

Assessment and Control of Radiation Doses in X-Ray Rooms of Treatment and Prevention Institutions of Khorazm Region

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Abstract: Background. The radiation safety system includes a set of measures aimed primarily at comprehensive reduction of radiation doses for the population belonging to category "A" (employees), that is, for persons in professional contact with radiation sources. In accordance with the requirements of the International Commission on Radiation Protection (ICRP), individual radiation doses should be monitored for all persons in this group to ensure that radiation does not exceed the established dose limit (20 mZv/year).

Material and methods. The ionizing radiation dose rate was measured at the workplaces of the X-ray rooms of the treatment and prevention institutions (TPI) in the Khorezm region, as well as the annual personal radiation doses were studied. The number of medical facilities using SIRs in Khorezm region is 54, and the total number of equipment using SIRs is 125. Measurements were made with a DRG-107C device. We estimated the value of radiation doses according to Radiation safety standards (RSS-2006) according to Sanitary standards and rules (SanNandR - 2006).

Results. According to the obtained results, it was found that the highest average indicator is behind the small curtain of object 1 (0,37 mkZv/hour), and the lowest average indicator is in front of the back wall of object 4 (0,15 mkZv/hour). The results of measuring the radiation dose power at the workplaces of employees, included in category "A", showed that the level of X-ray radiation in most points did not exceed the level of radiation dose stipulated in SanNandR 0194-06 "Hygienic requirements for installation and operation of X-ray rooms, equipment and conducting X-ray studies".

Conclusion. The results obtained allow us to characterize the working conditions of category "A" workers in X-ray rooms in the Khorezm region as favorable.

Keywords: radiation safety, radiation, radiation dose rate, X-ray rooms.

INTRODUCTION

The most important areas of human activity that use sources of ionizing radiation (SIR) are nuclear energy and medicine. Although the number of nuclear power plants is still limited, modern medicine cannot be imagined without radiation diagnostics and the treatment of many

diseases by radiation. Therefore, occupational radiation is often associated with sources used in medicine. [1-4]

The radiation safety system includes a set of measures aimed primarily at comprehensive reduction of radiation doses for the population belonging to category "A" (employees), that is, for persons in professional contact with radiation sources. In accordance with the requirements of the International Commission on Radiation Protection (ICRP), individual radiation doses should be monitored for all persons in this group to ensure that radiation does not exceed the established dose limit (20 mZv/year). To date, several thousand sources of ionizing radiation are used in Uzbekistan, 90% of them are used by various medical institutions, and the persons exposed to category "A" are mainly medical workers. [5-8]

The purpose of the study: the hygienic assessment of the radiation condition in the X-ray rooms of preventive treatment institutions in Khorezm region.

Research materials and methods. The main indicators of ensuring the radiation safety of employees are the strength of the radiation dose in the workplace, as well as the value of individual radiation doses for employees. In this regard, the ionizing radiation dose rate was measured at the workplaces of the X-ray rooms of the treatment and prevention institutions (TPI) in the Khorezm region, as well as the annual personal radiation doses were studied. Measurements were made with a DRG-107C device.

RESULTS

The number of medical facilities using SIRs in Khorezm region is 54, and the total number of equipment using SIRs is 125. The distribution of SIRs in Khorezm region by regional districts and cities is presented in table 1.

Table 1. Distribution of MSCT (multispiral computer tomography), fixed and portable X-ray, fluorograph, mammograph and dental X-ray equipment in the territory of Khorezm region

№	Districts and cities	Object number	Number of SIRs	In percentage(%)
1	Urganch c.	31	45	36
2	Khiva c.	2	2	1,6
3	Urganch r.	5	17	13,6
4	Khiva r.	3	7	5,6
5	Bogot r.	1	4	3,2
6	Khazorasp r.	1	8	6,4
7	Tuproqkala r.	2	8	6,4
8	Khanka r.	1	4	3,2
9	Shavat r.	3	8	6,4
10	Gurlan r.	2	11	8,8
11	Koshkopir r.	1	5	4
12	Yangariq r.	1	3	2,4
13	Yangibozor r.	1	3	2,4
Total	By province	54	125	100%

As can be seen from the information presented in Table 1, there are 36 facilities in Urganch city and Urganch district, and 62 of the total 125 SIRs in the region are located in these facilities.

The total number of preventive treatment institutions, industrial enterprises, and private clinics with x-ray radiology departments in Khorezm region is 32, these indicators are presented in table 2.

Table 2. Treatment and prevention institutions, industrial enterprises, private clinics with x-ray radiology departments in Khorezm region

№	Treatment and prevention facilities	The number	In percentage
1.	District and city medical associations	14	25,9
2.	Regional treatment and prevention institutions	13	24,09
3.	Dental polyclinics	1	1,85
4.	Private enterprises, clinics and treatment and prevention centers	21	38,9
5	HEO and PHD	5	9,26
	Total	54	100

Private medical institutions are considered to be the largest group of TPIs, which make up 38,9% of all TPIs in the Khorezm region, followed by district and city medical associations (25,9%), regional treatment and prevention institutions (24,09%) occuppies.

Due to the fact that the main indicators of ensuring the radiation safety of employees are the power of the radiation dose at the workplaces, as well as the calculation of the value of individual radiation doses for employees, we measured the ionizing radiation dose power at the workplaces of employees of the X-ray rooms of TPIs in the Khorezm region, and also studied the annual personal radiation doses. We estimated the value of radiation doses according to RSS-2006 according to SanNandR -2006. The results are presented in Table 3.

Table 3. TPI Ionizing beam dose rate in the area of the X-ray department Indicators

№	Measurement venues	TPI	Measurement points, relative to the floor, cm			Average indicator mkZv/hour
			180	150	90	
1	The remote control is in the control room (with the doors tightly closed)	1-object	0,29	0,21	0,19	0,23
		2-object	0,16	0,22	0,09	0,16
		3-object	0,28	0,16	0,20	0,18
		4-object	0,19	0,22	0,25	0,22
2	Behind the big shed	1-object	0,35	0,29	0,39	0,34
		2-object	0,27	0,31	0,37	0,32
		3-object	0,31	0,36	0,33	0,33
		4-object	0,29	0,38	0,30	0,32
3	Behind the small shed	1-object	0,23	0,34	0,38	0,37
		2-object	0,37	0,35	0,29	0,34
		3-object	0,31	0,39	0,22	0,31
		4-object	0,30	0,37	0,25	0,31
4	At the entrance	1-object	0,24	0,26	0,17	0,22
		2-object	0,28	0,36	0,25	0,30
		3-object	0,25	0,20	0,28	0,24
		4-object	0,22	0,09	0,31	0,21
5	Photo lab room	1-object	0,15	0,13	0,24	0,17
		2-object	0,21	0,25	0,18	0,21
		3-object	0,16	0,18	0,14	0,16
		4-object	0,21	0,15	0,24	0,20
6	In the adjacent rooms (rooms on the right and left)	1-object	0,25	0,18	0,31	0,25
		2-object	0,19	0,17	0,22	0,19
		3-object	0,23	0,25	0,23	0,24
		4-object	0,28	0,32	0,18	0,26

7	Corridor	1-object	0,15	0,27	0,23	0,21
		2-object	0,21	0,26	0,14	0,20
		3-object	0,15	0,19	0,21	0,18
		4-object	0,20	0,25	0,24	0,23
8	On the back wall (on the street, at least 1 m away from the outer wall of the X-ray room)	1-object	0,19	0,16	0,18	0,18
		2-object	0,14	0,18	0,21	0,18
		3-object	0,24	0,15	0,19	0,19
		4-object	0,15	0,14	0,16	0,15
SanNandR 0193-06 (RSS-2006) "Sanitary norms and rules of radiation safety"						

In order to carry out inspections, 4 X-ray rooms of 4 TPIs in Khorezm region were selected. As shown in Table 3, the remote control room, behind the large screen, behind the small screen, entrance door, photo lab room, adjacent rooms (rooms on the right and left side), corridor and back wall of each X-ray room were inspected, and the radiation dose was power indicators were determined.

According to the obtained results, it was found that the highest average indicator is behind the small curtain of object 1 (0,37 mkZv/hour), and the lowest average indicator is in front of the back wall of object 4 (0,15 mkZv/hour). However, it should be noted that all the determined indicators are within the current norm [8].

In order to estimate individual radiation doses, an analysis of archival materials of the regional sanitary-epidemiological peace center was conducted (2020-2022). These indicators are presented in Table 4 and it was found that they did not exceed the established standard.

Table 4. Annual personal radiation doses of X-ray department employees, mZv/year

TPI	Occupational group	Annual personal radiation doses (years of research)			Average annual radiation doses over long years
		2020	2021	2022	
1-object	Radiologist	0,43	0,55	5,2	2,06
	X-ray technician	1,31	0,30	5,6	2,4
2- object	Radiologist	0,37	0,50	4,0	1,6
	X-ray technician	0,71	0,30	7,8	2,9
3- object	Radiologist	1,71	0,50	9,0	3,74
	X-ray technician	1,75	0,31	7,6	3,22
4- object	Radiologist	0,43	0,46	2,0	0,96
	X-ray technician	0,37	0,35	5,2	1,98
SanNandR 0193-06 (RSS-2006) "Sanitary norms and rules of radiation safety"					20 mZv/year

The results of measuring the radiation dose power at the workplaces of employees showed that the level of X-ray radiation in most points did not exceed the level of radiation dose stipulated in SanNandR 0194-06 "Hygienic requirements for installation and operation of X-ray rooms, equipment and conducting X-ray studies".

DISCUSSION. The number of medical facilities using ionizing light sources in Khorezm region is 54, and the total number of equipment using SIR is 125. 36 of the total objects are located in the city of Urganch and the district of Urganch, and 62 of the existing 125 SIRs in the region are located in these objects. According to the Unified State System for Monitoring and Accounting for Individual Radiation Doses of Citizens of the Russian Federation, the average individual annual effective dose of man-made exposure to group A personnel in 2019 was 1,19 mSv, and to group B personnel – 0,64 mZv. [9]. The results of measuring the dose of ionizing radiation at the workplaces of X-ray room employees in treatment and prevention institutions of Khorezm region showed that it did not exceed the standard range specified in the current SanNandR 0193-06

(RSS-2006) "Radiation safety standards and regulations". [5]. Based on archival materials, the results of the assessment of individual radiation doses of employees included in category "A" showed that the radiation dose did not exceed the level stipulated in the current SanNandR 0194-06 "Hygienic requirements for the installation and operation of X-ray rooms, equipment and conducting X-ray research".[10].

Conclusions. The results obtained allow us to characterize the working conditions of category "A" workers in X-ray rooms in the Khorezm region as favorable.

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