like an economic crisis we are going through now, it is essential to create a spherical and well-informed opinion on the health sector and where our financial resources are spent. This will essentially help us compare the health services provided and

improve the quality of our services (Ahmed and Daw 2003)

The purpose of this work was to highlight the economic cost of the CT department at the Nicosia General Hospital for the year 2011. This study will provide important information to the medical staff as to be more conscientious about their patient's health status, as well as evidence informed practice for policy makers.

### Study Questions

- How much does it cost for the government the use of computed tomography?
- How much is the average cost per patient at the Computed Tomography Department in Nicosia General Hospital?
- What it costs to the insurance funds?

### Methods

The data were taken from patients individual records in CT department in the Nicosia General Hospital for 2011. The average number of patients per month was calculated for the entire year 2011. Table 1 presents the patients results for the year 2011 totalling in 9216.

The next step was to determine the total number of CT scans performed in the year 2011 according to each category scan. By categorizing the CT scans we are able to estimate the cost for every type of CT scan as shown in Table 2. All the information regarding the CT scan supplies were taken from the Department of Supplies of the General Hospital of Nicosia.

Furthermore all the supplies used for the CT exams together with their costs were calculated totalled to €165,108. 20 for the same year (Table 2).

Moreover, the employees' costs were calculated. In this department 5 professionals were employed. 2 Physicians Radiologists, 2 Technologists Radiologists and one nurse. Their earnings amounted at €381,020.16 for 2011 To collect these data we used the administrative records from the Accounting Department of the hospital.

An additional 20% indirect cost in terms of miscellaneous items such as cleaning, ambulances, service expenses, water and telecommunications was included (Kaitelidou et al 2010).

Finally, the total direct cost of the CT department amounted at €657,035.46 is presented in Table 3

### Results

The total number of scans conducted in the CT Department of the General Hospital of Nicosia for the year 2011 was 29.439 for all the 9216 patients, with an average of 3.2 scans for each patient. According to the information presented earlier the direct cost of operating the CT was estimated to be €657, 035. 46 (consumables €165, 108. 20, payroll €381,020.16, miscellaneous €110, 907.29).

The average direct cost for every patient entering the CT Department for a scan was estimated to be €71. 29, while the average cost for examinations that use contrast liquid amounted at € 240.6.

**Table 1: Total number of patients in CT department for the year 2011**

	Per Day	Per week	Per month	Year
	A	B= (AX5)	C= (BX4)	D= (CX12)
<b>Morning Patients</b>	<b>18</b>	<b>90</b>	<b>360</b>	<b>4320</b>
<b>Afternoon Patients</b>	<b>15</b>	<b>60</b>	<b>240</b>	<b>2880</b>
<b>Saturdays</b>		<b>27</b>	<b>108</b>	<b>1296</b>
<b>Sundays</b>		<b>15</b>	<b>60</b>	<b>720</b>
<b>Total Patients</b>				<b>9216</b>

Table 2: Total Cost of Consumables for the year 2011

CT exam	Total exams in 2011	Cost per examination	Total cost
		€	€
<b>Chest</b>	2,580	0.20	516.00
<b>Brain</b>	3,984	0.20	796.80
<b>Abdomen</b>	2,508	0.20	501.60
<b>Cervical Spine</b>	876	0.20	175.20
<b>Dorsal Spine</b>	192	0.20	38.40
<b>Lumbar Spine</b>	1,728	0.20	345.60
<b>Pelvis</b>	1,548	0.20	309.60
<b>Sinuses</b>	156	40.15	6,263.40
<b>Aorta</b>	432	40.95	17,690.40
<b>Liver</b>	120	67.63	8,115.60
<b>Pancreas</b>	84	67.63	5,680.92
<b>Femur</b>	36	0.20	7.20
<b>Inner ear canals</b>	84	40.15	3,372.60
<b>Scanogramm</b>	12	0.20	2.40
<b>Adrenals</b>	36	73.92	2,661.12
<b>Tibia</b>	84	0.20	16.80
<b>Brachial</b>	24	0.20	4.80
<b>Brain angiography</b>	36	46.73	1,682.28
<b>Chest Biopsy</b>	84	1.00	84.00
<b>Ankle</b>	96	0.20	19.20
<b>Carotid</b>	24	46.73	1,121.52
<b>Mastoid</b>	12	29.36	352.32
<b>Foot</b>	72	0.20	14.40
<b>Chest with contrast</b>	852	29.37	25,023.24
<b>Brain with contrast</b>	816	29.37	23,965.92
<b>Abdomen with contrast</b>	1,260	51.23	64,549.80
<b>Cd with envelope</b>			1,797.12
<b>Total</b>			<b>€ 165,108.20</b>

**Total 3: Direct Cost of CT department**

Cost Type	Cost analysis	Cost rate	Cost per unit	Total cost per type	Total Cost
<b>Annual earnings</b>					186,410.64
	Radiologist Physicians	2	5,6905.29	113,810.58	
	Technologist Radiologist	2	24,200.02	48,400.04	
	Nurse	1	24,200.02	24,200.02	
<b>Overtime Earnings</b>					194,609.52
	Radiologist Physicians	1	131,935.68		
	Technologist Radiologist	1	62,673.84		
<b>Consumables</b>					165,108.20
<b>Overheads</b>	Miscellaneous expenses	1		110,907.29	110,907.29
<b>Total</b>					<b>€657,035.46</b>

**Discussion**

The average cost per patient was almost the same as the price paid by the insurance funds for such examinations in our country. The average cost per patient was not very high compared with this of other countries. The cost of CT scan in our country is lower than the average cost of a CT scan in the United States (US). In the US, the average cost of a CT scan depends on the state and for this reason there is a variety of prices for the same health service. The prices for the same health service can vary from €495 to €2,193. In contrast the average cost of a CT scan in the UK according to the National Audit Office is around €187 (US National Academies Press 2006).

Besides the economic cost of CT scans there is a substantial biological cost for the patients

According to the survey BEIR VII (US NRC 2006), a formal examination using CT scans is estimated to cause cancer in 1 in 1000 patients. Combining this with our findings for the year 2011 and taking into account all the patients that visited the General Hospital of Nicosia for tomography examination, it is estimated that 9 out of the total 9216 patients may develop cancer at some point in their lives (US NRC 2011, and 2012).

The doctors choose the CT scan as an immediate action that will provide them with fast results without taking into consideration the future effects on the patient's health. They don't take into consideration the indirect biological cost on the patient after a possible reckless exposure of the patient to x-rays (Kaftantzis 1986). The hospital personnel must always have in mind the very

important cost/benefit relationship of the patient's health (ICRP, 1997). Another important conclusion that surfaces from this study is the frequency of CT scan per one thousands of Nicosia population. The average frequency in our country is 122.7. This is not a very high percentage if it is compared with data from the OECD countries. According to these data in Greece the frequency of CT scans was 320.4 per thousand persons in 2008 (OECD, 2012). Iceland has a higher percentage relatively to Cyprus with an average of 182.4 per 1000 persons. A lower percentage for the year 2011 is shown in Australia with an average of 90.6, whilst Ireland shows a rate of 78 per 1000 persons. Finally, the lowest percentage was achieved by Slovenia with an average of 12.8 per 1000. In general, the percentage that occurs from NGH is in line with the countries of OECD which average to 123.8 per 1000. This study was conducted using data from one hospital setting and showed that the average direct cost for a CT examination is comparable with this of other developed countries, and almost the same compared to the price paid by the insurance funds. However it revealed a higher number of CT scans per patient and this may create adverse effects (cancer) later in life, as is apparent in similar studies. Studies to include all the relevant settings in our country may help physicians and policy makers by providing evidence informed practice tools

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