

A REVIEW OF MEDICAL EXPOSURES FROM DIAGNOSTIC AND THERAPEUTIC NUCLEAR MEDICINE

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ABSTRACT

This article reviews medical exposures from diagnostic and therapeutic nuclear medicine practices based on the 2000 UNSCEAR (United Nations Scientific Committee on the Effects of Atomic Radiation) Report covering the period 1991-1996. In 1996 the world estimate for the annual per caput dose from diagnostic examinations is 0.4 mSv, of which nuclear medicine contributes only 0.03 mSv. For 1991-1996, the total frequency of all nuclear medicine examinations is estimated to be about 19 per 1000 population in countries of health-care level I, and 1.1 per 1000 population in health-care level II. The collective dose worldwide is estimated to be 150000 man-Sv, with 123000, 23000, 3500 and 200 man-Sv from health-care levels I - IV respectively. The majority of the collective dose (about 80%) is received in level I. The effective dose per examination averages 4.3 mSv in level I and 6.7 mSv in level II, but it is about four times higher in levels III and IV. The per caput dose is 0.08 mSv in level I but is an order of magnitude less in levels II and III. The estimated frequency of treatments with radiopharmaceuticals in level I is 0.03 per 1000 population; about an order of magnitude lower in level II. The UNSCEAR 2000 Report (1991-1996) includes diagnostic x-ray examination data from Malaysia for the first time. In 1994, a total of 3.6 million x-ray examinations were performed in Malaysia; the annual effective dose per caput to the population is estimated as 0.05 mSv and the total annual collective dose, 1000 man-Sv.

Key Words: Collective Dose, Effective Dose, Medical Exposure, Nuclear Medicine, Radiation Dose, Radiopharmaceutical

THE MALAYSIAN SCENARIO

Malaysia with 2216 persons per physician in 1994 belongs to health-care level II. Medical radiation usage for radiological procedures in Malaysia for 1990-1994 has been reported (Ng et al., 1999a & b), enabling comparisons to be made for the first time with the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) Report. It also allows appropriate radiation protection measures to be implemented.

In 1994, the number of physicians, radiologists, x-ray units and x-ray examinations per 1000 population was 0.45, 0.005, 0.065 and 183 respectively. (Level I countries had averages of 2.6, 0.072, 0.35 and 860 respectively) (Ng et al., 1999b). Doses received by patients undergoing seven common types of x-ray examinations in Malaysia had been measured by Ng et al (1998) in a national dose survey conducted from 1993 to 1995. This information will be useful in the formulation of national guidance levels for basic safety standards and as part of the national quality assurance programme. Another study reported on radiation exposure (annual examinations per caput and effective dose per examination) from radiological imaging (Table 4). In 1994, a total of 3.6 million x-ray examinations were performed in Malaysia; the annual effective dose per caput to the Malaysian population is estimated as 0.05 mSv per person and the collective dose, 1000 man-Sv (Ng et al., 1999b).

In 1998 there were 10 nuclear medicine facilities in Malaysia equipped with five gamma cameras and eight SPECT cameras (Ng and Bradley, 1998). However, there is no published information on the usage and radiation dose from nuclear medicine. It is hoped that medical exposures from nuclear medicine procedures would be studied by adopting the framework laid down in the national dose survey for x-ray examinations (Ng et al., 1998).

TABLE 1. IAEA Guidance Levels for Diagnostic Nuclear Medicine Procedures (IAEA, 1996)

Test	Radionuclide	Chemical form	Maximum Usual Activity per test (MBq)
Bone imaging	^{99m}Tc	Phosphonate & phosphate compound	600
Bone imaging (SPECT)	^{99m}Tc	Phosphonate & phosphate compound	800
Brain imaging	^{99m}Tc	TcO_4^- , DTPA	500
Brain imaging (SPECT)	^{99m}Tc	TcO_4^- , DTPA	800
Liver & spleen imaging	^{99m}Tc	Labelled colloid	80
Liver & spleen imaging (SPECT)	^{99m}Tc	Labelled colloid	200
Lung perfusion studies	^{133}Xe	Isotonic solution	200
Lung imaging (SPECT)	^{99m}Tc	MAA	200
Myocardial imaging	^{99m}Tc	Phosphonate & phosphate compound	600
Myocardial imaging (SPECT)	^{99m}Tc	Phosphonate & phosphate compound	800
Renal imaging	^{99m}Tc	DMSA	160
Renal imaging/renography	^{99m}Tc	DTPA, gluconate & glucoheptonate	350
Thyroid imaging	^{99m}Tc	TcO_4^-	200
Thyroid imaging	^{123}I	I^-	20
Thyroid metastases (after ablation)	^{131}I	I^-	400