

Appendix 9

Thyroid Cancer Incidence in Belarus after the Chernobyl Accident

Thyroid Cancer Incidence in Belarus after the Chernobyl Accident

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1. The Gender –Age Structure of the population Of Belarus in 1986.

The necessary demographic information has obtained as a result of the retrospective estimation of gender-age structure of the population for 1986 and than it was verified with statistical reports of Ministry of Health of Belorussian SSR.

The following algorithm of recalculation was used:

- Design of one-year gender-age pyramids of the regions population on the basis of census data for population structure [1];
- Calculation of the gender-age structure of every settlement inhabitants for 1989 by the use of projection method of correction of absolute age structure of the population [2];
- Transition from the gender-age structure of every settlement inhabitants in 1989 to the gender-age structure in 1986 by the use of method of back movement for age groups with regard to gender-age death-rate in 1986-88 [2].

Based on presented above method the database with the population structure in 1986 year on all Belarus oblast, raion, settlements with each record containing the population in 1986 according to age and gender was created. The database also contains the code number and geographical coordinates for each settlements of Belarus.

2. Incidence analysis of thyroid cancer

Sources of information of initially diagnosed malignant thyroid tumors were medical history records of the patients treated in the National Scientific and Practical Center of Thyroid Tumors, Belarusian State Chernobyl Registry and Belarusian Cancer Registry. Thyroid cancer incidence among exposed in various ages population was analyzed for the period of 1986-2002.

Belarusian State Chernobyl registry has been functioning in Belarus since 1987. It is four-level hierarchical system including state, region (oblast), district (raion), and medical institution (central raion hospital or polyclinic) levels.. Data collection for Chernobyl registry is totally based on follow up system (so called "special dispensary control") for certain groups of people in Belarus which are considered suffered in the result of the Chernobyl disaster according to the "Law (act) on social defence of persons suffered in the consequences of the Chernobyl accident"). Special orders of Belarusian Ministry of Health (1992, 1999) determine several groups for which periodical (mainly annual) medical examinations and registration in Chernobyl Registry are obligatory.

Belarusian Cancer Registry registration has been carrying out in Belarus according to the directive of the Ministry of Public Health of the USSR since 1953. It collects data from 12 oncological dispensaries, which are responsible for registration of all cancer patients residing in their service area. In fact dispensaries are regional sub-registries of Belarussian Cancer-registry.

In the Belarusian Cancer Registry all cancer cases are registered including skin basalioma and malignant neoplasms of lymphatic and hematopoietic tissues. Carcinoma in situ is also registered but is not included into cancer incidence tables.

The information obtained from the database of the Cancer Registry contains the following main groups:

- data on cancer patients registration;
- data on cancer diagnosis characteristics;
- data on quality of cancer preventive examinations;
- data on cancer incidence;
- data on cancer treatment;
- data on cancer mortality;
- data on cancer prevalence.

Incidence analysis was conducted in selected cohorts that included Belarus population subjected to ^{131}I exposure in various ages. The main interest of the project is Belarus population subjected to ^{131}I exposure in 0-18 years of age (born in 1968-1986).

The excess radiation-induced component was exarticulated from the total incidence as a difference between total and spontaneous incidence. To estimate spontaneous levels of thyroid cancer incidence among the population of the country for the post-accidental period this index was considered in different groups of population during the time before the end of minimal latent period, and based on its dynamics a spontaneous incidence estimated after end of minimal latent period.

For the period of observation from 1986 to 2002 among the cohort of exposed in the age of 0-18 and in utero there were diagnosed 1,916 cases of thyroid cancer including 1,878 cases diagnosed since 1990. General picture of thyroid cancer incidence among population during the post-accidental period is presented in Fig.1.

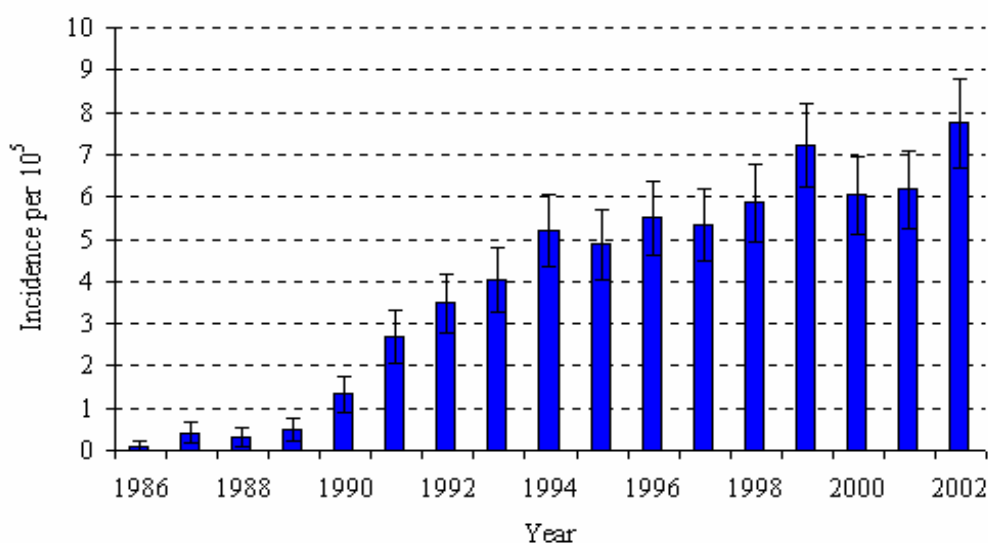


Fig.1. Thyroid cancer incidence among Belarus population subjected to ^{131}I exposure at 0-18 years of age at time of accident

Since 1990 a significant increase of incidence among population exposed at the age of 0-18 had been observed. Significant annual increase was continued till 1994, and then remained approximately at the same level. Number of cases and incidence levels among girls and boys are presented in Table 1.

Table 1.

Number of cases and thyroid cancer incidence in Belarus population exposed to ¹³¹I in the age of 0-18

Year	Cases			Incidence per 10 ⁵			Girls/boys ratio
	Girls	Boys	Total	Girls	Boys	Total	
1986	2	1	3	0.14	0.07	0.10	2
1987	9	3	12	0.63	0.21	0.42	3
1988	5	4	9	0.35	0.28	0.31	1.3
1989	9	5	14	0.63	0.35	0.49	1.8
1990	19	19	38	1.33	1.32	1.33	1
1991	54	23	77	3.79	1.59	2.69	2.4
1992	56	44	100	3.93	3.05	3.49	1.3
1993	88	28	116	6.18	1.94	4.05	3.2
1994	101	48	149	7.09	3.33	5.20	2.1
1995	92	48	140	6.46	3.33	4.88	1.9
1996	114	44	158	8.00	3.05	5.51	2.6
1997	104	49	153	7.30	3.40	5.34	2.1
1998	115	53	168	8.07	3.67	5.86	2.2
1999	139	68	207	9.75	4.71	7.22	2.1
2000	120	53	173	8.42	3.67	6.03	2.3
2001	120	57	177	8.42	3.95	6.17	2.1
2002	167	55	222	11.72	3.81	7.74	3.1

As it is evident from the Table 1 ratio of incidence with respect to the gender for giving age group confirms the fact that probability of development of radiation-induced cancer for girls twice higher than for boys.

Distribution of diagnosed cases during the period of 1986-2002 among the study cohort by age of disease manifestation is presented in Fig 2.

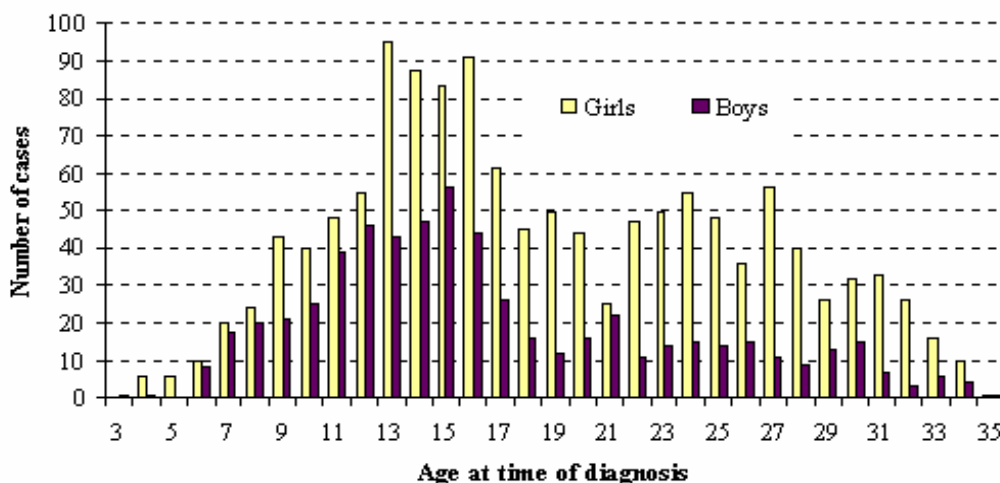


Fig.2. Number of thyroid cancer cases for the period of 1986-2002 in the cohort subjected to ^{131}I exposure in the age of 0-18 with respect to the age at the time of the diagnosis

The separate interest is the cases, which were born in 1986 years. On the Table 2 the available dates for children born in 1986, and operated during 1990-2002 period are presented.

Table 2

Available dates for children born in 1986, and operated during 1990-2002 period

Time of born	Number	%
Born before 26.04.86	48	67.6
Born after 26.04.86 (cases “in utero”)	23	32.4
Total	71	100

3. Reconstruction of thyroid doses from ^{131}I

Reconstruction of thyroid doses was made based on radioecological model [3]. The most important pathway of exposure was defined as ingestion of ^{131}I with locally produced milk. The ^{137}Cs activity per unit area was taken as the starting point of model. The addition data about time of start of deposition, values of rainfall event and information about stage of plant development, values of ^{131}I to ^{137}Cs ratio, available direct measurements of activity ^{131}I and ^{137}Cs and the using of the geographical approach allowed to divide the territory of Belarus on five zone. Inside of ones, the empirical dependences, connecting the rainfall and ^{131}I to ^{137}Cs ratio with ^{137}Cs deposition, were derived with very good correlation. It enabled to define as values of these parameters for each settlements as a form of such important parameter as interception factor for dry, wet and mix conditions of deposition.

The applied approach to assessment of parameters of the radioecological model was used to estimation of age-dependence thyroid doses for the Belarus population. Fig. 3 presents the average thyroid doses calculated for 0-18 age group for all Belarus oblasts and Gomel and Minsk cities. These assessments were

derived based on the estimated by model average doses for each age from 0 to 18 in each settlements and demographical data on settlements level in 1986.

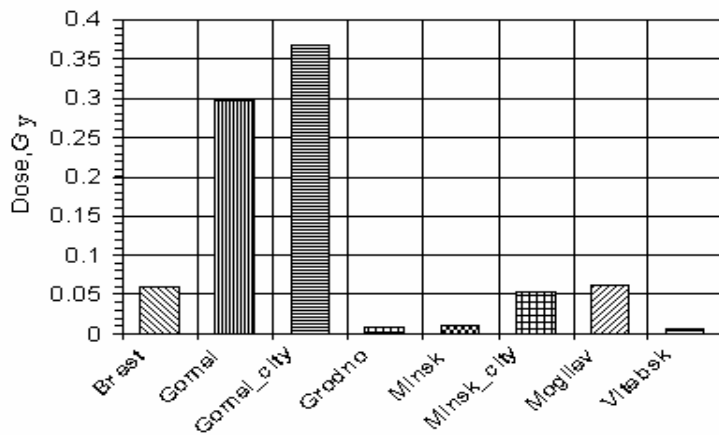


Fig. 3. The average thyroid doses for 0-18 age group for all Belarus oblasts and Gomel and Minsk cities.

The maximum values of thyroid dose were estimated for inhabitants of Gomel oblast that was characterized by the highest contamination. The minimum quantity of estimation was derived for Vitebsk oblast with the lowest level of depositions. The values for Grodno and Minsk areas are very close with the each other. The average assessment for Mogilev oblast is nearly equal to it for Brest oblast despite higher contamination. It is explained with combined (dry and wet) depositions for one and primary dry for second oblasts.

For verification derived results the estimated thyroid exposures for a number of settlements from different oblast were compared against the results of dose assessments obtained on the basis of ^{131}I -measurements in human thyroids (semiempirical model) [4].

On Fig. 4. the average thyroid dose assessments for one age-group inhabitants of all settlements with more than 10 measurements by two methods were plotted against ^{137}Cs -deposition.

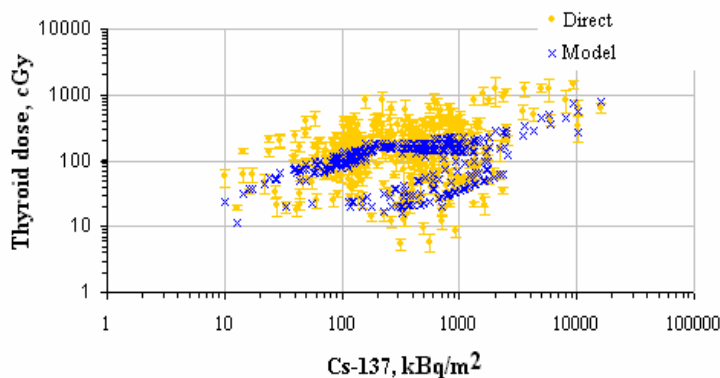


Fig.4. The dependences of thyroid dose from ^{137}Cs -deposition for one age-group inhabitants of all settlements with more than 10 measurements by radioecological model and semiempirical model.

The assessments by radioecological model are depending from ^{137}Cs -deposition stronger than ones by direct measurements, but the kinds of dependences don't conflict with each other.

4. Uncertainty of thyroid dose reconstruction

For the estimation of the uncertainty of the thyroid dose reconstruction the assumed distributions of the sensitive parameters using in model were done for two variant: optimistic and pessimistic. The uncertainty of optimistic variant is defined with transfer factor of milk and ratio ^{131}I to ^{137}Cs (more than 50%) and, practically, isn't connected with age groups. For pessimistic variant the initial interception factor and Cs-deposition are the most sensitive parameters (approximately 50%). The variance, which connected with age-specific rate of milk consumption, isn't very remarkable also.

The contributions of sensitive parameters to uncertainty for optimistic and pessimistic variants are presented in Figures 5-8.

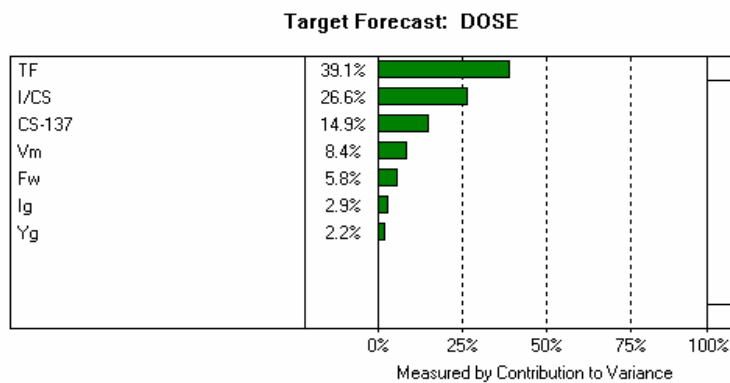


Fig.5. Sensitive chart of “Variant 1” for infants (0-3 age) rate of milk consumption.

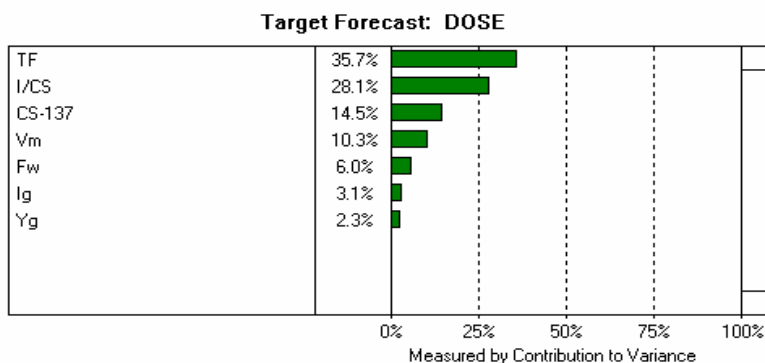


Fig.6. Sensitive chart of “Variant 1” for adult rate of milk consumption.

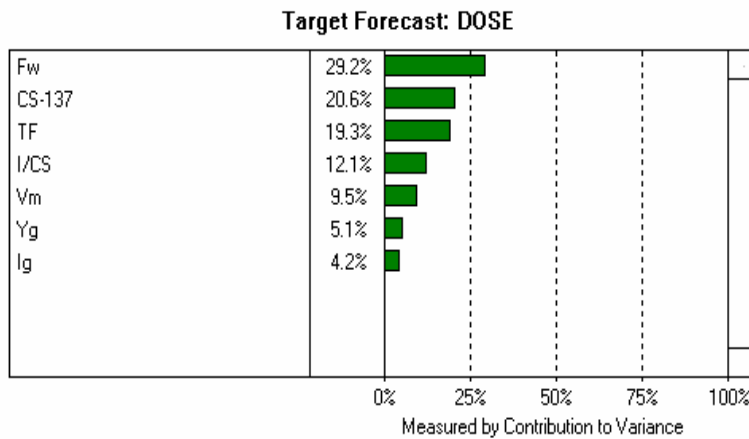


Fig.7. Sensitive chart of “Variant 2” for infants (0-3 age) rate of milk consumption.

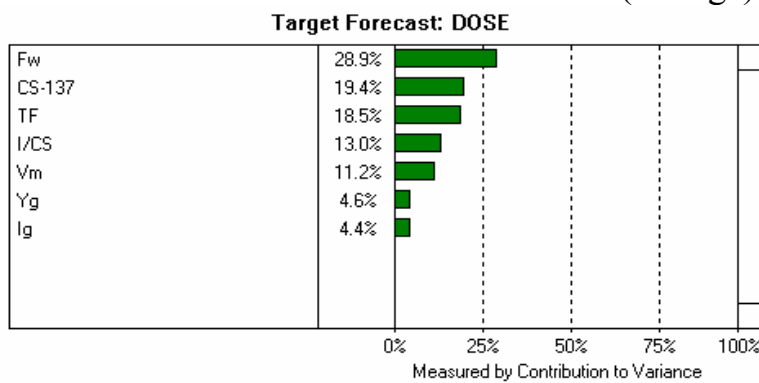


Fig.8. Sensitive chart of “Variant 2” for adult rate of milk consumption.

Uncertainty is defined as geometric standard deviation for 95% interval. The result of uncertainty estimation for two variant is presented in the next table (variant 1- optimistic, variant 2 – pessimistic).

Table 3.

Uncertainty factor as GSD for optimistic and pessimistic cases

Type of deposition	Age group	Variant1	Varant2
Wet	<i>Children</i>	2.05	4.48
	<i>Adult</i>	2.09	4.65
Dry	<i>Children</i>	2.13	4.49
	<i>Adult</i>	2.17	4.66

The optimistic variant is more sensible to type of deposition than the pessimistic. There is difference between adult and infants age groups, which is connecting with dietary feature.

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ANNEX 1

RADIOECOLOGICAL MODEL

Thyroid exposure for the Belarus population after the Chernobyl accident was formed with different pathways of exposure. The most important pathway of exposure was ingestion of ^{131}I with locally produced foodstuff.

It's known that the contaminated by ^{131}I milk and leafy vegetables are the main food formed thyroid exposure, but according to Belarus season conditions it was accepted that contribution from leafy vegetables was less than from milk consumption in April-May 1986. In this case thyroid dose due to ingestion of ^{131}I with contaminated foodstuffs for persons of i -age group is estimated based on ECOSYS-87 (Müller H., Pröhl G. 1993)[1]:

$$D_i = DF_{\text{ing}} \times V_{\text{m},i} \times GD \times TF_{\text{m}} \times I_{\text{g}} \times \frac{F_{\text{w}}}{Y_{\text{g}}} \times \int_0^T \left\{ \exp(-(\lambda_{\text{w}} + \lambda_{\text{r}}) \times t) \times \lambda_{\text{b}} \times \exp(-(\lambda_{\text{b}} + \lambda_{\text{r}})) \times (T-t) \right\} dt \quad (1)$$

Where:

D_i – is the thyroid dose (Gy);

DF_i – age-dependent dose factor for ingestion (Gy Bq^{-1});

$V_{\text{m},i}$ – consumption rate (kg d^{-1}) of milk;

GD - ^{131}I deposition to the ground;

I_{g} – feeding rate (kg d^{-1}) of cow;

F_{w} – initial interception factor;

Y_{g} – yield of grass at time of deposition (kg m^{-2});

λ_{w} – decrease rate of ^{131}I in grass due to weathering and growth dilution (d^{-1});

λ_{r} – the radioactive decay rate (d^{-1});

λ_{b} – rate representing the biological half-life of ^{131}I in milk (d^{-1});

T – time sine deposition (d).

In the model proposed, the ^{137}Cs activity per unit area is the starting point since the number of measurements of ^{131}I activity per unit area after the Chernobyl accident is very limited. In many settlements, measurements of ^{131}I depositions to the ground were not performed. For those cases, in [2], the ^{131}I deposition GD to the ground is estimated from the ^{137}Cs -deposition $\sigma_{\text{Cs-137}}$ and the $^{131}\text{I}/^{137}\text{Cs}$ $R_{\text{I/Cs}}$ ratio observed in the various parts of the country:

$$GD = \sigma_{\text{Cs-137}} \times R_{\text{I/Cs}} \quad (2)$$

Data for the ^{137}Cs deposition to the ground are available for the whole country, so from these data set the ^{131}I -deposition to soil can be estimated for the

whole country by interpolation. The data on the ^{137}Cs -activity per unit area is provided by the Belarus Republic Center of Radiation and Environment Monitoring, the data are decay-corrected to April 1986 for each settlement. All values are corrected for global fallout taking into account ^{137}Cs levels of $2 \text{ kBq}\cdot\text{m}^{-2}$ [3].

Another main question of the assessment of the iodine transfer in the food chains is the quantification of the interception by vegetation. Unfortunately, the available data of measured ^{131}I activities in soil and grass do not allow a reasonable estimation of the interception fraction. According to Pröhl and Hoffman (1996)[4], the interception depends on various factors as the deposition type (dry or wet), the chemical form and the amount of rainfall and the morphological development of the plant.

Within the framework of this project two methods for interception assessment were used combined: the interception of dry part deposition assessment according to Chamberlain ([5]) and the estimation of wet part by the approach described in radioecological model ECOSYS. This approach allowed describing the interception fraction as function of the amount of rainfall event. The function can be interpreted as a combination of the dependences for dry and wet depositions; it is approximated by an exponential function:

$$F_w = 0.3 \times \exp(0.2213 \times r) \quad (3)$$

Where:

r – the value of rainfall events in main day of deposition.

The data about time of start of deposition, values of rainfall event and information about stage of plant development, values of ^{131}I to ^{137}Cs ratio, available direct measurements of activity ^{131}I and ^{137}Cs and the using of the geographical approach allowed to divide the territory of Belarus on five zone. Inside of ones, the empirical dependences, connecting the rainfall and ^{131}I to ^{137}Cs ratio with ^{137}Cs deposition, were derived with very good correlation ($R^2 \geq 0.67$).

Within each zone, the deposition mode, the main day of deposition are the same or at least very similar. For all parts the deposition increases with increasing amount of rainfall ($1 \div 4$ – number of zone):

$$r_1 = 0.006 \times \sigma_{\text{Cs-137}} - 0.2315 \quad (4)$$

$$r_2 = 0.0349 \times \sigma_{\text{Cs-137}} + 0.0739 \quad (5)$$

$$r_3 = 0.145 \times \sigma_{\text{Cs-137}} + 0.0016 \quad (6)$$

$$r_4 = 0.0345 \times \sigma_{\text{Cs-137}} + 0.0289 \quad (7)$$

The amount of rain is less than 1 mm for the all points from zone 5. Following, this deposition can be characterized as "dry".

Using information about values of ^{131}I to ^{137}Cs , the ratio available from direct measurements of activity ^{131}I and ^{137}Cs , relationships between $R_{\text{I/Cs}}$ and σ_{137}

were derived for each zone ($R^2 \geq 0.73$). In general, the $^{131}\text{I}/^{137}\text{Cs}$ -ratio decreases with increasing ^{137}Cs -deposition:

$$R_{I/Cs}^1 = 38.794 \times \sigma_{Cs-137}^{-0.219} \quad (8)$$

$$R_{I/Cs}^2 = 42.18 \times \sigma_{Cs-137}^{-0.3712} \quad (9)$$

$$R_{I/Cs}^3 = 11.35 \times \sigma_{Cs-137}^{-0.905} \quad (10)$$

$$R_{I/Cs}^4 = 45.366 \times \sigma_{Cs-137}^{-0.3243} \quad (11)$$

It is assumed that the $^{131}\text{I}/^{137}\text{Cs}$ ratio in the 5th zone is equivalent to the minimum value of this parameter for Belarus ($R_{I/Cs}^{\min}$ was applied as 3). Such choice is clarified with low values of ^{131}I deposition for this regions [6,7].

The averages oblast doses were assessed with information of population in the age - groups of Belarus settlements in 1986 year:

$$D_{\text{avg}} = \frac{\sum_{i=0}^n D_{ij} \times (M_{ij} + F_{ij})}{\sum_{i=0}^n (M_{ij} + F_{ij})} \quad (12)$$

Where: D_{ij} – the average thyroid dose of inhabitants of j – age in i -settlement;

M_{ij} – number of males of j – age in i – settlement;

F_{ij} – number of females of j – age in i – settlement;

n – number of settlements in oblast.

The calculations do not take into consideration possible relocation or evacuation as a from their place of residence, excepting the part of the settlements from the 30km-zone, which were evacuated in three phases (the first was till 5.05.86 - 51 settlements, the second was till 9.05.86 – 29 settlements; the third was 1.09.86 and did not influence to the thyroid dose assessment). Consumption of locally produced milk by the rural population was assumed, for urban areas the consumption of contaminated milk was interrupted by 06.05.86. Any other possible countermeasures are not taken into account.

The every result of radioecological modeling is connecting with uncertainty [8]. The assumed distributions of the sensitive parameters using in model for the estimation of the uncertainty of the thyroid dose are presented in Table 1. “Variant 1” is applied as an optimistic estimation and “Variant 2” as a pessimistic estimation. Table 2 presents value of correlation between sensitive parameters.

Table 1.

Assumed distributions of the sensitive parameters of the thyroid dose for optimistic and pessimistic variants

Parameter	Type of distribution	Model value	Variant 1	95%	Variant 2	95%
Cs-137 (Bq/m ²)	Log-normal	1 ^a	GSD=1.2	0.7-1.3	GSD=1.5	0.44-2.25
Ratio ¹³¹ I/ ¹³⁷ Cs	Normal	10	Std=2	6-14	Std=3	4-16
Transfer factor milk	Triangular	0.003	0.002-0.006		0.0015-0.008	
Interception of wet deposition	Normal	0.06	Std=0.01	0.04-0.08	Std=0.2	0.02-0.1
Interception of dry deposition	Log-normal	0.3	GSD=1.2	0.2-0.43	GSD=1.5	0.13-0.68
Feeding rate	Triangular	43		35-50		25-55
Intake of milk (infants, 0-3 age)	Normal	0.4	Std=0.05	0.3-0.5	Std=0.1	0.2-0.6
Intake of milk (adults)	Normal	0.7	Std=0.1	0.5-0.9	Std=0.2	0.3-1.1
Yield of grass (fresh mass) ^b	Uniform	0.5		0.45-0.55		0.35-0.65

^aRelative distribution

^bInterception of dry and wet deposition dependent on yield

Table 2.

Correlation between sensitive parameters.

Correlation of interception factor for wet deposits with ¹³⁷ Cs-deposition	R = - 0.7
Correlation of interception factor for wet deposits with yield of grass	R = 0.8
Correlation ¹³⁷ Cs-deposition with I/Cs ratio	R = -0.7
Correlation yield of grass with feeding rate	R =0.5

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ANNEX 2

1. BELARUSIAN CANCER REGISTRY

Background

Cancer registration has been carrying out in Belarus according to the directive of the Ministry of Public Health of the USSR since 1953. First complete enough statistical data were obtained at the end of the 60-s.

Since 1973 Central computer cancer registry has been functioning in Belarus. It was based on the special forms called "Card of dispensary follow-up" (Form 30-6-Y (onco) filled in and coded in the oncological dispensaries of Belarus. Once a year all these forms were delivered to Minsk for the centralized processing. Information was transferred from paper documents to the computer media (cards, paper tape, magnetic tape) and then was entered into the computer memory where it was subjected to a strict computer check. After processing completion, the incidence reporting year files were created on the magnetic tapes and disks. The Belarusian Cancer Registry possesses such files from 1978.

Till 1985 the information in the computer files didn't contain personal details, such as family, first and patronymic names as well as and addresses of the cancer patients. It caused some difficulties in data verification and updating. In 1985-1989 an automated system of dispensary follow-up of cancer patients was gradually set up in the oncological dispensaries of Belarus. Data processing with the help of the system "Control of dispensary follow-up" envisages frequent usage of data on each patient during follow-up and treatment. Consequently, information reliability of the Cancer Registry has improved significantly. In 1990-1993 a version of this system for personal computers was developed and introduced into oncological dispensaries. In 1995-1997 the substantial improvement of software for the information processing automated system of the Belarusian Cancer Registry was performed. The approbation of the new version of this system has been performed since the second half of 1997 in Minsk City oncological dispensary. In 1999 the system has been installed in all dispensaries.

The main peculiarities of this new version are as follows:

- Usage of the complete International Classification of Diseases, the 10-th revision (ICD-10) for coding cancer diagnoses (topography and morphology);
- Built-in algorithms of information quality control (linkage of requisites: site-morphology-sex-age) created by the experts of the International Agency for Research on Cancer (IARC);
- Unification of some information sections with the State Registry of persons exposed to ionizing radiation as a result of the Chernobyl accident.

The Belarussian Cancer registry is now situated in Belarusian Centre for Medical Technologies, Minsk. The staff of the registry is responsible for development and improvement of all registry documents, including instructions on

filling in medical documentation, methodical manuals etc., development and improvement of software, data analysis and producing statistical reports, collection of data from local registries, supervision of their activities.

Sources of information

Belarusian cancer registry collects data from 12 oncological dispensaries which are responsible for registration of all cancer patients residing in their service area. In fact dispensaries are regional sub-registries of Belarussian Cancer-registry.

The majority of cancer patients are examined and treated in the oncological dispensaries and the Institute for Oncology and Medical Radiology. It makes data collection significantly easier. Most information is entered into computer directly from patients' medical records (outpatient medical card and history of the disease) stored in the dispensaries. Besides, extracts from medical documents and special notifications from other health care institutions (Institute for Oncology and Medical Radiology, Centre for Thyroid Tumours Pathology, haematological hospitals, hospitals with cancer beds etc.), where cancer was diagnosed and treated, are sent to the oncological dispensaries.

The notification cancer forms should be filled in and sent to the oncological dispensaries also by the pathomorphologists in case of post-mortem cancer diagnosis.

Additional sources of information on cancer patients are death certificates. Once a month the personnel of local divisions of the cancer registry visit the vital statistics department and search for death certificates with cancer as the cause of death. After that all cases of cancer deaths are checked against the data of the local cancer registries. If the case was not found in the data base, the personnel verify the diagnosis addressing to the person who signed the death certificate. These can be pathologist, district therapist and hospital doctor. In case the certificate was signed by the hospital doctor they check the medical card and if the cancer case was confirmed the case is included into the cancer registry data base. The same is true for pathologists. In case the district therapist signed it, the medical documents are also checked to get the information about basis of diagnosis. If the case was treated before death in the hospital, then hospital documents are addressed. In some rare cases the therapist can diagnose cancer after examination of the deceased without autopsy, when the relatives do not agree to make it, basing on some external signs. The number of DCO cases does not exceed 0.4% of all cases.

Registered tumours

In the Belarusian cancer registry all cancer cases are registered including skin basalioma and malignant neoplasms of lymphatic and hematopoietic tissues. Carcinoma in situ is also registered but is not included into cancer incidence tables.

Classification and coding

Since 1985 until 1999 tumour topography was coded on the basis of the International Classification of Disease of the 9-th revision (ICD-9). Full (4-digit) code is used for coding the following tumour sites: oesophagus, stomach, colon and rectum, liver, lung, mediastinum, bones, connective and soft tissues, skin (including melanoma), ovaries, kidney, endocrine glands, lymphoma and leukaemia. Other sites are coded by the first 3-digit ICD-9 codes. All previous files was also converted to ICD-9. The coding of morphology was based on local classification.

Since 1999 (in Minsk-city since 1997) cancer cases for topography and morphology are coded by ICD-10 classification.

Multiple primaries

The Belarusian Cancer Registry data base is person- and tumour-oriented. Each tumour of a person is recorded separately within the personal record that allows to count correctly all the cancer cases. Independent primaries are defined as tumours of different organs or different parts of organs, according to four-digit ICD-9 classification. Multiple tumours of skin are counted separately for different sites without regard to histology.

Incidence date

The date of incidence is defined as follows:

- for patient treated in the oncological dispensary it is the date when cancer is finally diagnosed;
- for patient treated or diagnosed in other clinics date of incidence is abstracted from the special notification form which is sent to oncological dispensary
- for cases first found by death certificates date of diagnosis is specified by inquiries to the source of the information
- for DCO cases the date of death is taken as the date of incidence

Stage

Local classification of stages is used: codes are ranging from 0 (Cr in-situ) to 4 according to the extent of disease.

Output data

Annual statistical data include information on incident and mortal cancer cases grouped by sex and age as well as crude intensive and age-adjusted incidence and mortality rates. The data on cancer diagnosis, the organisation of treatment in different administrative-geographical areas, are summarised and analysed, too.

The possibility to obtain various characteristics of oncological situation in different regions is foreseen while choosing the main statistical indicators. The information obtained from the database of the Cancer Registry contains the following main groups:

- data on cancer patients registration;
- data on cancer diagnosis characteristics;
- data on quality of cancer preventive examinations;

- data on cancer incidence;
- data on cancer treatment;
- data on cancer mortality;
- data on cancer prevalence.

2. BELARUSIAN STATE CHERNOBYL REGISTRY

The Chernobyl Registry has been functioning in Belarus since 1987. It was established by a directive of the Ministry of Public Health of the USSR as a comprehensive registration and follow-up system for the persons most affected by the Chernobyl accident. Till 1991 it acted as a part of all-Union distributed registry.

Since 1993 by decree of Council of Ministers it was reorganised in the "Belarusian State Registry of Persons Suffered from the Consequences of the Disaster on the Chernobyl Nuclear Power Plant". By that time it also undergone substantial remaking of it's documentation, concepts of data collection, software, etc.

Aims

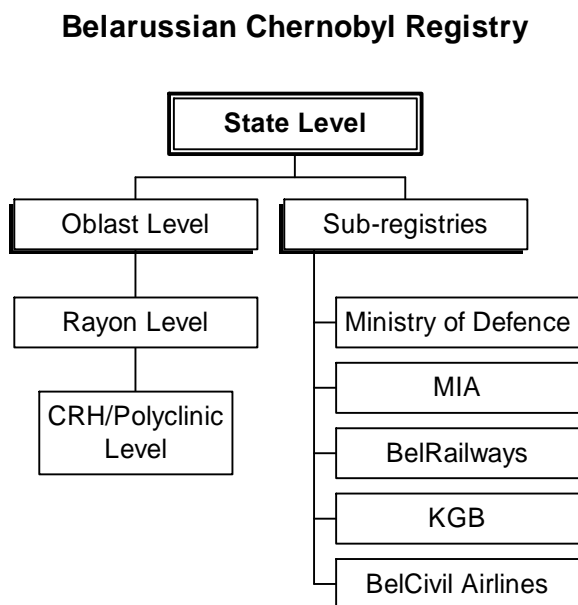
The main aims of the Chernobyl Registry are as follows:

- Informational support of health status follow-up (dispensary control) for the population exposed to radiation in the result of the Chernobyl accident;
- Collection of authentic medical data on the above population.

Organizational structure

Chernobyl registry is four-level hierarchical system including state, region(oblast), district(rayon), and medical institution (central rayon hospital or polyclinic) levels.

At each level special groups and departments of the Chernobyl Registry function.



CRH - central rayon hospital

Rayon Hospital and Polyclinic groups are the basis of the Chernobyl registry functioning, because they are allocated in medical units which are directly responsible for the treatment and follow up of the persons included in the registry who are living in their area. The tasks of the hospital and polyclinic groups are as follows:

- Revelation and registration of relevant persons;
- Data base formation, including quality control and verification of the information;
- Regular delivery of the registry information to the oblast level.

Most of this groups are equipped with their own PC's and enter the information directly from medical records (ambulatornaya carta). Those who do not have computers for data processing fill in special registry forms which then are delivered to oblast registry departments for input in the data base.

Rayon level practically is the same as above described.

Oblast Chernobyl registry departments are generally departments of central oblast clinics except Gomel, Mogilev, and Minsk, where they are situated in Gomel Dispensary for Radiation Medicine, Mogilev Oblast Diagnostic Centre, and Minsk City Hospital #1 respectively. The tasks of oblast registry departments are as follows:

- Receiving regularly the information from lower level registry groups on magnetic or paper media;
- Control of rayon groups and assistance on all problems of Chernobyl Registry functioning (follow up, collecting information, coding, quality control, verification, running software and installing new versions, maintaining and repairing PC's);
- Input of the documents received from lower level registry groups not equipped with PC's;
- Regular delivery of the oblast registry information to the state level.

Sub-registries

Chernobyl Registry organisational structure also includes sub-registries that belong to special medical services that traditionally existed since former USSR. They are as follows:

- Medical service of the Ministry of Defence;
- Medical service of the Ministry of Internal Affairs
- Medical service of The KGB;
- Medical service of the Belarussian Railways;
- Medical service of the Belarussian Airlines;

These services are responsible for registration and subsequent follow up of the persons - subjects of their service - who considered suffered from the consequences of the Chernobyl disaster. Actually, most of them are liquidators. All of these services have special Chernobyl groups that act much the same way as oblast level departments. They all have PC's with the identical software and also regularly deliver the information to BelCMT.

State level of the Chernobyl registry is situated in Minsk in the Belarussian Centre for Medical technologies (BelCMT). On the state level following activities are carried out:

- Receiving regularly the information from oblast level on magnetic media or by E-mail ;
- Updating and maintaining the joint state level Chernobyl registry data base;
- Control of oblast, rayon departments (groups) and sub-registry groups and assistance on all problems of Chernobyl Registry functioning (follow up, collecting information, coding, quality control, verification, running software and installing new versions, maintaining and repairing PC's);
- Development and improvement of all registry documents, including instructions on filling in medical documentation, methodical manuals etc., preparing the regulating directives to be issued by the Ministry of Health;
- Development, improvement and dissemination of the Chernobyl registry software system for all registry levels;
- Data analysis, preparing statistical reports to the Ministry on health;
- Running scientific programs on studying medical consequences of the Chernobyl disaster;
- International exchange of data.

Staff of various groups (departments) of Chernobyl Registry depend on size of the population under registration in area of their responsibility. It includes generally 1 position for a doctor (chief of group, partly or fully employed), 1 to 4 positions of middle medical personal, trained to work on PC. Oblast departments have also 1 to 2 positions of programmers.

Population to be registered

Data collection for Chernobyl registry is totally based on follow up system (so called "special dispensary control") for certain groups of people in Belarus which are considered suffered in the result of the Chernobyl disaster according to the "Law (act) on social defence of persons suffered in the consequences of the Chernobyl accident". Special orders of Belarussian Ministry of Health (1992, 1999) determine several groups for which periodical (mainly annual) medical examinations and registration in Chernobyl Registry are obligatory. They are as follows:

- **group 1** - participants in the "liquidation" of the consequences of the Chernobyl accident, the so-called "liquidators" or clean-up workers. This group is divided in two risk sub-groups according to time and place of their activities:

- first subgroup: worked in 1986-1987 within 30-km zone
- second subgroup: worked in 1988-1989 within 30-km zone and those worked in 1986-1987 in areas with Cs-137 radiation contamination higher than 15 Ci/sq km;

- **group 2** - evacuees from 30-km zone;

- **group 3** - residing or working in areas with Cs-137 radiation contamination higher than 15 Ci/sq km (so called "zones of immediate and subsequent resettlement") or resettled from those territories after Chernobyl accident;
- **group 4** - children born from parents, included in groups 1-3;
- **group 5** - residing or working in areas with Cs-137 radiation contamination less than 15 Ci/sq km;
- **group 6** - persons exposed to radiation in other nuclear accidents on territory of former USSR;
- **group 7** - persons with cancer, diagnosed after Chernobyl accident in age of 0-17 (introduced in 1999).

Active follow-up

Following directives of Ministry of health (#102, 1992 and #122, 1999) every person from above follow up groups must undergo an obligatory annual medical examination in which he or she is seen by various specialists according to risk groups. At the minimum he or she should be examined by therapist (paediatrician) and blood sample should be taken.

Liquidators of the first subgroup and persons of the 2nd group (see above) is to be examined by the following specialists:

- therapist;
- endocrinologist;
- ophthalmologist;
- neuropathologist;
- otolaryngologist;
- gynaecologist (for women and girls above 12);
- blood sample.

In addition persons of 2nd group must undergo ultrasound examination of thyroid gland.

When necessary the person could be directed for additional examination to the oncologist and other specialists.

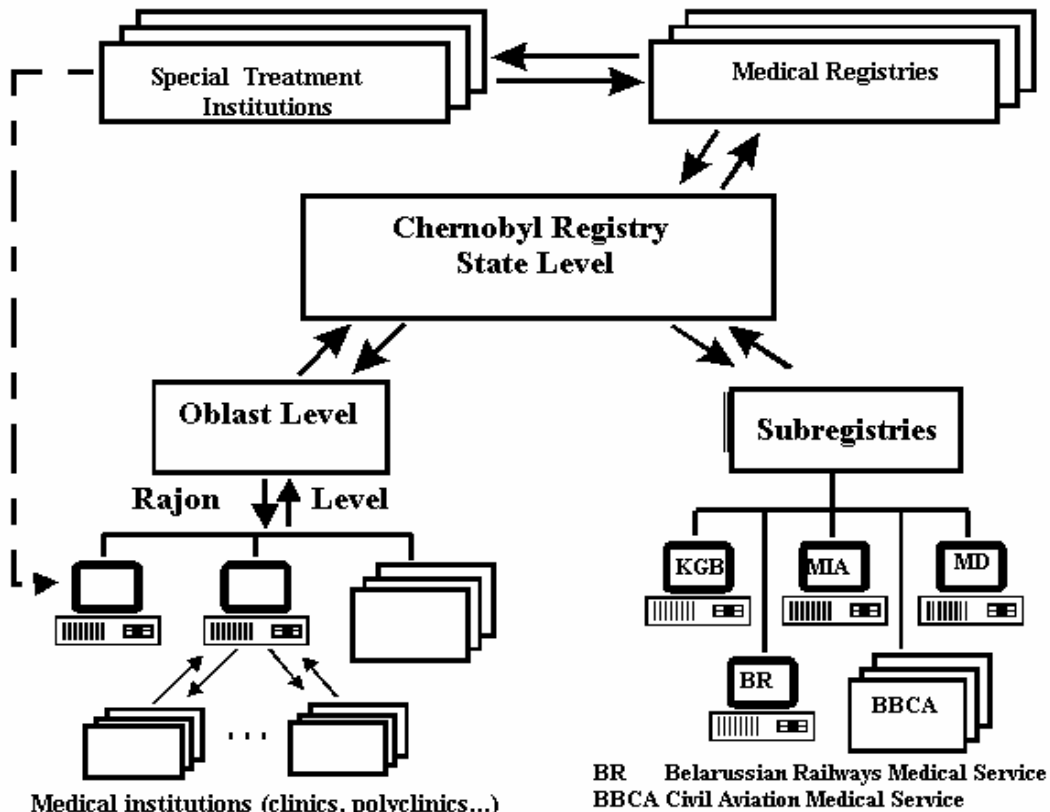
Adults of 5th group are to be examined biennially.

In Belarus, several official directives regulate the activities of groups which are in charge of controlling the special dispensary examinations and the local registries. According to them, if a person does not present him or herself for the obligatory annual examination, the cause must be ascertained: personal refusal, emigration outside of the area covered by the health institution activities or outside of Belarus, or death. For this purpose, a nurse from the outpatient clinic visits the subject at home. If he or she has moved, staff of registry groups tried to inquire passport departments where all population is registered to confirm the move and information is entered into the database of the Chernobyl Registry. In case of death, a nurse may be sent to the district bureau for registration births and deaths to ascertain the date and cause of death, which are also entered into the registry data base.

Data registration and collection

All data on diseases diagnosed during the annual medical examination, as well as at any other time during the year, is entered in the personal outpatient card at the regional polyclinic (central rayon hospital) from which the person depends.

Data collection in the Chernobyl Registry



Note. It should be mentioned that this medical card undergone substantial remaking at the time of the Chernobyl registry reconstruction (1993) in order to make data collection and input more convenient and easier.

Then all information is entered directly in the PC's or rewritten on special registry form and sent to oblast level depending on availability of computers. Polyclinics that equipped with PC's once in a quarter upload all updates of their data bases and send it to the oblast level. Those not equipped with computing facilities deliver paper documents to oblast level on their convenience but not less than once in a quarter.

Oblast level check the information received on magnetic media and re-send it to the state level together with the information entered on oblast level also once in a quarter.

On state level the received information is used for updating the joint Chernobyl registry data base.

Note: On the state level information on 5th group is not collected.

Data base

The Chernobyl registry data base have following main sections:

- Identification and address
- Data on follow-up termination (death)
- Staying (working) in contaminated area
- Migration
- Dosimetric data
- Diseases (including chronic before the accident)
- Diseases considered related to Chernobyl accident
- Disability
- Rehabilitation and treatment
- Annual medical examinations

Below substantial variables of some section are listed.

1. Identification and address

Full name

Date of birth

Sex

Follow up (registration) group

Polyclinic code

Date of registration

Place of residence

Address

Liquidator's certificate

Passport/birth-certificate

2. Data on follow-up termination (death)

Cause of follow-up termination

Date of death

Cause of death (diagnosis, ICD-classification)

3. Staying (working) in contaminated area

Date of entry

Date of exit

Code of settlement

Purpose of staying (permanent living, permanent work, mission, etc).

4. Migration

Code of previous polyclinic

Code of previous place of residence

Date of entry

5. Dosimetric data

Measured dose for thyroid gland

External dose for reporting year

Internal dose for reporting year

Summary dose for the whole period

Note: dosimetric information is poorly presented in the registry

6. Diseases (including chronic before the accident)

Date of diagnosis

ICD-9 code of disease

Characteristic (acute, chronic first revealed, chronic previously known, etc)

Circumstances of detecting (personal visit, screening etc)

7. Disability

Cause of disability

Date of certification

Degree of disability

8. Annual medical examinations

Date of examination

Volume of examinations (what specialists were involved)

Access to the data

Chernobyl Registry do not have well developed strict confidentiality rules.

On state level according to the Chernobyl registry STATUT access to statistical information is provided unconditionally to the Ministry of health and Chernobyl Comity. To other users (mostly they are medical research institutes) access to data is provided by written permission of responsible deputy Minister of Health.

On rayon level access to the registry data could be provided by permission of polyclinic/rayon hospital chief doctor.

On oblast level access to the registry data could be provided by permission of Oblast Health Department.

The most of provided data are statistical. But in some cases personal data could be provided.