

## ANALYSING THE EXPOSURE TO IONIZING RADIATIONS OF THE POPULATION IN BIHOR COUNTY

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### **Abstract**

*In recent years the number of radiological investigations has increased, due to patients' concern for their health on the one hand and to people's need for a more precise and quickly established diagnosis, obtained with the help of high performance equipment and technology, on the other hand (Jardine C, et al., 2003). During the last 5 years, the number of nuclear units has increased at the level of Bihor county, though the frequency of radiological examinations in the county population is beneath the values published at the international level (Vischers VHM, 2007).*

*Long-term effects of medical radiological exposures are known, therefore a program for the education of both population and medical staff should be initiated, in order to increase radiological safety and avoid unnecessary exposure, although data are still not worrying (Hampel J., 2006). It is also necessary to enhance the regulatory capacity of central public health authorities and establish national standards regarding the number and territorial distribution of radiological units to prevent the increased use of radiological services through the recommendation of unnecessary investigations. (Mănescu S, 1986).*

**Key words:** ionizing radiations, nuclear units, medical exposures, industrial exposures

### **INTRODUCTION**

The use of high technology and expensive imaging techniques has increased substantially in recent decades. This tendency may be attributed to several factors such as the aging of the population, advances in imagistic diagnosis and the fact that radiology is indicated in several clinical situations where it is available, increasing the number of specialists in medical imaging (Olerud H.M, et al., 2009, Tenkanen-Rautakoski P, 2008). Physicians requesting radiological examinations have a central role in the use of radiological services; studies have reported several factors that determine the application of radiological examination: patients' expectations, professional uncertainty, stress determined by time constraints, defensive medicine, the pay system, peer relations among physicians (International Atomic Energy Agency, 2005, Hatfield J., et al. 2002).

Recently more attention is given to the risk of radioactive medical exposure, as the growth of medical imaging services is not always beneficial for the medical care provided to patients (Gestal JJ., 1987, Hruddy ES., 2003).

The aim of the study is to track the evolution of digital radiological investigations and synthesize the reported activity data at the level of Bihor county, in accordance with current legislation. Concern for the number of radiological examinations is determined by the obvious increase in the number of radiological service providers.

## MATERIALS AND METHOD

Data collected for the purpose of this study has been obtained from the Laboratory for Ionizing Radiation Hygiene, which functions within the Public Health Administration Bihor, and reflects the situation over five years, between 2005 and 2009. Data were analyzed and summarized using Microsoft Excel.

## RESULTS AND DISCUSSION

The number of nuclear units represents the units that are authorized annually by the laboratory, in accordance with current legislation.

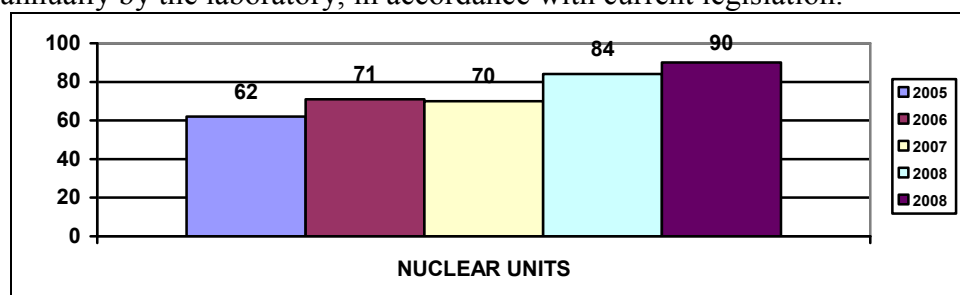


Fig.1 – The number of nuclear units registered in Bihor county in the period 2005-2009

In the period 2005-2009 we can observe an increase in the number of nuclear units.

The evolution of the nuclear units number in Bihor county in the period 2005-2009 and the corresponding indicator (number of radiological units at 10 000 inhabitants) has increased with only 28 units in the period investigated, despite the period of economic growth (between 2005 and 2007) and implicitly the increase in the financing of health services, during the same period.

Table 1

The numerical evolution of nuclear units in Bihor county in the period 2005-2009

Year	The population of Bihor	Nuclear units	Nuclear units at 10.000
2005	596670	62	1,04
2006	595448	71	1,19
2007	594615	70	1,18
2008	593897	84	1,41
2009	592654	90	1,52

This study has evaluated the number of exposures to ionizing radiations, the number of people exposed to ionizing radiations and the number of medical investigations that use ionizing radiations.

a. Exposure to ionizing radiations

Between 2005 and 2009, the number of exposures to ionizing radiations has increased progressively. The number of exposures increases gradually starting with 2005 and continuing up to 2009, while the population of Bihor county has remained unchanged in terms of number.

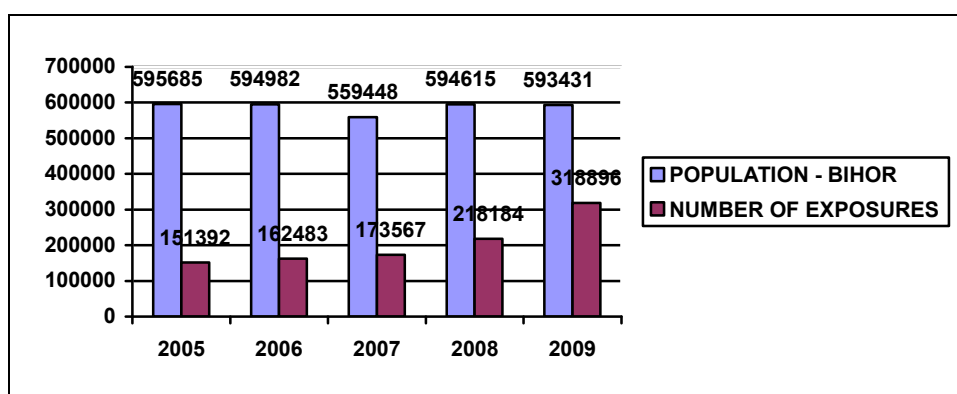


Fig.2 – Number of exposures to ionizing radiations and the population number of Bihor county, between 2005 and 2009

The number of medical exposures includes: radiological examinations and the radiotherapies performed in one year, being available due to the data gathering procedures performed between 2005 and 2009. For each year, the number of medical exposures has been related to 1000 inhabitants, so as data may be compared with values obtained in other countries of the world.

Table 2

The number of medical exposures at the population of Bihor county in the period 2005-2009

Year	Number of medical exposures	Medical exposures at 1000 inhabitants
2005	151392	263,81
2006	162483	275,39
2007	173567	291,90
2008	218184	367,38
2009	318896	538,08

The comparative analysis of the 5 years of the interval 2005-2009 indicates a progressive increase in the number of exposures, from 21,83% in 2005 to 44,87% in 2009.

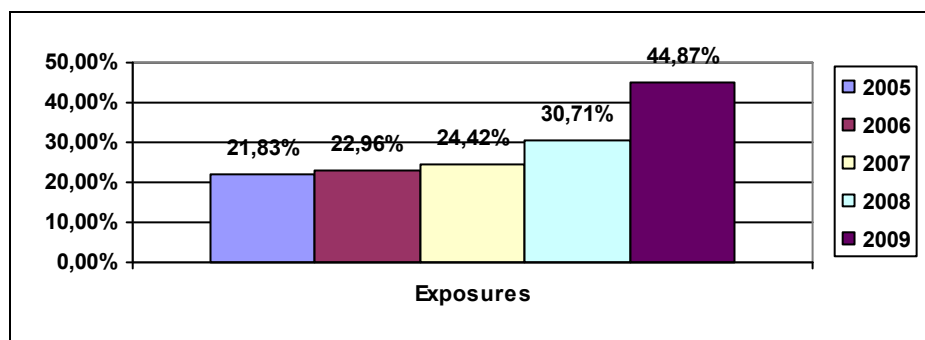


Fig. 3 – The percentage of exposures in the population of Bihor county in the period 2005-2009

Evaluated on trimesters, exposure has varied in the five years investigated, but no correlation could be established between the increased number of exposures in a semester or another, the population having exposed itself aleatorily to ionizing radiations.

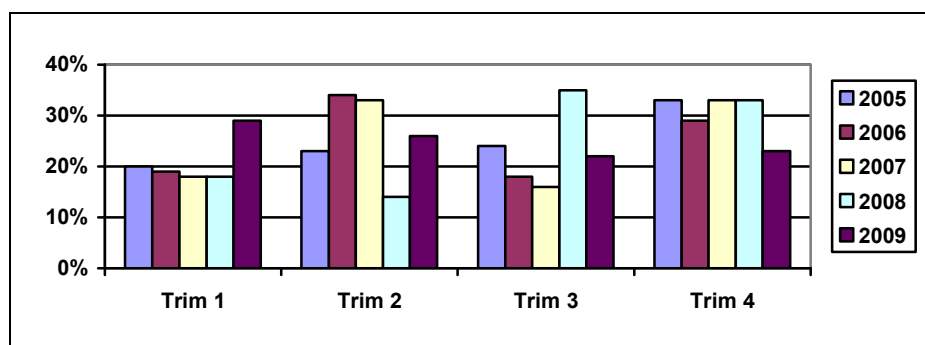


Fig. 4 –Exposure to ionizing radiations during the four trimesters in the period 2005-2009

b. The number of people exposed to ionizing radiations

The number of people exposed professionally to radiations refers to the staff working in nuclear, medical or industrial units.

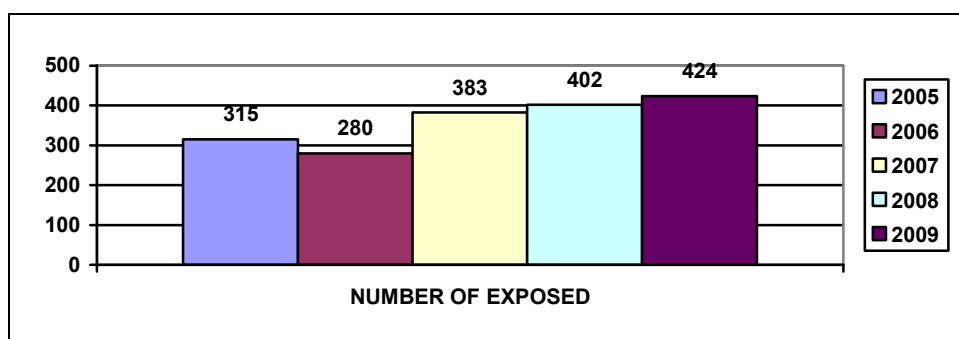


Fig. 5 - The number of people exposed to ionizing radiations in the period 2005 - 2009

Starting with 2005 and continuing up to 2009, one may observe an increase in the number of professionally exposed persons. The situation may be associated with the increase in the number of nuclear units.

Professional exposures may occur in the medical or the industrial sector. The evolution of the number of professional industrial or medical exposures in the period 2005-2009 is presented in fig.no.6.

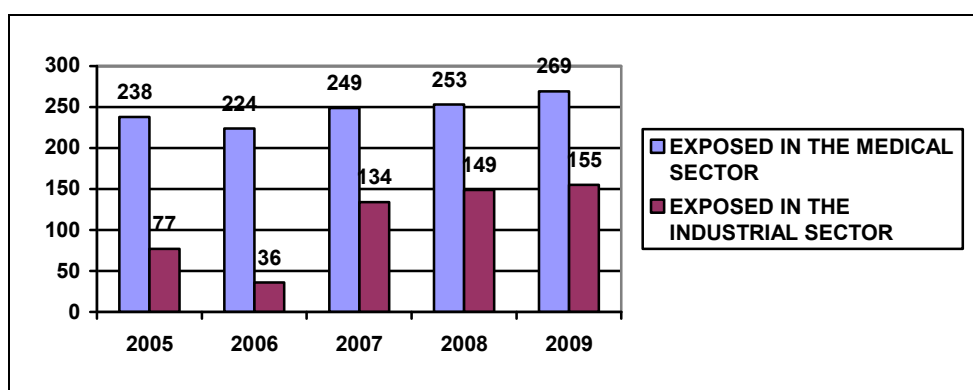


Fig. 6 – The number of professional medical or industrial exposures in Bihor county in the period 2005-2009

In the period investigated, one may observe an increase in the number of exposed, both in the industrial and the medical sector.

#### c. Medical investigations that use ionizing radiations

Lately, the number of radiological investigations of the radiography type, computerized tomographies, mamographies, panoramic dental radiographies has increased due to both patients' preoccupation for their health and because of people's need for a diagnosis that would be as precise and quickly established as possible, with the help of technology and high-performance devices (Lysdahl KB, I Borretzen, 2007).

Evaluation of medical examinations in terms of investigation type has been performed by centralizing data reported by nuclear units in Bihor county, only data related to 2009 being available.

In terms of exposure-types, the most common radiographies are the dental ones, radioscopies, followed by CT, cobalt-therapy, nuclear medicine and PET-CT.

*Table 3*

Number of medical radiological investigations in terms of exposure-types, during the 1-4 trimesters of 2009

2009	Trimes- ter 1	Trimes- ter 2	Trimes- ter 3	Trimes- ter 4	Number of procedures performed	Frequency (at 1000 inhabitants)
<b>Radiographies</b>	62183	56296	46419	48420	213318	359,94
<b>Radioscopies</b>	9565	8359	9102	7879	34905	58,90
<b>CT</b>	5362	4054	4303	4325	18044	30,45
<b>PET-CT</b>	151	152	154	129	586	0,99
<b>Dental radiography</b>	14533	11890	11745	11860	50028	84,41
<b>Cobalt- therapy</b>	212	380	194	172	958	1,62
<b>Nuclear medicine</b>	246	295	252	264	1057	1,78
<b>Total</b>	92252	81426	72169	73049	318896	538,08

Comparing the information above with the data included in specialised literature, one may observe lower values of radiologic examinations at 1000 inhabitants, as compared to data published at the international level.

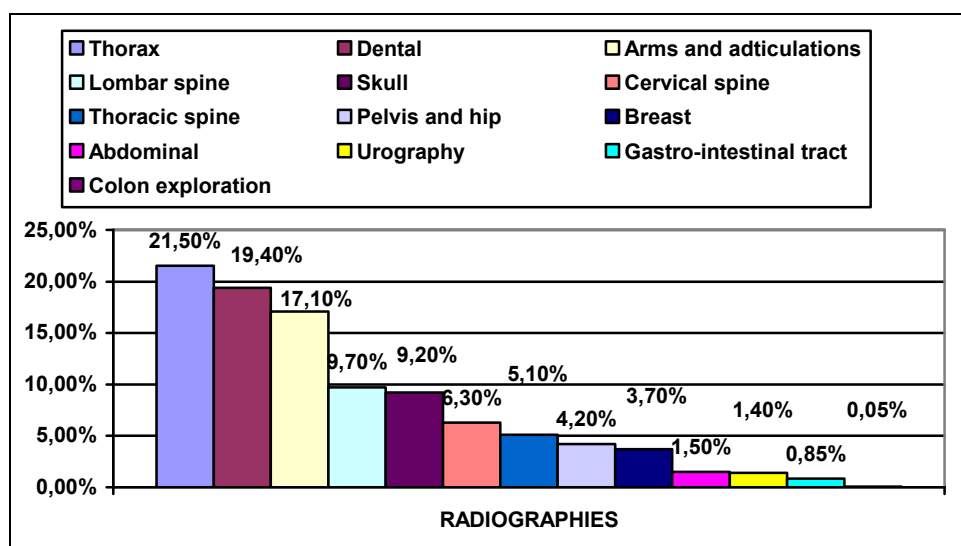


Fig. 7 – Number of radiographies in terms of investigations type, performed in 2009

Among radiographies, thorax, dental, limbs and articulations, cervical spine, thorax, pelvis, hip, breast, belly, urographies and of the gastro-intestinal tract are more frequent.

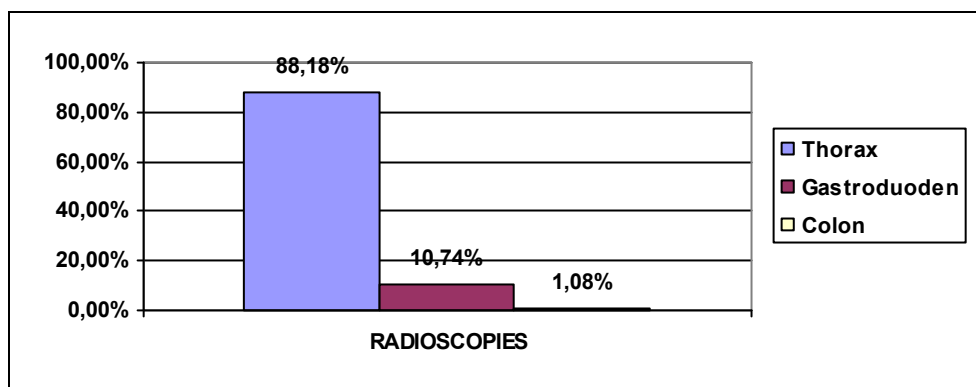


Fig. 8 – Number of radioscopies in terms of investigation types, performed in 2009

The demands of consumers of health services and specialized medical indications are higher for thorax radiscopies, which represent 88,10% of the total number of radioscopies performed.

### CONCLUSIONS

Despite the increase in the number of nuclear units during the last 5 years in Bihor county, the frequency of radiological examinations at the population of the county (related to 1000 inhabitants) presents inferior values to the ones published in countries such as Finland, Great Britain, Switzerland.

Between 2005 and 2009, one may observe an increase in the number of people professionally exposed, both in the medical and the industrial domain. This increase may be associated with the increase in the number of nuclear units. The highest number of professionally exposed is in the medical field, where women are predominant, while in the industrial domain men are more numerous. Among the radiological procedures patients are exposed to, the first place is occupied by radiographies, followed by dental radiographies, radioscopies, computerized tomographies, cobalt-therapies, nuclear medicine and PET-CT.

The long-term effects of exposure to medical radiations being known, it is very important to initiate programs meant at the education of the population and of the medical staff, in order to increase radiological safety and avoid unnecessary exposure, though data are yet not worrying.

It is necessary to increase the regulation capacity of public health central authorities and to establish national standards concerning the number and territorial repartition of radiological units, in order to prevent the increase in the use of radiological services, by reducing unnecessary investigations.

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