

# WORLD-WIDE VARIATIONS IN EXPOSURES OF PATIENTS TO IONISING RADIATION

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## ABSTRACT

X-ray examinations increase in developing and nuclear medicine examinations in all countries, but all are less frequent in developing countries. Children are not infrequently examined, more so in developing countries. Doses per x-ray examination can be lower in developing countries, but nuclear medicine doses are similar in all countries.

## INTRODUCTION

UNSCEAR (the United Nations Scientific Committee on the Effects of Atomic Radiation) has estimated medical exposures to 0.4-1 mSv annually per caput (1). This refers mostly to the early 1980ies, and rests on extrapolation from few countries. Access to medical radiation increases in developing countries, and the pattern of investigations changes.

Hence UNSCEAR initiated a Survey of Medical Radiation Usage and Exposures in 1989. Some 40 very differing countries have responded so far. This paper describes some aspects of the answers. The paper states the author's personal views only and does not predict any future UNSCEAR conclusions.

The Survey contained questions on national conditions and numbers of patients, their age and sex, doses or activities for diagnostic and therapeutic uses of radiation. However, this paper deals with diagnostic radiation uses only. Many countries do not have the statistics requested. Still, even the relatively few answers obtained now extend our knowledge appreciably. These answers come from all inhabited continents, developing as well as industrialised countries, and small as well as large ones.

Countries are grouped in four levels of health care, according to the frequency of physicians. 22 answers come from level I countries (<1,000 population per physician), 7 from level II (1,000-3,000), 6 from level III (3,000-10,000) and 2 from level IV (>10,000 population per physician).

## RESULTS: GENERAL CONDITIONS

The Survey provides national averages and ranges of individual values for the various quantities. Here, most results are given as ranges and medians of national averages.

Some countries could not answer all questions, so entries in subsequent tables do not always represent all countries.

Table 1 shows arithmetic mean frequencies of radiologists, diagnostic x-ray units and nuclear medicine clinics. For health care levels I and II, a time trend is indicated. Access to medical radiation increases quicker at level II, but is still lower than at level I (where access may be close to satisfying demand).

Table 1. Access to medical radiation by level of health care (number per 1,000 population)

Level of health care:		I	II	III	IV
Radiologists	1970-74	0.063	0.023	-	-
	1985-89	0.076	0.038	0.009	0.0003
Diagnostic	1970-74	0.45	0.026*	-	-
x-ray units	1985-89	0.39	0.11*	0.037	0.004
Nuclear medi-	1970-74	0.005	0.0003	-	-
cine clinics	1985-89	0.008	0.0009	0.0004	0

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\* including dental units

#### RESULTS: DIAGNOSTIC X-RAY EXAMINATIONS

Table 2 shows that the frequency of x-ray examinations has increased only slightly at level I, but almost doubled at lower levels. At level I, both maximum and minimum national averages are actually lower in the 1980ies, reflecting substitutions of ultrasound, endoscopy etc for x rays.

Table 2. Number of x-ray examinations per 1,000 population (range and median of national averages)

Level of health care:		I	II, III, IV
1970-74	Range	369 - 2705	<8 - 26
	Median	586	17
1985-89	Range	144 - 1157	14 - 81
	Median	613	29

Table 3 shows patient age distributions for some x-ray examinations. Examination of children is not very infrequent and often more common at lower levels of health care, probably due partly to young populations of developing countries.

One could expect high doses per examination in developing countries. But as Table 4 shows, no such trend was reported. National ranges of individual doses are also narrower for developing countries. If this is correct and representa-

Table 3. Patient ages for some x-ray examinations 1985-89  
(national average percentages)

Level of health care:		I		II		III	
		Age: <16		>40		<16	
Chest	Range	4.6-13	49-80	7.6-32	33-43	6.0-27	28-38
	Median	6.7	63	16	38	15	34
Lumbosacral	Range	1.2-13	47-67	2.6-12	40-50	7.4-15	41-43
	Median	3.9	61	4.0	48	14	42
Upper GI tract	Range	0-5.1	56-81	2.1-10	30-47	2.0-10	44-55
	Median	1.5	67	6.1	39	9.1	52
Mammography	Range	0-1.2	49-91	0	9.9-49	0	89
	Median	0	68	0	29	0	89
Computed tomography	Range	4.5-12	49-80	4.4-6.5	37-64	-	-
	Median	6.1	64	5.5	51	-	-

tive, various causes of the lower doses are conceivable.

Table 4. Entrance surface doses for some x-ray examinations 1985-89 (national averages, mGy)

Level of health care:		I		II		III	
Chest - radiography	Range	0.13 - 1.5		-		-	
	Median	0.4		0.8		0.8	
Lumbosacral	Range	4.2 - 30		9.8 - 27		2.8 - 4.0	
	Median	22		18		3.4	
Upper GI tract	Range	2.2 - 40		3.3 - 30		2.6 - 3.4	
	Median	8.0		17		3.0	
Mammography	Range	1.5 - 165		-		-	
	Median	8.5		7.9		0.6	
Computed tomography	Range	29 - 78		-		-	
	Median	37		14		-	

## RESULTS: DIAGNOSTIC NUCLEAR MEDICINE

The frequency of all nuclear medicine examinations is

Table 5. Number of nuclear medicine examinations per 1,000 population (range and median of national averages)

Level of health care:		I		II		III		IV	
1970-74	Range	3.8-14		0.04-3.8		-		-	
	Median	6.2		0.5		-		-	
1985-89	Range	3.5-56		0.2-2.0		-		-	
	Median	13		0.9		1.0		0.09	

given in Table 5. Nuclear medicine was hardly available at lower levels of health care in the early 1970ies. The examination frequency has increased with time, and in contrast to x rays, the increase is marked also at health care level I.

Patient age distributions are shown for some nuclear medicine examinations in Table 6. Again, it is not extremely rare that children are examined.

Table 6. Patient ages for some nuclear medicine examinations 1985-89 (national average percentages)

Level of health care:		I		II		III,IV	
		Age:<16	>40	<16	>40	<16	>40
Bone	Range	0.8-45	25-91	5.1-21	40-70	-	-
	Median	3.4	76	20	44	0.3	67
Brain	Range	0-21	20-90	0-48	26-86	1.4-12	24-73
	Median	2.1	73	17	59	6.7	49
Liver/ spleen	Range	0.6-8.1	40-87	1.7-5.8	43-62	0.3-1.2	40-73
	Median	1.7	76	5.6	48	0.8	57
Renal	Range	3.8-3	13-70	0-9.9	11-51	1.7-7.7	18-76
	Median	15	51	1.8	41	4.7	47
Thyroid uptake	Range	0-2.2	10-80	3.4-12	38-69	0.7-1.8	20-46
	Median	0	61	9.1	41	1.3	33
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Finally, Table 7 shows some average activities in nuclear medicine examinations. No trend can be seen. Thus, the doses per examination are similar for different countries.

Table 7. Activities used in some nuclear medicine examinations 1985-89 (national averages, MBq)

Level of health care:		I	II	III,IV
Bone Tc-99m	Range	420 - 783	182 - 740	570 - 740
	Median	614	740	555
Brain Tc-99m pertechnetate	Range	60 - 801	-	500 - 740
	Median	615	370	620
Liver/spleen Tc-99m coll	Range	75 - 196	37 - 296	74 - 111
	Median	125	204	93
Renal I-131 hippuran	Range	0.9 - 6	0.4 - 1.1	-
	Median	4.9	0.8	0.9
Thyroid I-131 uptake	Range	0.2 - 9.5	0.1 - 3.0	1.7 - 2.2
	Median	0.9	0.4	1.9
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REFERENCES

1. United Nations: Sources, effects and risks of ionizing radiation. UN Sales publ E.88.IX.7. New York (1988)