

# TRENDS OF RADIATION DOSE TO THE SLOVAK POPULATION FROM DIAGNOSTIC NUCLEAR MEDICINE EXAMINATIONS DURING THE PERIOD FROM 1985 TO 1995

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## 1. Introduction

Medical uses of ionizing radiation contribute significantly to the radiation exposures of individuals and populations. These exposures (0.4 - 1 mSv annually per caput (1)) far exceed those from other man-made sources. There is need to analyze the frequencies, doses and trends of diagnostic and therapeutic medical radiation procedures world wide. Such information could also be used in optimization of the dose for radiation protection purposes because the use of ionizing radiation in diagnostic nuclear medicine procedures is associated with the risk of the damage of organs not only on the actual patient but also on the next generation. The radiation dose depends on the type of used radiopharmaceuticals, the tested organ, the amount of administered radioactivity, patient's age and weight and on the velocity of physiological processes in the human body.

In our Institute of Preventive and Clinical Medicine we are following up the radiation burden to the patients of nuclear medicine departments from diagnostic procedures during the period of 11 years.

## 2. Materials and methods

The effective dose provides a possibility of expressing the radiation risk to patients undergoing different radiodiagnostic procedures by means of single figure. To evaluate the radiation dose to population from radiodiagnostic procedures a mathematical formalism was proposed (2), (3). In Slovak Republic are located 12 hospitals with nuclear medicine departments. For 1992 and 1995 we have sent the questionnaires to all hospitals in Slovakia and received 100 % response. The requested information was about the type of used radiopharmaceuticals and the mean administered radioactivity per examination, about the frequency of examinations and in period 1994 - 1995 also the information about the age distribution of the pediatric patients was received (these were divided to the 4 age groups - up to 1 year, 1 to 5 year, 6 to 10 year and 11 to 15 year old).

The mean effective dose for the procedure was determined by multiplying the administered radioactivity by the value of effective dose per unit of applied radiopharmaceutical's activity. These latter quantities were taken from the work of Stabin et al. (4), in which the values of effective dose per unit of administered activity were published for 6 different age groups ( newborn, 1 year, 5 year, 10 year, 15 year old children and for adults) and for different radiopharmaceuticals used in nuclear medicine procedures.

## 3. Results and discussion

The collective effective doses ( $S_E$ ), total numbers of examinations (N), the value of mean effective dose per exam ( $E_i$ ) and per caput ( $E/\text{caput}$ ) as well as the number of examinations per 1,000 inhabitants during the period from 1985 to 1995 in Slovak Republic are summarized in Table 1. Table 1 shows also these values for another countries (USA, UK, Czech Republic, Bulgaria and Holland). The value of  $S_E$  in Slovakia demonstrates no significant changes during the examined period. However there is some maximum in 1991 and after this time stable decrease till today. The total numbers of performed examinations and the values of  $E_i$  demonstrate the similar patterns. Favorable is the decreasing trend of the value of mean effective dose per exam which occurred from 1991.

This is mainly caused by replacing  $^{131}\text{I}$  labeled compounds with  $^{99\text{m}}\text{Tc}$  radiopharmaceuticals what reduced radiation exposure significantly. In Figure 1A the relative frequency of examinations performed using different radionuclides in SR is compared for years 1992 and 1995. Similarly in Figure 1B the relative contributions of radionuclides to the annual collective effective dose to the Slovak population is displayed for the same years 1992 and 1995.

There is a need for the evaluation of the radiation dose from diagnostic nuclear medicine in pediatric patients. The more precise analysis is included in the contribution (Ragan, Ftacnikova) presented at this Symposium, in which the authors summarized the radiation burden to the children during the period from 1994 to 1995 in Slovak Republic. Table 2 comprises an information about diagnostic nuclear medicine practice for pediatric and adult patients during the period 1992 and 1995. From this table one can see that during examined period the value of  $S_E$  and  $E_i$  for adults has decreasing tendency and for the children they increased.

**Table 1. Collective effective dose  $S_E$ , mean effective dose  $E_i$  and E per caput, and the number of examinations in Slovak Republic in comparison with other countries.**

Country	Year	$S_E$ [manSv]	$E_i$ [mSv]	E/caput [mSv]	# of exams	# /1,000 inhabitants
Slovak Republic	1985	68.1	2.81	0.014	23,645	4.7
	1986	69.7	2.92	0.014	24,163	4.8
	1987	80	2.87	0.016	24,353	4.9
	1988	83.5	2.97	0.017	26,258	5.3
	1989	79.9	2.96	0.02	26,025	5.2
	1990	76.7	3,1	0.015	23,214	4.6
	1991	112.7	3.63	0.023	31,055	6.2
	1992	98.6	3.22	0.018	30,645	5.8
	1993	92.4	2.67	0.017	34,532	6.5
	1994	66.1	2.37	0.012	27,855	5.2
	1995	54.6	2.13	0.010	25660	4.8
Czech Republic	1987	609	2.44	0.059	250,000	24.2
Bulgaria	1980	980	8.4	0.11	116,666	13.1
Holland	1985	112	2.7	0.037	41,481	13.7
UK	1982	950	2.5	0.02	380,000	7.2
USA	1982	32,000	4.3	0.14	7,441,860	32.6

**Table 2. Overview of nuclear medicine diagnostic practice for pediatric and adult patients during period 1992 - 1995 in Slovak Republic**

Year	# of exams	# of exams	# of exams	$S_E$ [Sv]	$S_E$ [Sv]	$S_E$ [Sv]	$E_i$ [mSv]	$E_i$ [mSv]	$E_i$ [mSv]	N/1000	N/1000
	Total	Adults	Children	Total	Adults	Children	Total	Adults	Children	Adults	Children
1992	30,645	28,663	1,982	98.6	95.6	3.0	3.22	3.34	1.53	7.7	1.4
1993	34,532	33,564	968	92.4	90.6	1.8	2.67	2.7	1.79	8.6	0.7
1994	27,855	26,113	1,742	66.1	62.5	3.6	2.37	2.39	2.06	6.5	1.3
1995	25660	24,151	1509	54.6	52.0	2.6	2.13	2.15	1.71	5.8	1.3

Figure 1A. Changes in usage of radionuclides in Slovakia

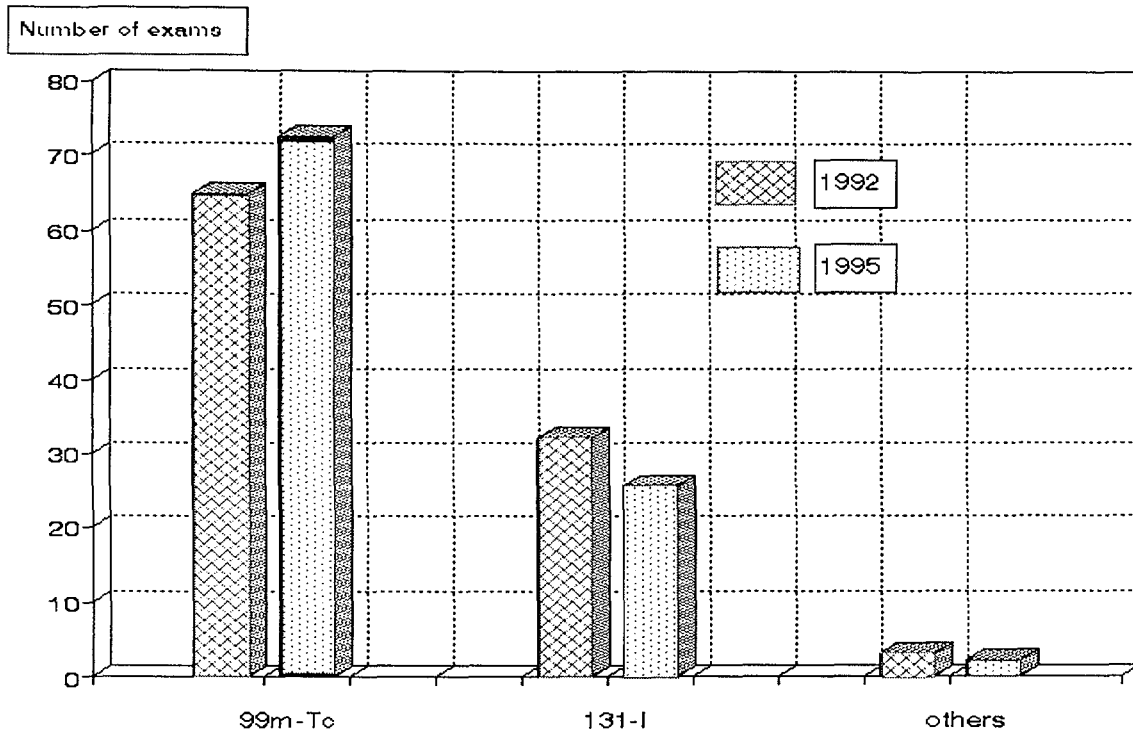
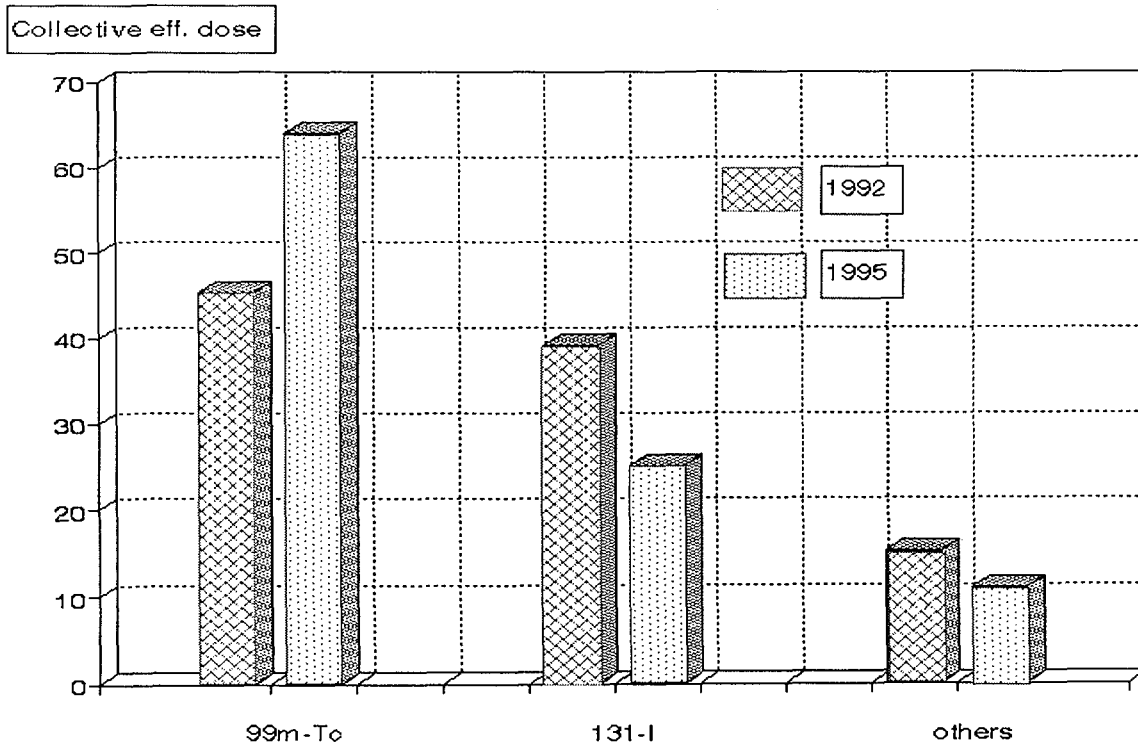


Figure 1B. Relative changes in usage of radionuclides in SR



#### **4. Conclusion**

The radiation dose in nuclear medicine examinations might be used as the criteria for the quality of health care of patients. This is done by evaluating the mean effective dose per examination. This contribution represents the overview of the evaluation of diagnostic nuclear medicine produced ionizing radiation exposure in Slovak Republic during the 11 years period. In comparison to other countries the ionizing radiation exposure is relatively low (Table 1), suggesting a very judicious use of radiopharmaceuticals in the country. On the other hand, the number of diagnostic procedures per 1,000 inhabitants is significantly lower (and still has a decreasing tendency) than in most developed countries (Table 1, Table 2). This fact is explained by the lower capacity of health care facilities in SR, related to the depressed economic situation.

#### **5. References**

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