Health of Liquidators (Clean-up Workers), 20 Years after the Chernobyl Explosion

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WELCOME ADDRESS

Mr. Chairman, Ladies and Gentlemen

On behalf of the Swiss Federal Office of Public Health, I am very pleased to welcome you all to this Symposium entitled "Health of Liquidators (Clean-up Workers), 20 Years after the Chernobyl Explosion".

We would like to express our sincere gratitude to the speakers and to the Physicians for Social Responsibility / the International Physicians for the Prevention of Nuclear War for the organization of this symposium.

Switzerland witnessed the Chernobyl disaster from afar and the Swiss population was never in a situation of acute danger. Nevertheless, the Chernobyl accident led to the contamination of the country and to a significant contamination of the foodstuffs. Albeit Switzerland was relatively well prepared for severe nuclear accidents, and had a trained Emergency Organization, the Chernobyl accident led to a crisis in our country, and as a result, the Swiss population partially lost confidence in the authorities.

We can hardly imagine how the young, so-called "liquidators" in Chernobyl, were worried and how much they suffered when they were enrolled to work in heavily contaminated areas in very high radiation fields. Now, almost 20 years after the disaster, we ask ourselves several questions and among these are the following: First of all, what do we know about the consequences of this nuclear accident? Secondly, what do we know about the health effects of the radiation? Thirdly, what do we know about the liquidators? Certainly, we do not know "the True Scale of the Accident" and unfortunately, we cannot give "definitive answers" as stated in a press release a few weeks ago.

It will take at least 20 more years before we get a better estimate of the radiation-induced cancer and non cancer diseases among the affected population, especially liquidators and children living on contaminated territories. Therefore, we should remain humble and we must exercise extreme care when advancing numbers of deaths and hypothetical expected ones, since nobody can actually pretend to hold the truth.

Different approaches and different ways of seeking means to overcome the Chernobyl consequences are needed. The strategy must create viable life conditions and also focus on health problems which include the improvement of medical care, equipment and medical personnel. High quality cancer registries should be used to better understand what makes people ill. Incidence rates of thyroid cancers, leukaemia, radiation cataracts as well as cardiovascular and other non cancer-related diseases should continue to be monitored.

Typical liquidators' disorders must be given special attention. This attention should be independent from the knowledge of their exact origin, be it radiological or not.

I am convinced that the presentations of this Symposium will lead to a better understanding of the overall radiological and psycho-social consequences of the Chernobyl tragedy, and also bring forth some principles which will enable us to mitigate to a certain extent the health consequences of this disaster.

Thank you very much for your attention.

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INTRODUCTION

ON NOVEMBER 12, 2005, NEARLY 20 YEARS AFTER THE CHERNOBYL EXPLOSION A SYMPOSIUM UNDER THE AUSPICES OF THE MEDICAL FACULTY OF BERN, SWITZERLAND, WAS DEDICATED TO THE HEALTH OF LIQUIDATORS (CLEAN-UP WORKERS)

At an International Conference on Chernobyl in Kiev in 2001, rapid health deterioration of the clean-up workers - the so called liquidators - was reported. At that time, one third of them already were incapacitated. In 1986 in the aftermath of the Chernobyl reactor explosion, 800'000 mainly younger adults (mean age 33 years) were enrolled to decontaminate the heavily contaminated areas in the 30 km zone around the exploded reactor. Half of them were military personnel of all republics of the Soviet Union, the others were civilian technicians, miners, pilots, drivers, all healthy young men and also women. During the first weeks, it was mostly external radiation affecting them. Thereafter internal contamination through inhalation of Radio-iodine, Cesium, Strontium, Transuranians, various "hot particles" and gases became prevalent. The dosimetry was problematic to accomplish, as the available dosimeters were unable to measure the very high doses.

PSR/IPPNW Switzerland established contacts with independent scientists and physicians of the affected countries. We were concerned all along, but became especially interested in the long term health problems of liquidators after the publication of a press release by the Ukrainian Embassy in Paris, in April 2005. This document announced that 2'646'106 Ukrainian have to be recognized as victims of Chernobyl, one third among them being children. 85% of the citizens living in contaminated areas are ill and their health is still deteriorating. Of the registered Ukrainian liquidators 94% were ill. The diseases encountered among them need to be clarified by unbiased work-up and medical help needs to be provided.

SCIENTIFIC RESEARCH ON THE MEDICAL CONSEQUENCES AFTER THE CHERNOBYL EXPLOSION – THE ROLE OF IAEA AND WHO

Members of the medical community face great difficulties finding reliable data on damage by ionizing radiation on genome, cells and organs in animals and humans. The commercial nuclear industry is a by-product of the development of atomic bombs and other nuclear military tools. The International Atomic Energy Agency (IAEA) is the UN organisation in charge both of the promotion of the commercial nuclear technology and the prevention of the dissemination of atomic weapons. The IAEA statutes indicate that its main objective is "to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world". It is obvious that the IAEA has major conflicts of interest, when reporting on negative medical health consequences of commercial reactor accidents. Contrary to other UN agencies, the IAEA reports directly to the UN Security Council, which is dominated by the five nuclear powers.

On health issues, an IAEA / WHO Agreement (WHA12.40) signed in 1959 forces the World Health Organisation WHO to submit any research on nuclear related health issues to the IAEA and requires confidentiality on different subjects. According to Dr. Nakajima, former Director General of the WHO, in this regard the proceedings of a 3-day WHO Chernobyl Conference in Geneva, in November 1995 were "censured" as a consequence of these legal obligations of the WHO vis-à-vis the IAEA (1). Obviously, the mentioned agreement limits the freedom of the WHO in the field of medicine and could explain why the WHO started its scientific work on radiological damages after the Chernobyl accident in contaminated regions only after 1991. In projects established by the IAEA apparently genetic research had no priority, although it is well known, that the genome is the most important target for ionizing radiation, whereas dental caries was prioritized (!). The restriction on information on medical consequences of ionizing radiation stays in contrast to the WHO Constitution, which according to the Basic Documents WHO, Ed. 44, Geneva, 2003 has the obligation "to act as the directing and coordinating authority on international health work"; and "to assist in developing an informed public opinion among all people on matter of health" .

The UN Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), whose duty is to inform the UN Assembly on the consequences of the Chernobyl accident, agrees with the IAEA. Likewise at the International Chernobyl Conference in Kiev, 2001 the UNSCEAR representative, N.Gentner, confirmed what the IAEA representative stated: *"The great majority of the population needs not fear serious health consequences as a result of the Chernobyl accident."*

THE POSITION OF PSR / IPPNW

PSR/IPPNW (Physicians for Social Responsibility / International Physicians for the Prevention of Nuclear War) Switzerland dismiss the standard arguments claiming that most of the health problems after Chernobyl are due to radiophobia, stress, alcohol, tobacco and disinformation by the media – arguments which were also published in the recent report of the Chernobyl Forum (Vienna, September 2005).

Already in February 2003, under the auspices of the Medical Faculty of Basel, the Swiss affiliate of IPPNW presented studies on the ***Medical Consequences after "Chernobyl" in Children***. The focus was on chronic Cs137 irradiation by oral uptake. Several reports from this meeting were published in peer re-viewed medical journals since (Swiss Medical Weekly, SMW; www.smw.ch). A summary by M.Fernex of the most important results is enclosed in this abstract book (Attachment 1). The radiological damages in children are both complementary and consistent with the results of pathologies in liquidators. Also a second abstract by N. Gres on radiocontamination and severity of diseases in children is added (Attachment 2).

We hope this publication will contribute to a heightened awareness for the true dimensions of "Chernobyl", the biggest industrial catastrophe in world history.

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RADIATION PROTECTION OF THE POPULATION OF THE REPUBLIC OF BELARUS (ESPECIALLY CHILDREN AND LIQUIDATORS) AFTER THE CHERNOBYL ACCIDENT.

Vasily B. NESTERENKO

Belarus does not have any nuclear power plant (NPP), but its territory was contaminated by the fallout of Chernobyl : 23% of the surface contaminated with >1Ci/square km of Cs-137, 10% with Sr-90, and 1% with Pu-239. The iodine-131 dispersal by the fire, which lasted 10 days, progressively covered a major part of the national territory.

On April 29, 1986, our proposal to distribute stable iodine to the population, and to evacuate the population in a radius of over 100 km was rejected by the authorities, as a panic generating measure. The decision to finally evacuate 135'000 was taken later, when the population was already irradiated.

The evacuation of the 30-km zone started in May. And 100'000 children of the Gomel region were sent to clean districts of Russia, up to September 1986.

In the night of April 30, Academician V.A. Legasov consulted experts about the use of liquid nitrogen to stop the fire, and he was informed that nitrogen would provoke no explosion.

For the NPP „Pamir" I designed, we had developed a spectrometer, capable of measuring high radiation doses. These instruments were used to assess the risk for military personnel sent on the roof of the burning reactor, and to protect the thousands of liquidators acting there.

Already during the first days after the explosion, the Radiation Safety Service and over 1'000 persons of the staff of our Institute for Nuclear Power Engineering were involved in establishing the maps of the radiological contamination in the republic. The measures for the region of Gomel were completed by the end of May by the Institute for Nuclear Power Engineering. On this basis, additional evacuation of 24'000 inhabitants of Southern regions took place.

For the Mogilyov and the Brest region, the measures were completed in September 1986, and reported, as well as the contamination maps for Strontium and Plutonium in Belarus.

All data were recorded in four 250-page-volumes, also including information about the contamination of settlements and foodstuffs. Proposals for radioprotective measures were formulated.

The top secrecy shrouding of information on the scale of the Chernobyl accident and the refusal by the Government of USSR to permit protective measures, prohibited to undertake protective measures.

In spring 1989, all the documents concerning the Chernobyl accident were removed from the secret list. My articles „Would the secrets become obvious" and „Chronicle of the Chernobyl Accident" were published in the magazine „Rodnik" (No 5,6,7) in 1990.

1'800'000 hectares of agricultural lands and 1'600'000 hectares of forest with long-term contamination by Cs-137 were withdrawn from exploitation.

The global economical damage was estimated as equivalent to 32 annual budgets (1985) of the Belarus Republic. In case of a major NPP accident, no state will be able to achieve the safety of its population. At present, international aid is provided by the European Chernobyl initiatives, but at the governmental level it remains insignificant. A first experience has started with the CORE project of the EC.

From 1989 to 1993, about 140'000 additional persons were resettled, but 200'000 persons moved to clean regions by themselves.

Radiometers for controlling foodstuffs were urgently produced, and distributed to meat, bread, and dairy factories.

The academician A.D. Sakharov, the writer Ales Adamovich, and the chess player A. Karpov suggested that I should

establish a non-governmental Institute that would deal with problems of radiation safety of the population. That suggestion was accepted by V. Kebich, head of the Government of Belarus.

The new Institute „Belrad" financed by these private donors, created in 1989, proposed to the Supreme Soviet, to the Government of Belarus and to the chairman of the regional executive committees, the establishment of a network of Local Centers for Radiation Control for the population (LCRCs), located in schools or official buildings in villages, allowing the families to check the quality of their food and to receive full information about safe consuming.

The institute developed a highly sensitive dosimeter „Sosna". Over 300'000 were produced by regional industries. Thereafter, „Belrad" developed and produced more than 1000 radiometers RUG-92, for the ministry of Agriculture, to measure the content of Cs-137 in foodstuffs.

Komchernobyl appointed „Belrad" for the creation and the management of 370 LCRC. The staff had to be trained. In addition to the state system, NGOs established LCRCs for monitoring the foodstuffs produced in the private sector, which represents more than 50% of the food production. Informing the rural populations includes teaching the use of fertilizers (Calcium and Potassium salts) to reduce the uptake of radionuclides by the plants. The foodstuffs contamination remained 10 times higher in the private sector, than in the state sector, the amount of fertilizers used by families remaining low for financial reasons.

At present, „Belrad" has a data bank of more than 340'000 measurements of foodstuffs. 19 years after Chernobyl, in the private sector, the Cs-137 contamination remains ten times higher than in the state production, often above the permissive level in Belarus. A very efficient measure for the reduction of the radiocontamination of milk, is an addition of adsorbents in the forage. This reduces the levels of Cs-137 by 3 to 4 times in the milk.

Unfortunately, the information and education program was not effective enough. Even the distribution, free of charge, of non-contaminated food in the school canteen, since kindergarten, was not sufficient to reduce correctly the Cs-137 load in the organism. 80-90% of the radiation dose is internal, due to the oral intake of contaminated food (especially home produced milk, wild fruits and mushrooms).

The contamination through inhalation was important in early days, when high iodine concentration was present in the air. The highest doses were absorbed by liquidators and the inhabitants of the most contaminated communities. These persons became more radiosensitive.

Small chronic doses, due to repeated incorporation of radionuclides from contaminated food, lead to a great variety of pathologies, as the endocrine and the immune and cardiovascular systems are affected. These organs are concentrating far the highest concentrations of cesium (1).

„Belrad" managed to set-up 8 mobile laboratories with human radiation spectrometers, offered by Chernobyl initiatives. The 137-Cs load was measured in 250'000 children in the Chernobyl districts of Belarus. To prevent the consequences of chronically accumulated Cs-137, „Belrad" used a pectin food additive, with vitamins, „YablopectR" produced in Ukraine, for the mobilization of Cs-137 from the organism (2).

Later, „Belrad" developed its own preparation (VitapectR), which was studied initially by N. Gres et al (3). In a placebo-controlled double-trial, one group receiving 10 gram of VitapectR daily, the other placebo for 21 days, in a sanatorium with clean food, the reduction of the Cs-137 load was 65.6% in the group receiving pectin, versus 13.9% in the placebo group, this difference being highly significant ($p<0.01$), and medically relevant(4).

Repeated pectin courses could be given to highly contaminated communities of school children, with the financial support of NGOs: Children of Chernobyl Belarus (with the support of PSR/IPPNW Switzerland, and Enfants de Tchernobyl, Alsace), the French Foundation Danielle Mitterand, the Fund „Children of Chernobyl Belgium". Thousands of children showed a 3 to 5 times reduction of their annual radiation exposure with repeated VitapectR courses.

For four years, the French Association CRIIRAD together with „Belrad", supported the operation of the LCRC at the Valavsk school. The radiometric controls were followed by „VitapectR" courses for the contaminated children. A reduction factor of 2 to 3 for the Cs-137 levels was achieved, and the children health which was followed up, improved according to the cardiological examination, as in earlier studies in sanatorium (5).

From 2003 to 2004, the international project „highly exposed children of Belarus“, a collaboration between „Belrad“ and the nuclear Research Centre „Juelich“, Germany, with the financial support of the Federal Agency for Environment Protection and Radiation Safety of Germany, compared „VitapectR” and placebo among contaminated children. Besides three sanatoria, the partnership included also the Central Research laboratory of the Belarusian Medical Academy for Postgraduate Education (BELMAPO) of the Ministry of Public Health Services of Belarus. The final report indicates that the intake of pectin preparations maintained a positive balance of potassium, Copper, Zinc, and Iron in treated children. No reduction of these microelements was noticed in the blood of the children (6).

In March 22, 2005, the Federal Commission for Radiation Protection of the Population, Germany, evaluated the medical part of the project, mentioning that repeated pectin cures can form the basis for preventive measures for the radioprotection of the population, as they reduce the annual radiation exposure.

More recently, the Russian Federation approved a new pectin preparation for the treatment or prevention in case of nuclear accidents with release of different radionuclides (7).

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Personal data and background

Professor Vassily Nesterenko was the Director of the Institute for Nuclear Physics of Minsk, member of the Academy of Science of Belarus, when the Chernobyl atomic reactor exploded. Being in charge of the radioprotection of the Republic, he mobilized the national specialists and one thousand experts from his institute to establish the maps of the radioactive fallout. With the academician Legasov, a fireman and a helicopter pilot, he flew over the burning reactor, to find a way to bring tons of liquid nitrogen to extinct the fire of the core, liberating tons of radionuclides in the air. (except Nesterenko, two died shortly after this exposition to the radioactive smoke and Legasov took his own life later, unable to bear with the cover-up, leaving a public “Testament”.). The decision was taken, that miners would bore a tunnel through the ruin to introduce the nitrogen and concrete containers. Their goal was achieved after ten days, thus avoiding the feared atomic explosion.

The written demand of Nesterenko to the Supreme Soviet in Moscow to immediately distribute iodine to the population, and to evacuate a perimeter of 100 km from the fire, was rejected by the Sovietic authorities, claiming that this would cause panic. With his team, Nesterenko established the maps of radiocontamination of iodine (I), cesium (Cs), strontium (Sr) plutonium (Pu). Later, Nesterenko had to give up his function of Director, because he was exclusively active in protecting the populations and “neglecting more important taks”. He could still work in the Institute with a group of physicists, but having insufficient support, he created an independent Institute for Radioprotection “Belrad”, realized with the financial an moral support of Sakharov, the chessmaster Karpov and the writer Adamowich and foundations.

”Belrad”, established a strategy to protect populations, after the massive radioactive Chernobyl fallout, polluting 23% of Belarus with >1Ci of Cs-137/km2. Still, 2 million person, including 500’000 children, live there. Long lived radionuclides remain in the upper part of soils; they are recycled in plants and animals, especially wood and agricultural products, becoming the main source of the radioactive contamination of humans.

Economic crisis and poverty makes the production of clean food for villages impossible, as it requires specific fertilization of pasture and fields. Milk-producing cows should receive adsorbent (Prussian blue) to avoid Cs137-contaminated meat and milk, a major source of Cs137 uptake in children.

With international support, “Belrad” established networks of centers for radioactivity control in food samples, established in schools, dispensaries. There the population is taught how to use local products in contaminated regions. Children contamination is precisely measured with human spectrometers, and courses of food additive containing apple-pectin reduce the Cs-137 burden, and reduce symptoms due to the chronic irradiation of organs, such as endocrine glands, heart and thymus.

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"THE SACRIFICE"

Film by Emanuela ANDREOLI and Wladimir TCHERTKOFF

This documentary film is a testimony of a group of Chernobyl liquidators. It describes the activities of military personnel intervening after the explosion of the atomic reactor. It focuses on the degeneration and suffering of these young men, followed–up by an Swiss TV journalist, over several years. It is an illustration of poorly known diseases of young adults, characterized by premature aging. The liquidators became invalid 5 to 10 years after their exposition to radioactive dust and external irradiation, when obliged to clean the radioactive environment up to 30km from the destroyed reactor, the evacuated safety radius. The aim of their activity was to reduce the radioactive pollution of land and evacuated villages, where houses were scraped off years later. This activity allowed the neighboring reactors to continue to produce electricity, for a few more years.

The film received the first price at the "Festival du Film de l'Environnement" by the Conseil Régional of Ile de France. It was award winning in the Festival of the Scientific Film, in Oullins, France, in 2004, and in Lausanne, Switzerland, in 2005. The film is a description of facts, and a dialog with a group of young liquidators, describing their activities around the exploded NPP. It shows the way the radioactive dose was falsified in the liquidator's certificates by officers, the incompetence of medicine for pathologies for which physicians had no knowledge. Physicians could not understand what happened, or cope with these health problems. The film shows also the willingness of these victims to persist in working, in spite of progressing invalidity, to maintain an income for their families.

The statements pronounced by these young men during the film are important. Three examples may help to understand the role and the fate of the Chernobyl clean-up workers:

Borovsky explains :
"We decontaminated villages. We scrubbed the earth with spades, we had to shovel up the earth with our hands to bring it onto lorries. Of course there was a lot of dust all around and we inspired this dust. As an officer, I knew that soldiers considered this as an important task: "Yes, we are saving lives…"

Groudino says in 1990:
"Now I am already a second category invalid. I am suffering from so many diseases, that I cannot quote them. But with 35 years of age, I became like an old man of 70 years."

Anatoli Saragoviets, said, a few months before he died:
"In November I lost the sensation in my left hand, later of the left arm, finally of half of my body. Later I suffered from palsy of the left arm, and now of both two legs. They did not know what to do, but they did not consider the radiation as a cause of my suffering. I still went working as trolleybus conductor, and I said nothing about my problems, because I needed an income for my family. I was driving the bus with one hand and one foot, until the day where I fell unconscious, and where they brought my home. Now I cannot walk, my legs are no more supporting my body, at home I have to lean against the wall.
I was constantly falling, so my wife told me to remain in a rolling chair, where I am now. Nightmare! "The man is rotten, that's all". I have to resign. I am rather young, age 38, but one could say 60 years.
His other colleagues had already died, so he concludes: *"From the five friends we were, I remained the only one alive, like a white crow, an original."*

His widow explains:
He remained six months bedridden, he progressively decomposed, still living…
All specialists consulted said: "We don't know this disease."

"The Sacrifice" (english, french or russian) and "Nuclear Controversies" (english, german, french or russian) can be purchased for Euro 20 by the address below.

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ROLE AND FATE OF CHERNOBYL „LIQUIDATORS“

Georgij LEPIN

Chernobyl represents not only a nuclear holocaust for million of people. It is not only a catastrophe for many countries of the world. Chernobyl is such a many sided phenomenon, that nobody can fully understand and evaluate it up to this day.

The fact that it happened during the last years of the Soviet Union, gave to this accident specific characteristics. The main problems were not of technical nature. They concerned acts of negligence towards life, medical and social needs of the liquidators and victims. Political interests prevailed over humanity.

All features of the socialist system became apparent : disorderly actions, confusion in overcoming the consequences of the accident. Would there be any other civilized country who would accept so big number of victims among its citizens?

Chernobyl is a many headed monster, where every head defended only what was in its advantage. If you cut one head, you can still be devoured by the other heads.

There is so much in the word „chernobylschschina“ (Chernobylism) :

1. it is a tissue of lies
2. it is the aspiration to defend its own life, without caring for the victims (of course when one is not a victim himself)
3. for people who still believed in state appeals and promises, it is selflessness and honesty
4. it is cruelty to the people who were in Chernobyl against their wish, and to the people who were in Chernobyl with patriotic true enthusiasm
5. it is disregard of the fate of people who worked in Chernobyl, most of them dragging along a miserable existence, of becoming young pensioners, with a miserable pension, or even dead, leaving their children and their families in a desolate situation because of a ruthless state
6. it is the combination of generalized mismanagement, absence of control, permissiveness and irresponsibility
7. it is the irresponsibility of the state, facing serious accidents, with an absence of technical competence and assets, for the removal of the consequences of the accident and for the protection of its citizens.
8. for us , it is a commonly adopted principle : „We are not afraid of difficulties“.

The need to tell the world that Chernobyl was not a serious problem appeared immediately after the nuclear holocaust.

For the Soviet Union, it was very important to withdraw rapidly all visual consequences of the catastrophy, in order to demonstrate that there was nothing serious. The Instructions given to liquidators did not aim at minimizing the consequences on their own health. It was dirty politics, and its results rest on the conscience of the Soviet Union and of M.S. Gorbatchev, who did not want, or was not able, to prioritize the defense of citizens and a safe attitude towards humans, over political and monetary problems.

All decisions on these questions were taken not by specialists, or people able to work out timely and good decisions, nor by people who had the moral right to speak for their people, and who tried to defend people's interests. The decisions on these problems were taken by political leaders.

For those political leaders, „orders from the top“, were more important than concrete proposals from intellectuals and technicians. No wonder that most of the decisions on the „liquidation of the consequences“, appeared to be mistaken, shortly after their „successful realization“. No wonder that the costs to be paid for decisions „from the top“, remain enormous, in a human and in an economic sense.

What were the reasons to try to liquidate the consequences so quickly after the catastrophe, and to send young people there ? There existed no procedure for their work. There was no conviction, that some sorts of work would produce positive results, and would not make the situation even worse. This work reminds of the behavior a of a bad housewife, who wants to hide quickly the rubbish somewhere. It reminds of the uncoordinated behavior of a man, who does not understand his misfortune and tries to hide it from others.

Political adventures started one after the other. „Work procedures“ were designed to start the building of the sarcophage and the decontamination of blocks 3 and 4. Very difficult and dangerous works were performed in a hurry.

From September 20 to October 1st 1986, more than 3000 „soldiers-partisans“ worked on the roof, with a radiation dose of about 1000 Roentgen/hour. There was no time left to think about technology and mechanization.

In the first days after the catastrophe, there was only one mechanical tool available : „clones“, which were soldiers in service for a fixed period, and individuals taken from the reserve of „partisans“. As there was no time to prepare technologies for coping with Chernobyl, „clones“ were the best solution available : they can be „consumed“, because new „clones“ will be sent in. There were no human limitations whatsoever.

In all my time of 6 years of work in Chernobyl, the question about taking care of people's life was not addressed seriously, and very little was undertaken to replace people with technical devices.

So the whole work, aimed to „liquidate the accident consequences“, has to undergo an objective analysis, and we have to draw conclusions on this work.

As a long time worker in the heart of Chernobyl, and as an organizator of the „Union of Chernobyl“, to defend the victims, these are my conclusions on the co-existence of people and atomic energy on our planet.

The words of Academician P.L.Kapitsa are true : „Atomic power plants are atomic bombs producing electricity“. This peaceful bomb was worse than many military bombs : more than 5 million people suddenly found themselves in a very dangerous environment, in Belarus, the Ukraine and Russia.

This inhumane attitude towards the victims of Chernobyl continues up to this day, where people still fall ill and die. They went cheerfully to Chernobyl, but encountered severe problems and sufferings after their work.

No government defends these people, governments defend the state from the claims of these people.

The truth about Chernobyl and about other nuclear accidents could open the eyes of many people. The truth about the mass victims of nuclear accidents could help many potential victims to understand : the next victims could well be themselves, their children and grandchildren.

Remark:
Book Annoucement: Prof. Georgij Lepin,“The Bitter Truth about Atomic Energetis” available in russian. English version follows in april 2006.
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MENTAL HEALTH OF THE CHERNOBYL ACCIDENT CLEAN-UP WORKERS (LIQUIDATORS): CRITICAL REVIEW OF THE CURRENT EPIDEMIOLOGICAL EVIDENCES

Konstantin N. LOGANOVSKY

Background

International consensus exists that the mental health impact of Chernobyl is the largest public health problem. The UN Chernobyl Forum Expert Group «Health» (EGH) has outlined related four areas of concern: stress-related symptoms; effects on the developing brain; organic brain disorders in highly exposed clean-up workers, and suicide. Although the UNSCEAR-2000 (Annex J) experts acknowledged psycho-social consequences of the Chernobyl accident only, «…today, it is recognised that the CNS is a radiosensitive organ whose degree of dysfunction can be quantified by electrophysiological, biochemical and/or behavioural parameters. Abnormalities in CNS function defined by these parameters may occur at a low dose of whole body radiation…» (Gourmelon et al, 2005 — Institut de Radioprotection et de Surete Nucleaire, Fontenay-aux-Roses).

Epidemiological studies of the atomic bomb survivors have suggested dose-related increases in mortality from diseases other than cancer. Cardiovascular disease is one such non-cancer disease for which increases in both mortality and incidence have been found to be associated with radiation dose (Kusunoki et al., 1999). The recognition in the atomic-bomb survivors of non-cancer effects at doses on the order of 0.5 Sv (half the dose level considered a threshold in earlier studies) should stimulate interest in deterministic effects (Shimuzu et al., 1999; Fry, 2001; Preston et al., 2003; Yamada et al., 2004) and non-cancer morbidity and mortality following the Chernobyl accident. It was indicated that the atomic bomb exposure has affected survivors' mental health and that the care of their mental health is important (Honda et al., 2002). The prevalence of anxiety symptoms and somatization symptoms was elevated in atomic bomb survivors even 17-20 years after the bombings had occurred, indicating the long-term nature of the psychiatric effects of the experience (Yamada and Izumi, 2002). However, these studies were related to neurotic symptoms only — anxiety and somatization. At the same time, the linkage of The Life Span Study (LSS) and the schizophrenia register in the Department of Neuropsychiatry, University School of Medicine, Nagasaki allowed to reveal that the prevalence rate of schizophrenia in A-bomb survivors is very high : 6% (Nakane and Ohta, 1986).

Undoubtedly, the clean up workers of the Chernobyl accident are under the highest risk of neuropsychiatric disorders due to their greatest exposure to both radiation and non-radiation factors of the disaster aftermath. However, till now there is a gap in knowledge concerning evidence-based estimation of their mental health. There are many contradictions concerning neuropsychiatric effects at exposure to low doses (<1 Sv). Whether such exposure is the risk factor for neuropsychiatric disorders, particularly, schizophrenia spectrum disorders and Chronic Fatigue Syndrome (CFS)? There are no clear data on cerebral radiation effects, cerebral radiation markers and dose–effect relationships. The goal of this presentation is to analyse the currently available data and their limitations concerning mental health and CNS damage in the clean-up workers. Furthermore we consider the research and measures for improving mental health care both of Chernobyl accident survivors and of victims of possible radiation accidents in the future.

Recent and on-going studies

In the Chernobyl accident clean-up workers (liquidators) radiation risks on non-cancer effects has been revealed (Biriukov et al., 2001; Buzunov et al, 2001, 2003). For some classes of non-cancer diseases among liquidators, statistically significant estimates of radiation risk ERR (95% confidence interval) were derived for the first time for mental disorders : ERR 1/Gy=0.4 (0.17; 0.64); neurologic and sensory disorders : ERR 1/Gy=0.35 (0.19; 0.52); endocrine disorders : ERR 1/Gy=0.58 (0.3; 0.87). Among mental disorders, the highest radiation risk per Gy was found for neurotic disorders : ERR=0.82 (0.32; 1.32) (Biriukov et al., 2001). The highest excess relative risk per 1 Gy was found for cerebrovascular diseases : ERR 1/Gy=1.17 at the 95% confidence interval (0.45; 1.88) (Ivanov et al., 2000). Recently, the significant cerebrovascular diseases's risk from averaged dose rate was defined for external doses higher than 150 mGy (ERR for 100 mGy/day = 2.17, with 95% CI = (0.64; 3.69) (Ivanov et al., 2005).

According to the data of State Register of Ukraine and Clinical and Epidemiological Registry of Research Centre for Radiation Medicine, Academy of Medical Sciences of Ukraine there is an increased level of cerebrovascular disorders in liquidators. Exposure to small doses of ionizing radiation is a significant risk factor of accelerating ageing. Thyroid exposure by 300 mGy and more is a significant risk factor for vascular and cerebrovascular disorders. Thyroid exposure by 2 Gy and more is a significant risk factor for mental disorders, vascular and cerebrovascular diseases, and peripheral

nervous system. Exposure to doses of 250 mGy and more is a significant risk factor for neuropsychiatric disorders and vascular disorders. There is a dose–effect relationship for cerebrovascular disorders in liquidators. Relative risk of cerebrovascular diseases increased in the groups exposed to 0.5–0.99 Gy and 1 Gy in comparison with the group of <0.1 Gy. Non-radiation risk factors include: industrial hazards, stress, smoking, heredity, life style (Buzunov et al., 2001, 2003).

However, concerning mental health assessment of liquidators these studies have significant limitations: they deal with *registered mental disorders by national health care system*, but not with the data obtained as a result of well-designed psychiatric studies with standardized diagnostic procedure. Taking also into account the current changes of the psychiatric system in the post-soviet countries, this leads to dramatical underestimation of mental disorders and their possible misclassification as physical diseases and/or wrong diagnoses of mental disorder itself (neurotic instead to be actually psychotic or organic, etc.).

For example, according to the official Public Health Ministry of Ukraine data, the prevalence of all mental disorders (registered) in Ukrainian population consisted: in 1990 : 2.27%; in 1995 : 2.27%, and in 2000 : 2.43%. However, according to the results of the World Health Organization (WHO) World Mental Health (WMH) Survey Initiative, where they assessed mental disorders with the WMH version of the WHO Composite International Diagnostic Interview (WMH-CIDI), a fully structured, lay-administered psychiatric diagnostic interview, the prevalence of having any WMH-CIDI/DSM-IV disorder in the prior year in Ukraine was 20.5% (95% CI : 17.7–23.3%) (Demyttenaere et al., 2004). So, the public health psychiatric system underestimates mental disorders by a factor of 10 and more. It should be stressed, that the WMH-CIDI/DSM-IV disorders include so-called psychological disorders (anxiety, depression, somatization, alcohol abuse, etc.) only, and disregard severe mental disorders like psychoses, organic mental disorders, and mental retardation.

At the frame of the Franco-German Chernobyl Initiative sub-project 3.8.1 «Data base on psychological disorders in the Ukrainian liquidators of the Chernobyl accident» the cross-sectional study of representative cohort of liquidators, using standardized structured psychiatric interview : Composite International Diagnostic Interview (CIDI), has been done. The preliminary results (Romanenko et al, 2004) revealed a two-fold increase of the prevalence of any mental disorder (36%) among liquidators in comparison with the general population of Ukraine (20.5%). The prevalence of depression dramatically increased among liquidators (24.5%) in comparison with Ukrainian general population (9.1%) (Demyttenaere et al, 2004). The dataset is open to analysis. However, the limitation of this study is the assessment of psychological disorders only without severe mental disorders.

Suicide was the leading cause of death among Estonian clean-up workers (Rahu et al., 1997). Age-adjusted mortality from suicide rates were higher among the Chernobyl clean-up workers compared to the general population in Lithuania (Kesminiene et al, 1997). These findings have to be replicated in studies of clean-up workers from other countries using standardized methodology for suicides due to possible misclassification of them as another cause of death.

Progressive character of neuropsychiatric disorders and somatic pathology is observed in liquidators of 1986-1987, especially in those who worked for 3-5 years at the Chernobyl exclusion zone. Prevalence of neuropsychiatric disorders among personnel working since 1986-1987 and irradiated in doses above 250 mSv is 80.5% while for the same group, but irradiated in doses below 250 mSv, it is 21.4% ($p<0.001$) (Nyagu et al, 2003).

Since 1990, an increase of the schizophrenia incidence rate in the clean-up personnel, in comparison with the general population was found : 5.4 per 10'000 vs. 1.1 per 10'000, respectively. The relative risks are 2.4 in 1986-1997, and 3.4% from 1990 to 1997; this proves that working or living in the Chernobyl exclusion zone is associated with a 2.4-3.4 time higher incidence than in the general population. Furthermore, it was established that there was a significant increase of the percentage of schizophrenia among all psychoses in the Chernobyl exclusion zone, when comparing staff members with the general population. Moreover, a non-typical clinical form of schizophrenia was revealed in the personnel who was working from 1986 to 1987. Those irradiated by moderate to high doses (more than 0.3 Sv) had significantly more left fronto-temporal limbic alterations and schizophreniform syndromes. The hypothesis is that ionizing radiation may be an environmental trigger that can actualize a predisposition to schizophrenia or indeed cause schizophrenia-like disorders (Loganovsky & Loganovskaja, 2000). An integration of international efforts to discuss and organize collaborative studies in this field is of significance for both clinical medicine and neuroscience (Loganovsky et al, 2005).

Chronic Fatigue Syndrome (CFS) is a one of the most important consequences of radioecological disaster resulting in an interaction of different hazardous environmental factors — low and very low doses, stress etc. 26% clean-up workers

exposed to doses below 0.3 Sv met the CFS diagnostic criteria (Loganovsky, 2000, 2003). CFS frequency decreased (from 65.5% in 1990–1995 to 10.5% in 1996–2001) and Metabolic Syndrome X (MSX) frequency increased (from 15 to 48.2%). CFS and MSX are considered to be the stages of another neuropsychiatric and organic pathology development (Kovalenko and Loganovsky, 2001). CFS can be considered as environmentally induced predisposition and vestige of forthcoming neurodegeneration, cognitive impairment, and neuropsychiatric disorders (Volovik et al, 2005).

Conclusion

According to current knowledge on mental health of liquidators it could be concluded:

- mental disorders are one of the important medical and social problem among liquidators in up to 20 years after the Chernobyl accident;
- mental health care of victims should be the focus of public concern at possible radiation accident in the future;
- potential radiation cerebral effects could occur following exposure to >0.15–0.5 Sv
- mental health impact on the liquidators of Chernobyl accident includes:
  - psychological disorders
  - organic brain damage
  - suicides
  - Chronic Fatigue Syndrome
  - schizophrenia spectrum disorders
  - accelerated aging processes and neurodegeneration
  - premature ageing
- there is a big gap in epidemiological evidences concerning mental health of liquidators, as well as in knowledge about biological mechanisms of low doses effects on the brain
- here is a deficiency of mental health care and psychorehabilitation of liquidators.

Outlook

Further well-designed neuropsychiatric epidemiological studies in Chernobyl accident survivors have a priority.

An integration of international efforts to discuss and organize collaborative studies concerning neuropsychiatric disorders, including organic brain damage, CFS, schizophrenia spectrum disorders, suicides and parasuicides are of great importance for both clinical medicine and neuroscience.

Further radiation clinical and experimental neurophysiological, neurobehavior, neuroimaging, neurochemical and neuroimmunological studies are of the greatest importance for the radiation risks for the brain assessment.

International efforts should be done on improvement of the mental health care and psychorehabilitation of Chernobyl accident survivors.

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RADIATION AND THE LEFT HEMISPHERE: INCREASED INCIDENCE OF SCHIZOPHRENIA AND CHRONIC FATIGUE SYNDROME IN EXPOSED POPULATIONS IN CHERNOBYL, HIROSHIMA AND NAGASAKI.

Pierre FLOR-HENRY

The Ukrainian Embassy in Paris issued a press report (25 April 2005) stating that 3'500'000 people, of whom a third were children, received high doses of radiation after the Chernobyl catastrophe and that by January 1, 2005 2'646'106 Ukrainian citizens were officially victims of the catastrophe. In 2004 94% of the liquidators were ill, 90% of those evacuated from the contaminated regions and 85% of those living in regions affected by radiation. The World Health Organization report of the UN Chernobyl Forum Expert Group (August 31, 2005) concludes that "the largest public health problem unleashed by the accident is the mental health impact" which they attribute to psychological and social stress.

I will review the evidence which indicates that radiation, has a direct impact on the central nervous system, particularly affecting the left hemisphere. Further low level radiation, at the cellular level, is much more destructive of cell membranes than high level radiation by a factor of some 3000. This explains the increased incidence of schizophrenia and chronic fatigue type syndrome observed in exposed populations in Chernobyl, Hiroshima and Nagasaki. Following exposure to radiation abnormal EEG changes have been reported in France, the Ukraine, Russia and Japan. Also an excess of epilepsy, intellectual retardation, and neuropsychiatric disorders have been found by Russian and Ukrainian investigators. Further children irradiated in utero in the 4th – 5th months of gestation have EEG changes in the left hemisphere and reduced verbal IQ when tested at the age of eleven. Interestingly low dose radiation in infancy for the treatment of cutaneous haemangioma and tinea capitis (ringworm) leads to a deficit of verbal, but not spatial cognitive functions in late adolescence together with an increase in psychosis, personality disorders, intellectual retardation and epilepsy fifteen to twenty years later. What is more soldiers exposed to depleted uranium particles in the First Gulf War exhibited a "Gulf War Syndrome" with symptomatology similar to that seen in the chronic fatigue/fibromyalgia syndromes with neuronal changes in the left basal ganglia.

In conclusion the evidence suggests not only that radiation directly disrupts the central nervous system, but that paradoxically low level radiation is the most damaging. The psychological and social psychosomatic stress model which WHO emphasize as the cause of the widespread and increasing morbidity in populations exposed to radiation is in fact predominantly the result of radiation induced neuropsychiatric disturbances. This explains the increased incidence of schizophreniform and chronic fatigue type syndromes through disruption of left hemispheric cortico-limbic systems. The peculiar susceptibility of the left hemisphere to ionizing radiation will be discussed.

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Remark: Since the Symposium, a fundamental paper has been published with Konstantin Loganovsky as the first author and Pierre Flor-Henry as the last. It its on page 16, 4th reference "accepted".

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Personal data and background

Prof. Pierre Flor-Henry is of French decent. He is specialised in the area of neuropsychiatry in Great Britain, clinical director of adult psychiatry and director of the clinical diagnostics and research centre at Alberta Hospital in Edmonton, Canada.

Dr. Flor-Henry's scientific interest lies in neuropsychiatric clinical pictures in people exposed to radioactive radiation. Experts' opinions are rather controversial. Some scientists attribute neuropsychiatric diseases to unspecific stress in the people exposed to radiation in Chernobyl. Others, however, have observed organic cerebral changes among those affected over many years, which can be objectified in an EEG (electroencephalogram). Psychiatrists like Zhavoronkova from Moscow or Loganovsky from Kiev, Ukraine, have observed an increase in clinical syndromes like schizophrenia and chronic fatigue, which prevail among a high percentage of radiated clean-up workers, together with depressive clinical pictures (that can result in suicide). These diseases of the central nervous system (CNS), which principally contribute to invalidity among clean-up workers of Chernobyl, go hand in hand with cerebro-organic changes, which are mainly seen in the left hemisphere of the cerebrum (in right-handed people). The syndromes furthermore manifest themselves in the phenomenon of premature aging: studies show that these neurological clinical pictures appear even earlier and to a more severe extent, the younger the person is at the time of exposure to radioactive radiation.

Similar clinical syndromes, which are accompanied by EEG changes in the left cerebral hemisphere, are also observed among clean-up workers, who have suffered from acute radiation syndrome. Dr. Flor-Henry was surprised that these psychiatric diseases or EEG changes were not found among the Russian veterans of the (lost) Afghanistan war; these soldiers were, after all, also subjected to a great deal of stress and not celebrated like heroes in their homeland, much different to the Chernobyl clean-up workers.

New technologies like magnetic resonance tomography (MRT), EEG and positron emissions tomography (PET) facilitate the proof that cerebral changes among Chernobyl clean-up workers and veterans of the first Gulf War or the war in Bosnia are extremely similar to each other.

Just recently, previously unidentified symptoms among veterans of the Gulf War in the USA have been juristically recognised as a pathological entity. Modern wars are characterised by their massive use of projectiles containing 99 % of Uranium238 (so-called depleted uranium, DU). Large amounts of uranium238oxide are released into the air on detonation, which, as a dust, is capable of infiltrating the human organism via inhalation and damaging lung alveoli. This results in chronic radioactive radiation, which may be weak, but signifies continual exposure to the tissue cells. Dr. Flor-Henry has established that victims, who are exposed to uranium238, develop similar neuropsychiatric syndromes to survivors of the atomic bomb drops on Japan 1945.

Dr. Flor-Henry discusses the connections, which exist between neurological diseases and the anatomical localisation of cerebro-organic changes. He particularly deals with the topic of left hemispheric degeneration, whereby external exposure to radiation or incorporated radionuclides (like, for example micro or nano particles deriving from uranium and plutonium) principally infiltrates the organism via the air passages. The affinity between diseases in Chernobyl clean-up workers and those of the victims exposed to uranium238 has to be associated with chronic, radioactive radiation in the low-dose range.

A court in Great Britain recognised the existence of Gulf War Syndrome in 2005, which greatly varies to other diseases due to its clinical picture. France has, on the other hand, admitted that it cannot be the duty of the victims (war veterans, who were subjected to atomic bomb tests) to prove that their diseases have been caused by radioactive radiation, it is moreover "the task of the state to accept the invalids after nuclear tests".

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RISK ASSESSMENT OF EYE DISEASES DEVELOPING IN POPULATIONS EXPOSED TO IONIZING RADIATION

Pavlo FEDIRKO

Key words: ionizing radiation* Chernobyl disaster* cataract* macular degeneration* angiopathy

We conducted several investigations on the influence of ionizing radiation on the visual organ. The data we are presenting in this report, are the result of our investigations, based on the CES (clinical - epidemiological register) project. An ophtalmological examination was carried out among 14'731 liquidators (clean-up workers).

Since 1991, a repeated ophtalmological follow-up examination has been conducted in a cohort of 5'195 clean-up workers. 1'122 of them had received a radiation dose of 0.05 to 0.25 Gy. A subcohort of clean-up workers with a radiation dose below 0.05 Gy was considered as the internal control group. An additional group of non irradiated persons was selected as an external control group (288 persons).

In the statistical analysis, parameters as risk, confidence limits, and descriptive statistics parameters such as mean, dispersion, standard deviation, standard error, were assessed. Morbidity and prevalence, absolute and relative risks for eye diseases, for various radiation doses and age groups were analyzed. Models of absolute and relative risks were developed for the most frequent findings. Clinical peculiarities of eye diseases and visual function, in subjects with different radiation doses, were studied.

It has been shown that the degree of eye morbidity, and of eye disease prevalence, in the investigated clean-up worker groups, exceed the control level. The prevalence of eye diseases in the groups of clean-up workers was 950 ±45 per 1000 in 1992, and 4'259 ±296 persons in 2004 (1'413 ±45 per 1000 in the control group). The ophtalmopathologic examinations show an increase in lens and retina diseases, as well as in vascular eye pathologies, with statistically significant radiation dose-dependent changes, including involutional cataract, macular degeneration, angiopathy and angiosclerosis of the retina, chronic conjunctivitis and vitreous body destruction.

Microcirculatory disturbances have been noticed in the majority of investigated subjects. We noticed a high prevalence of retinal angiopathy, with an increase from 315 ± 14 per 1000 in 1993, and 911 ± 19 per 1000 in 2004. Furthermore, we observed an early development of sclerosis in the retinal vessels.

The central chorioretinal degeneration, with clinical symptoms of a predominantly age-related macular degeneration, was found to be the most frequent form of the retinal pathology in the observed period : 136 ± 10 per 1000 subjects in 1993, and 585 ± 23 per 1000 subjects in 2004.

The radiation cataract has been additionally studied by means of the "case-control" method. The radiation cataract has been diagnosed in 114 clean-up workers, with radiation doses ranging from 0.02 to 2 Gy. The adequate model of the radiation cataract is non-threshold, and includes such factors as absorbed radiation dose and time after exposure. The involutional cataract is the most frequent form of this pathology. Its prevalence (per 1000 persons), during the observation period, increased from 294 ± 32 in 1993, to 766 ± 35 in 2004.

The result of the mathematical modelling of the risks for the most widespread pathological findings, permits to demonstrate that the risks of involutional cataract, macular degeneration and retinal angiopathy depend on age, external radiation dose, and time after exposure.

The risks of the development of radiation effects has been shown to be higher in young people than in middle-aged people.

We found that the effect of ionizing radiation was the cause of the deterioration of the visual function, even before the appearance of pathologic clinical symptoms. Radiation influenced negatively the electrobiological activity of the retina and of the optic nerve. A dose-dependent deterioration of the capability for accommodation of the eyes, has been demonstrated in irradiated persons.

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VESTIBULAR SYNDROMES IN LIQUIDATORS

Andreas ARNOLD, Rudolf HÄUSLER

Vertigo is known to occur in Liquidators. Different studies tried to find the cause, but data still is limited. One question is, whether the vestibular symptoms arise from the peripheral or central vestibular system.

Vertigo is a subjective feeling with loss of orientation and it is difficult to describe for the patient. A large test battery often is necessary to find the diagnosis.

This presentation gives an introduction to the vestibular system from an anatomical, physiological and pathophysiological point of view. The difference in function and symptomatology between the peripheral and the central vestibular system is of great importance to find the organ of malfunction in a patient with vertigo.

Changes of the vestibular system in case of irradiation and related symptoms are presented and compared with results of studies on liquidators found in pubmed online medline search. All the different diagnosis in liquidators with vestibular symptoms are assumed to be central in origin, most probably due to cerebral microvascular dysfunction secondary to irradiation.
Also similar conditions of possible irradiation with vestibular disorders are presented and discussed.

The presented studies allow the conclusion that vestibular symptoms, that occur in Liquidators, seem to be due to central nervous system lesions, which might well be caused by irradiation.

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INCIDENCE OF MALIGNANT TUMORS AMONG CLEAN-UP WORKERS OF THE CHERNOBYL ACCIDENT IN THE REPUBLIC OF BELARUS

A.E. OKEANOV, E.A. SOSNOVSKAYA

Background: It is well known that somatic carcinogenic effects after A-bombing in Japan (except for leukemia and thyroid cancer) appeared 12-20 years after a single and short-lived but high external dose of radioactive exposure [1]. In case of the Chernobyl accident we are confronted with a principally different situation where a permanent dose accumulation takes place over a long period of time and where combined external and internal irradiation takes place. Under these conditions carcinogenic effects due to chronic radioactive irradiation might be higher than expected from radiobiological models. The most affected groups of the whole population are those who participated in clean-up works at the Chernobyl Nuclear Power Plant.

Methods: For the actual study baseline computerized data of 94'798 clean-up workers from the period of 1993–2003 were linked to the database of the Belarusian Cancer Registry.

Standardization of the incidence parameters in the groups of clean-up workers was done using truncated age standardized rate (TASR) for subjects aged 20-85 years and older, and also through the direct method (World standard).

The population of the Vitebsk region (which was less subjected to the radiocontamination following the Chernobyl accident) was taken as a control-group. For the analysis of the cancer incidence in the control group cases from relocated populations, evacuated populations and clean up workers were excluded from the study.

Results: It was demonstrated in our country [2] for the period 1993-1996 (when the latent period between the Chernobyl explosion and the occurrence of cancers did not exceed 10 years) that no cancer of any localization (except thyroid) did show a statistically significant excess of relative risk.

However, since 1997 a significant increase of relative risk for malignant tumors of some localisations (colon, urinary tract) has been observed when compared with the incidence in the Vitebsk region.

For the whole period of 1993-2003 the increase of the incidence (regression indices) of malignant tumors in clean-up workers was significantly higher than in the population of the control group. During the period of 1997-2003 the relative risk exceeded 1 for malignant tumors of all localisations in the group of clean-up workers in comparison to the population of Vitebsk region. The relative risk [95% confidence interval] was 1.23 [1.18 - 1.27] for tumors of all localisations, 1.15 [1.02 -1.29] for gastric, 1.33 [1.11-1.59] for colon, 1.26 [1.14-1.39] for lung, 1.24 [1.05 - 1.47] for kidney, 1.65 [1.37 – 1.98] for urinary bladder and 2.62 [2.23 - 3.07] for thyroid cancer.

Remarkably, data showed a stable trend towards increase of relative risk for tumors of the stomach and the lung, whereas the incidence rate of these tumors tended to decrease in the control population of Vitebsk region during the study period. It is important to note that the analysis of the age distribution of tumor incidence have shown the most marked increase in the cancer incidence among the relatively young group of clean-up workers (< 50 years of age).

Conclusion: These data are extremely important as they give a statistically significant evidence of an increase of the incidence of cancer among clean-up workers already after a 10-15 year latent period following the exposition to the radioactivity from the Chernobyl explosion.

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A FUTURE SWISS NATIONAL CANCER REGISTRY?

Silvia ESS

At present 9 epidemiologic cancer registries exist in Switzerland covering 12 of the 26 cantons and semi-cantons and about 52% of the population. While in the French and Italian speaking cantons the coverage is almost complete there are large regions in the German speaking part of the country without a cancer registry (e.g. none of the cantons with a nuclear power plant (Aargau and Bern) have a cancer registry).

The 9 cancer registries are grouped in the Swiss Association of Cancer Registry. The basic activity of the association is to provide federal and cantonal authorities as well as researchers with high quality statistics on cancer incidence and mortality including trends, to assist the development of cancer control programs. Incidence statistics for the whole country are based however only on estimates. In the last years the association has moved on to more clinical issues and has initiated a patterns of care and survival study on breast cancer and is planning another one on colorectal cancer.

Most of the registries were born due to the private initiatives of local pathology institutes. They are mostly financed with cantonal contributions. The federal government finances the coordinating center in Geneva, who produces the national statistics. A small amount of federal money is distributed among the registries.

Since 2002, when Oncosuisse (a joint venture of the Swiss Institute for Applied Cancer Research, the Swiss Institute for Basic Cancer Research and the Swiss Cancer League) was mandated to develop a Swiss cancer control program, there has been an increased awareness of the paucity of data in our country. This awareness has resulted in an increased interest of some cantons to have their own registries.

There are two basic models for the realization of a Swiss national registry: a network of cantonal (or regional) registries and a central national central registry. The international experience shows that regional registries can better accomplish their mission than a central registry. This also applies for Switzerland. Even without obligation to notify, the cantonal registries have a high degree of completeness because of their nearness to the sources of information and their anchorage in the region. The most important barrier to the creation of a Swiss national cancer registry remains the lack of political determination and as a consequence the lack of financial resources.

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CARDIOVASCULAR DISEASES AMONG LIQUIDATORS AND POPULATIONS OF BELARUS

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Among the participants of liquidation of consequences of Chernobyl disaster (Liquidators, L) – cardiovascular diseases (CVD) as the cause of disablement take the first place (41-43%). Furthermore they take the second place (20.3%) among the diseases for which influence of Chernobyl disaster as one of the reasons had been confirmed. CVD are polyetiological; it is difficult to characterize one of the reasons as leading cause or to exclude some additional effects other than low doses of ionization radiation.

The laboratory of the radiation cardiology Unit is a part of National Scientific Practical Center "Cardiology" which set up in 1993. The financial support stopped in 2002 and the Unit was abolished two years later. The aim of the Unit was to study the CVD in residents of Chernobyl zone and in the population of about 6000 L, living in Minsk, (6 217 in 2002, the annual examination ranged from 5 847 to 5 945 L). The groups were compared with population of Belarus as a whole. The evolution of death rate from CVD between 1989 and 2000 in different regions of Belarus and among L is shown in table 1.

Table 1
Evolution of Death Rate from Cardiovascular Diseases (CVD) between 1989 and 2000 in the Population of Different Regions of Belarus and among Liquidators (L)

		Years	Death from CVD/100'000	Annual increase
All Belarus	AA	1989 - 1991 1992 - 1997 1998 - 2000	340 - 341 341 - 403 413 - 414	+ 0.1% + 3.0% + 0.1%
Liquidators	AA	1992 - 1997	55 - 128	+ 22.1%**
	WA		33 - 60	+ 13.7%*

AA - all ages; WA - working age (male <60 y, female <55 y);
** p-value from other groups <0.01; * p-value from other groups <0.05.

Within the Minsk cohort of L the annual increase of the CVD death-rate in 1992-1997 was 22.1%. This is higher than the average for Belarus (annual increase 3%). Among working L during the period 1992-1997 the CVD death rate increased by 83.0% and is much higher than the increase in Belarus (17.6%). The low number of cases in the L cohort limits the power of this observation, however the differences are high.

To specify the condition of CVS and the rate of risk-factors and some characteristics of CVD the group of L was examined. From the group of L living in Minsk in 1996-1998 620 L were randomly invited to the Unit for examination. The number of L coming to the Unit was 254, the response rate was 41%. In 1999-2001 for second examination all 254 L were invited and 126 of them came, the response rate was 49.6%. The results of L were compared with date of 84 persons who lived in Minsk and did not take part in the works in contaminated zones (control group). Table 2 displays the distribution of L according to CVD.

Table 2: The distribution of cardiovascular diseases (CVD) among 254 liquidators

Cardiovascular diseases	Number of patients
Ischemic heart disease (all forms)	76
Arterial hypertension	72
Functional disorders (neurocirculatory asthenia)	51
Other CVD	21
Liquidators without CVD	34

We acknowledge the following limitation of the study: The incidence of CVD in the group of 254 L is rather high, what might be explained by the fact that the invitation came from the National Cardiocenter and most participants expected a CVS examination in view of probable CVD. Each participant was examined by physicians, the history of angina was assessed from Rose Chest Pain Questionnaire, cuff blood pressure (BP), Spilberger Anxiety Inventory, 12-leads ECG recording, blood lipid spectrum, EchoCG (M-mode,B-mode, PW,CW-doppler), microcirculation by bulbar microscopy, Reeder Stress Inventory.

From total group of 254 L in 96 (all men, age 25-74) the rate of incidence of risk factors, level of stress by Horowitz IES-R Inventory, thyroid gland hormones were investigated. Table 3 displays the CVD and risk factors distribution among 96 L.

Table 3: The Distribution of CVD and Risk Factors among 96 Liquidators

Cardiovascular diseases	Number of patients (%)
Ischemic heart disease (all forms)	20 (20.83)
Arterial hypertension	22 (22.92)
Functional disorders (neurocirculatory asthenia)	27 (28.15)
Liquidators without CVD	27 (28.15)
Risk factors	
Smoking	44 (45.83)
High BP > 140/90mmHG	35 (36.45)
Body weight > 20%Ketle	9 (9.36)
Total blood cholesterol >5.2mmol/l	65 (65.70)
Triglycerides >2.8mmol/l	30 (31.25)

In L group the incidence of high total cholesterol (67.70%; $P<0.01$)) was higher than in non-selected population in Minsk (32.0%) (I.Kozlow, 1996), and the incidence of high body weight was lower (9.39%), than in population (23%). The incidence of other risk-factors is the same as in population.

The results of EchoCG examined in 114 L in 1996 showed the higher level of mean BP (mBP) in pulmonary artery (43.80 mm Hg) in subgroup of L with arterial hypertension (AH), in comparison with control group (27.6 mmHg; $P<0.01$). In examined in 2001 the mBP in subgroup of L with AH had decreased (22.44 mmHg) and was lower than in control group (28.00 mmHg).

The study of microcirculation in L show some kinds of disorders as sludge-phenomena, micro-thromboses, decreased number of functioning capillaries in 92.2% of L with ischemic heart disease (IHD) and AH. In 60.9% L without CVD some kind of microcirculatory disorders were observed (in control group – in 33.0%), and severe disorders as sludge-phenomena, micro-thromboses in venules and capillaries were fond in 26% L and absent in control group.

The results of Spilberger Anxiety Inventory show, that in the examined L in 1996-1997 the level of Situational Anxiety (SA) was higher (49.4) and Personal Anxiety (PA) was lower (42.1) in subgroups of L with CVD, than in control group with CVD (SA : 38.0; PA : 58.5). In the examination after 5 years (2001) in L with CVD the level of SA (46.6) and PA (47.8) are mainly the same as in control group (SA : 47.3; PA : 46.0).

For summary, the results of investigation showed, that in L and in populations living in contaminated regions the rate of annual CVD death-rate increased. In L we observed higher total blood cholesterol level than in population. In addition we observed more often deep disorders of microcirculation even in L without CVD, some changes of mBP in pulmonary artery and normalizing levels of psychological stress after 10 years.

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IONIZING RADIATION AND PREMATURE AGEING

Elena B. BURLAKOVA

In 1987-1998, the scientists of the Emanuel Institute of Biochemical Physics, Russian Academy of Sciences, carried out a series of studies on the effect of low doses of low-level irradiation on biophysical and biochemical parameters of the genetic and membrane apparatus of cells of organs of exposed animals.

We studied structural characteristics of the genome by invoking the method of DNA binding on nitrocellulose filters. Structural parameters of nuclear. microsomal, mitochondrial, and plasmatic (sinaptic and erythrocyte) membranes were studied by the method of spin probes localized in various layers of the membranes. We also studied the composition of membrane lipids, a degree of oxidation of the membranes, the functional activity of cells - the activity of enzymes, the relation between the isozyme forms, and regulatory properties, as well as the effect of irradiation on the sensitivity of cells and biopolymers to a subsequent action of a variety of damaging factors including high-dose exposures.

Animals were exposed to ^{137}Cs y-irradiation at the dose-rates 41.6 x 10^{-3}, 4.16 x 10^{-3} and 0.416 x 10^{-3} mGy/min. Irradiation doses were varied from 6 x 10^{-4} tî 1.2 Gy.

The following conclusions were drawn from the studies performed:

1. The dose–effect dependence is non-monotonic, nonlinear, and polymodal in character.
2. Doses, for which extrema are observed, are related to a dose-rate (intensity) of the irradiation.
3. Exposures to low doses cause changes (mainly increase) in the sensitivity to the action of damaging factors.
4. Exposure results depend on the initial parameters of bioobjects.
5. Within certain dose ranges, low-level irradiation is more efficient than acute one.

We explain the nonlinear and non-monotonic character of the dose–effect dependence that we discovered in our experiments in terms of the concepts about changes in the relation between damages, in one hand, and repairing the damages, on the other, as a result of low-level irradiation. In this case, the reparative systems may not be induced at all or may work less intensively and be switched on later after an exposed object suffered a radiation damage already.

We think it important to consider free-radical reactions that develop in organs and tissues of a living organism after exposure and subsequent changes in the structure and properties of membranes, activity of antioxidant and regulatory enzymes, and concentrations of antioxidants. We showed that animal and human organisms feature similar tendencies in modification of radiation-induced free-radical reactions. These are a decrease in the level of antioxidants (tocopherol, vitamin A, and ceruloplasmine), an increase in the concentration of products of free-radical reactions, an enhancement of the level of free radicals, higher rigidity of membrane, and a break in the correlation between the oxidizability and AO activity and fluidity of the lipid and protein components.

We studied erythrocytes and blood plasma of liquidators of various ages who received irradiation doses from 0.1 to 150 cSv at different times after the accident.

Part of liquidators received antioxidants - vitamins as a therapeutic means during a month and was reexamined. It was shown that 80% of measured parameters of the AO status and immunological indices had been normalized after the antioxidant therapy.

However, some people were insensitive to the therapy. It was important to examine liquidators of various ages as to their reaction to irradiation doses received. For that purpose, the activity of antioxidant enzymes were studied. We determined the age-dependent activity of the key antioxidant enzymes of blood (superoxidismutase, glutationperoxidase, and glutationreductase) of 104 men and women of age from 25 to 60 - participants of liquidation of consequences of the Chernobyl accident 6 years after the accident. The control groups were 35 men and women of the same age range.

The most sensitive chain of the antioxidant system of liquidators to the action of low radiation doses were enzymes of the glutation cycle. Changes in all chains of the antioxidant system of liquidators favor the formation of the prooxidant state in the organism. According to data of the Russian Register and assessment of doses by the percent of chromo-

somal aberrations in lymphocytes, the average dose received by liquidators in 1986 is 15-16 cGy. According to our data, irradiation doses above this average value produce a prolonged damaging effect on the antioxidant system. Also, as was mentioned above, a decrease in the activity of SOD and GP of middle-aged liquidators and a significant decrease in the GP activity of liquidators older than 55 were noted for all irradiation doses studied.

Previously, we showed that a decrease in the SOD/PG activities relation and a low level of the GP activity are characteristic of preneoplastic changes in the cell metabolism. These both indices were noted for liquidators of the older age.

The results obtained in this work on remote after-effects of low doses of low-level irradiation on the protective antioxidant system of people show that the most sensitive part of population are, along with children, young people of age below 30; middle-aged people are the most resistant to irradiation. The latter fact should be taken into account when determining highest-risk groups of people working in spheres associated with chronic low-level irradiation.

As regards irradiation of young people, low-level irradiation with low doses causes a disbalance in the antioxidant system, which is characteristic of an ageing organism. The presentation will contain additional data obtained by Russian radiobiologists on the state of health of liquidators; a comparison will be made between changes in biophysical and biochemical parameters associated with ageing and action of low-level irradiation.

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HEALTH PROBLEMS IN CHILDREN OF LIQUIDATORS

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Clinical, laboratory and instrumental examination of 58 children born in 1987 in people who participated in liquidation of consequences of the Chernobyl accident in 1986 was conducted at the Pediatric Department of the Clinic of Institute for Radiation Medicine (the main group). Mean dose of external exposure in liquidators was estimated to be 12.5 cSv. The age of children at the time of examination was 10-11 years old (boys – 27, girls - 31). The control group was formed of 57 examined children aged 10-11 years old (boys – 34, girls - 23) born in 1987 in the city of Minsk in parents who were not liquidators.

The program of examination included the observation of a pediatrician, psychoneurologist, endocrinologist, dentist, oculist; general blood and urine analysis; electrocardiography; ultrasound examination of the thyroid gland and the abdominal cavity; fibrogastroduodenoscopy.

The parameters of intrinsic and probe fluorescence of erythrocyte membranes were measured with the help of spectrofluorimeter "Jobin Yvon" (France). The membranes of erythrocytes were isolated by a method of Dodge et al.

Lipid peroxidation was assessed by measuring the thiobarbituric acid-reaction products (MDA concentration) in blood plasma. The function of the antioxidant system (AOS) was assessed in the erythrocytes by the activity of enzymes: superoxide dismutase (SOD), catalase, glutathione reductase (GR), glutathione peroxidase (GP)

Statistical processing was performed using sign-test, U-test, t-test, Spirman correlation coefficient.

Assessment of the indices of physical development of children from the main (n=100) and the control (n==108) groups did not reveal any significant differences. Children with low (39% and 37.85%, accordingly) and lower than average (26% and 24.8%, accordingly) values of physical development index prevailed in both the groups. The average value of this index was observed in 15% of children of liquidators and in 23.1% of the control group.

Chronic pathology of the upper alimentary tract was prevalent in the morbidity structure. It made up 95% in the main group and 66.7% in the control. Chronic foci of infection and vegetative dysfunction syndrome were observed in the main group (32.7% and 21.8%, repectively) as often as in the control group (28.9% and 17.6%, repectively). Endocrine disorders were recorded in the form of euthyroid goiter of the 1st and 2nd degree without significant differences in 1/3 of the observed children.

Higher morbidity of psychic disorders was revealed in children of liquidators as compared with the control group (67.1% versus 30.9% in the control, $p<0.001$). This is caused by a considerable number of neurotic (35.4% in the main group versus 14.5% in the control, $p<0.001$) and neurosis-like disturbances (22% in the main group versus 7.3% in the control, $p<0.001$).

Intensification of lipid peroxidation was revealed in 65.8% of children of liquidators (23.2% in the control). Simultaneously, a significant increase ($p<0.05$) in the GR (2.05±0.07 versus 1.67±0.06 mcmol NADPH/ml/min in the control) and GP activity (297.4±11,0 versus 245.4±7.4 mcmol TNPA/min/ g Hb in the control) with practically unchanged SOD activity (40.3±1,1 and 41.2±1.2 % of inhibition) and catalase (115.7±3.47 and 118.7±2.3 mcmol H_2O_2/ml/min) has been observed.

The damage of cell membranes is the first event in the chain of disorders caused by the effect of unfavorable factors on a human organism. Physical state of lipids in erythrocyte membranes of the examined children was studied with the help of the lipophilic probe pyrene. Coefficient of eximerisation (K ex) of pyrene included to isolated membranes of erythrocytes, characterizing the state of lipid bilayer microviscocity in off-springs of the first generation of liquidators has been shown to have no significant differences as compared with the control (1.06±0.08 and 0.99±0.04 relative units, accordingly). At the same time, a statistically significant difference ($p<0.05$) of ultraviolet (intrinsic) luminescence intensity of erythrocyte membranes (I fl.) has been ascertained (56.1±2.1 and 26.4±3.4 relative units, accordingly), which testifies to the modification of membrane proteins.

Mean value of the index characterizing intrinsic luminescence blood plasma (ILP), was significantly higher ($p<0.05$) in children of liquidators and made up 1.22 ± 0.04 relative units versus 0.96 ± 0.03 relative units in the control. The obtained data testify to the modification of structural state of plasma proteins and may indicate the presence of a pathological process in the organism.

Correlation analysis of AOS enzymes activity indices, MDA, luminescent parameters of plasma and membranes of erythrocytes revealed the presence of weak correlation links or their complete absence in children of liquidators (Table 1) as compared with the high correlation dependence in the control (Table 2). This indicates the damage of normal physiological relationships between them which, possibly, is caused by modification of protein components of erythrocyte membranes and blood plasma.

The set of the given data shows that in children of liquidators, the analyzed indices exceed the bounds of a broadened physiological norm, and the adaptive possibilities of the organism decrease with the development of a disregulatory syndrome.

Table 1
Correlation links of studied indices in children of Liquidators

	I fl.	ILP	K ex.	SOD	Catalase	GP	GR	MDA
I fl.		0.03	0.4	0.16	-0.03	-0.09	-0.01	-0.3
ILP	0.03		-0.2	0.16	0.2	0.15	-0.2	-0.12
K ex	0.4	-0.2		0.02	-0.1	0.2	0.07	-0.03
SOD	0.16	0.16	0.02		-0.07	0.02	0.3	-0.23
Catalase	-0.03	0.2	-0.1	-0.07		0.2	0.1	-0.2
GP	-0.09	0.15	0.2	0.02	0.2		0.06	-0.31
GR	-0.01	-0.2	0.07	0.3	0.1	0.06		0.09
MDA	-0.3	-0.12	-0.03	-0.23	-0.2	-0.31	0.09	

Table 2
Correlation links of studied indices in children of the control group

	I fl.	ILP	K ex.	SOD	Catalase	GP	GR	MDA
I fl.		0.12	0.4	**0.9**	-0.1	0.4	**-0.9**	**-0.9**
ILP	0.12		-0.31	0.09	0.14	0.07	0.17	-0.19
K ex	0.4	-0.31		0.21	**-0.94**	**-0.61**	**-0.62**	-0.3
SOD	**0.9**	0.09	0.21		0.12	0.14	-0.25	**-0.91**
Catalase	-0.1	0.14	**-0.94**	0.12		**0.98**	**0.91**	-0.06
GP	0.4	0.07	**-0.61**	0.14	**0.98**		**0.88**	**-0.58**
GR	**-0.9**	0.17	**-0.62**	-0.25	**0.91**	**0.88**		**0.93**
MDA	**-0.9**	-0.19	-0.3	**-0.91**	-0.06	**-0.58**	**0.93**	

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GENOMIC INSTABILITY AFTER CHERNOBYL, PROGNOSIS FOR THE COMING GENERATIONS

Rose I. GONCHAROVA *(Translated from Russian by Lisa Mouravieff)*

Assessment of the remote consequences of the Chernobyl accident was reduced to the estimation of the effects of low doses and low dose rates chronic combined (external and internal) radiation on human and animal health.

The Chernobyl accident caused radioactive contamination of many countries of the Northern Hemisphere [1]. However, the Republic of Belarus was affected by the accident most of all. According to the Atlas of Caesium deposition on Europe after the Chernobyl accident, practically the whole area of Belarus was contaminated with different radionuclides above the level of global fall-out [1]. The ground deposition density equal to 37 kBq/m^2 is accepted as a cut off value for distinguishing the so-called "clean" regions from the contaminated ones making up 23% of the country area. So, all inhabitants of Belarus (10 million people) as well as flora and fauna have been exposed to ionizing radiation due to the Chernobyl catastrophe since 1986. Clear understanding of this fact is of great importance for interpreting the effects recorded.

The problem of biological efficiency of low doses and low dose rates became a central radiobiological problem after the Chernobyl accident due to its importance for the evaluation of risk from exposure to low radiation doses. Before the Chernobyl disaster the dimension of genetic effects of very low doses of ionizing radiation remained unclear. Now convincing data have been obtained by us and other researchers.

Since 1986 we have been studying the biological effects of chronic low dose radiation in natural populations of wild small mammals named bank vole and in laboratory mice, exposed to chronic irradiation at radioactively contaminated sites [2]. We established genetic effects of low dose chronic irradiation in somatic and germ cells of bank vole and laboratory mice in the range of doses from close to background and up to 10 cGy [2–5]. The analysis of our and literature data shows that the doubling dose estimates for acute irradiation of somatic cells in bank vole and human lymphocytes as well as for germ cells in laboratory mice are close to each other [4]. Therefore, the choice of bank voles as a model species for assessing radiation genetic risk is justified. (see table 1).

The recent general report on mortality in the cohort of atomic bomb survivors followed up by the Radiation Research Foundation give strong evidence that there is direct, statistically significant evidence of risk in the dose range of approximately 0-0.10 Sv [6]. Pierce and Preston used Life Span Study (LSS) solid cancer incidence data for the period from 1958 through 1994 in an assessment of low-dose risks [6].

Further, recent cellular and molecular studies have increased our understanding of low dose radiation effects, first of all induced genome instability and bystander effects.

We have analysed the long-term development of mutagenesis in bank vole populations chronically exposed to low doses of ionizing radiation over 22 animal generations within 1986–1996 [2]. The frequencies of different end-points (chromosome aberrations in bone marrow cells and embryonal mortality) as well as the whole-body absorbed dose rate and absorbed doses from external and internal exposure were determined for bank vole populations inhabiting four sites in Belarus with different ground deposition of radionuclides (8-1526 kBq/m2) due to the Chernobyl accident. It has been first revealed that the main feature of the long-term development of mutagenesis is a steady increase in the rate of chromosome aberrations and embryonal lethality over 22 generations while the whole body absorbed dose rates exponentially decreased since 1986 [7]. These findings have shown that the long-term chronic low-dose exposure of mammals over many generations result in a transgenerational accumulation of genomic instability, manifested in cellular and systemic effects [8]. This transgenerational long-term effect of chronic low dose exposure is detrimental because the genomes of animals in distant generations are more sensitive to the impact of very low radiation doses, as compared to the genomes of animals in a few first generations. There is also good evidence about the radiation-induced genomic instability in F_1 and F_2 offspring after irradiation of human males or both parents before conception.

For the time being there is great controversy of the long–term health consequences of the Chernobyl disaster excluding very high excess of thyroid cancer incidence in three affected countries.

As to ionizing radiation-induced late effects, such as cancer incidence, hereditary and development effects, it is necessary

to keep in mind the following circumstances

1) Radiation-related cancer risks at low doses among atomic survivors with doses less than 0.5Sv are well established by Pierce and Preston in 2000 [6]. That is why the latent period of stochastic effects depends on a dose of exposure, the lower radiation doses are the longer latent periods. It is well known that populations of the affected countries received low dose exposures excluding thyroid gland doses.
2) There is an increasing set of data on inverse radiation dose-rate effects on different end-points at somatic and germ cells of animals and human. We have shown inverse radiation dose-rate effects on somatic mutations of bank voles chronically exposed to the Chernobyl fallout [9]. The estimated excess relative risk (ERR) per Sv for the selected dose ranges of Life Span Study cohort was the highest for the lowest dose category, namely from 0 to 20 mSv in the comparison with dose range of 0-2 Sv [10]
3) Recently, the scientists of Radiation Effects Research Foundation gave strong evidence of radiation effects on noncancer mortality. Statistically significant increases are seen for heart diseases, stroke, digestive diseases, and respiratory diseases [10].
4) Evidently, non-targeted effects of ionizing radiation such as genomic instability, bystander effects and other new phenomena have to contribute to short-term and long-term overall outcome after low dose and low dose rates of radiation exposure. I think that increased thyroid cancer incidence of children from irradiated parents would be the first manifestation of the induced genomic instability.

All these data considered jointly allow us to conclude that remote consequences of the Chernobyl disaster have been observed not only in affected people but will also be noted in coming generations.

Table 1 Ground deposition of Radionuclides in trapping sites

Sites	radionuclide Deposition (kBq/m^2)								
	^{137}Cs	^{134}Cs	^{106}Ru	^{144}Ce	^{90}Sr	^{239,240}Pu	^{238}PU	^{241}PU	^{241}Am
1	8	4	5	0	3.81	0.09	0.04	2.98	0.14
2	18	9	12	0	5.12	0.14	0.07	5.10	0.19
3	220	140	150	440	38.56	1.26	0.60	48.76	1.73
4	1526	1020	1090	3050	117.24	2.35	1.17	86.67	3.21

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CALLING OFF CHERNOBYL?

A.YABLOKOV
(Chairman: Session on Premature Ageing)

Statement of the Russian political parties

In September, 2005 the report "The Heritage of Chernobyl: medical, ecological and social and economic consequences" prepared under the initiative and with financial support of the IAEA (International Atomic Energy Agency, Vienna) has been presented to the world community.

The public was surprised to hear that the consequences of the Chernobyl accident should have been exaggerated, that not radiation, but lack of information, unreasonable fears and wrong implementation of a resettlement program accounted for major health problems. The expected mortality from radiation cancer would not significantly differ from deaths caused by other origin. According to the IAEA report, not radiation but poverty and immoral life style (smoking, promiscuous sex, etc.) and alteration of mental health should have widely increased in the former USSR and mainly affected residents of Chernobyl areas. It is also mentioned in the report that the radiation situation would be worse in regions where sufferers of Chernobyl receive financial support (because this is said to cause a welfare mentality and forming the psychology of victims).
Building upon their conclusions on this "scientific" report, authors propose to significantly reduce the programs of support for Chernobyl victims.

It is what the Judge, François Rigaux, President of the Permanent People's Tribunal in Vienna (12-15 April 1996) defines as a major crime: "*revictimization of the victims, an the arrogant denial of their suffering* "(1).

This cynical profanation of the consequences of the biggest technological disaster in history is a sacrilege towards the enormous number of Chernobyl victims; it pushes a new round of pro-nuclear propaganda aimed to restart the NPP construction programs. This is the main reason why nuclear industry wishes the whole world to forget Chernobyl.
Pseudoscientific arguments of the IAEA' experts are built on the methods of radiation risks estimation developed by the nuclear industry itself. The report openly ignores, tendentiously interprets, and even falsifies the results of the research of thousands of specialists from Ukraine, Belarus and Russia. The report is mostly the work of western specialists sometimes not sufficiently familiar with the real situation. Moreover, the report dissembles the data on the impact of Chernobyl to the countries beyond former USSR borders.

But it is impossible to "call off" Chernobyl:

- The memory of hundreds of thousands of Chernobyl victims not mentioned in officially falsified reports keeps us from forgetting about this disaster.

- The danger of genetic consequences that will amplify in dozens of generations, helps us not to forget about this disaster.

- The concern about the destiny of millions of persons suffering from diseases that according to IAEA' experts should have no relationship to radiation but concentrate (strangely!) mainly on Chernobyl areas, keeps us from forgetting about this disaster.

- The concern about growing (rather than decreasing) internal irradiation of populations living in Chernobyl' areas keeps us from forgetting about this disaster.

Instead of calling for forgetting Chernobyl, we must be prepared to mass radiogenic cancer after 20 years of latent period. We must prepare a life-long medical care for those irradiated *in utero*, whose mental development is damaged. There is a need to concentrate efforts on the development of new capable methods of individual biodosimetry (to organize targeted and efficient help). There is a need to give hundreds of thousands of liquidators who have been swept out of normal life by the atomic Moloch the possibility to live as they deserve.

On the eve of the 20 year anniversary of the Chernobyl disaster we appeal to all political parties of Russia, Ukraine and Belarus and other European countries to express their concern about the peoples welfare, to pay attention to a research which aims for a development of safe energy sources and to acknowledge the moral obligation of society to care about victims of the most horrible technological disaster in history. The first 20 years are only the beginning of recompense for Chernobyl.

Valentina Mel'nikova, on behalf of "United People's Party of the Mothers of Solders",
Vladimir Ryzkov, on behave of "Russian Republican Party",
Alexey Yablokov, on behalf of "Green Russia" Party,
Grygory Yavlinsky, on behalf of "YABLOKO" Party

Moscow, Russia,
September 17th, 2005.

Personal data and background

Alexey V. YABLOKOV from the Centre for Russian Environmental Policy, of the Russian Academy of Sciences, Moscow, studied the reasons of the systematic underestimation, by international organizations, of the impact on public health of the Chernobyl explosion. He criticizes «official» reports to the United Nations, especially «UNSCEAR 2000» and the last IAEA/WHO report of 5 September 2005.

Among the pathological conditions due to radiation, excluded from such official reports, Yablokov notes :

- increased number of spontaneous abortions, stillbirths, and mortality within 28 days after birth
- growing number of birth defects and genetic anomalies
- disturbance (retardation) or mental (psychic) development
- the growing number of neuro-psychiatric and eye diseases
- the increased frequency of immunity anomalies, with aggravation of bacterial infections, autoimmune conditions, leading to endocrine diseases
- increase and premature occurrence of different oncological diseases
- diseases of the respiratory, cardiovascular, gastrointestinal, urogenital system, and endocrine diseases (sterility)
- delayed recovery after trauma or diseases, and premature aging.

The ignoring by official international organizations of the tragic dimension of the health consequences of the Chernobyl fallout, leads not only to the unwillingness to recognize the suffering, and to spend money to care for the victims, but above all, facilitates the lobbying by the IAEA and nuclear states, for the construction of more commercial atomic power plants worldwide.

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Attachment 1

SUMMARY OF THE SYMPOSIUM 15.2.2003 : HEALTH CONSEQUENCES OF "CHERNOBYL" IN CHILDREN:

Michel FERNEX

On February 15, 2003, under the auspices of the Medical Faculty of Basel, the Swiss affiliate of IPPNW (International Physicians for the Prevention of Nuclear War) focused the presentations of this scientific meeting on the pathology in children suffering from the consequences of "Chernobyl".

IPPNW concentrated the subjects on children's diseases, especially on the consequences of chronic oral uptake of Cs-137 by contaminated food. This avoided discussing the only officially recognized stochastic disease after the Chernobyl explosion - thyroid cancer due to the iodine-131 shock of spring 1986, where the 2003 children were not yet born.

Twelve physicians, eight of them originating from the most affected countries, actively participated at the symposium. Professor ***Yuri I Bandazhevsky***, leading pathologist and former Rector of the Medical Institute of Gomel, the most radio-contaminated region by "Chernobyl", had been personally invited by Professor W. Steinbrich, Dean of the Medical faculty of Basel. However, Bandazhevsky, who studied the health problems of the most radio-contaminated population during 9 years, analyzing the role of the chronic Cs-137 incorporation in different organs, was not permitted to leave the prison being condemned for eight years with conditions comparable to a "Gulag". The studies of Bandazhevsky on Cs-137 measures in different organs of adults and of children were published (1) in Swiss Medical Weekly (SMW), a peer-reviewed medical journal (www.smw.ch).

Since kindergarten, children in highly radiocontaminated areas of Belarus receive clean food in the school canteens free of charge. Furthermore, these children are offered a one-month holiday in a sanatorium, in a radiologically clean environment each year. ***Nesterenko*** et al. (2) undertook a placebo-controlled, randomized, double-blind trial in children during their sanatorium stay studying an apple-pectin preparation (Vitapect®) which accelerates the elimination of incorporated Cs-137 from the organism. After "clean" diet alone for 3 weeks Cs-137 fell by 14%. Adding one spoon of a 16% pectin-powder preparation during the meals of clean food led to a drop of Cs137 body concentration of 64% after 3 weeks, this difference being significant ($p<0.01$). With repeated 3-4-week pectin courses, at 3 to 4 months interval over a year, the same team achieved an average of a four-time reduction of the Cs-137 burden of the children in contaminated rural areas.

In charge of the Cancer Registry of Belarus, which was functional since 1973, ***A.E. Okeanov*** & al. found a significant increase of the relative risk for malignant tumors after "Chernobyl" in people living in the Gomel region between 1976-1985 compared to 1990-2000 (3).

A geneticist from the team of A.J. Jeffries, ***Yuri E. Dubrova*** (4) showed a doubling of the mutation rate, when studying minisatellites of children from parents living in highly radiocontaminated areas of Belarus, close to Moguilev. He studied Ukrainian families living in the Chernobyl area, and found significant differences between the mutation rates among children born before, and those born after "Chernobyl" of fathers living in heavily contaminated areas.

Rose I. Goncharova with ***N.I. Ryabokon*** compared the mutations among wild bank voles living in forests from Chernobyl to Minsk, in four territories with decreasing radioactivity. They found very high initial mutation rates, with increased rates proportionally to the level of the soil contamination. After 20 generations, the mutation rate was still increasing in all contaminated bank-vole populations. However the increase was more marked in lesser contaminated areas. The increasing mutation rate was associated with an increase in-utero death rate. This evolution appears to be the consequence of a genome instability following the massive initial irradiation of April-June 1986, and the persistent presence of long-lived radionuclides of Chernobyl persisting, even in very low concentrations in the soil (5).

G. Lazjuk noticed a significant increase of congenital malformations in new-born babies and fetus, in areas with over 15 Curies of Cs-137/km2 (6).

A. Körblein confirmed for Bavaria, Germany, the increased perinatal mortality after Chernobyl, described in Germany as a whole, by H. Scherb et al. (7). Körblein showed furthermore an increased malformation rate in children born in the

most contaminated valleys of the German Alps. The level of this fall-out was comparable to that of Tessin (Switzerland) and regions in the Alps of several other countries where epidemiological studies were not undertaken.

The team of the institute of radiation protection Belrad (Minsk), with the help of ***G.Bandazhevskaya***, pediatrician, studied 94 children with different levels of Cs-137 in the organism. She found a statistically significant correlation between cardiovascular symptoms of children and the Cs-137 level in the organism measured with anthropogammametres. At baseline arterial hypertension after minimal efforts was found in 9.1% of children with a cesium load of less than 5 Bq/kg bodyweight (BW), in 25.8% of the group of children with a mean Cs-137 load of 38 ±2.4 Bq/kg and in 50% of the children in the group with 122 ±18.5 Bq/kg BW. A16-day pectin course significantly reduced the Cs-137 burden in the groups with mean values of 38 and 122 Bq/kg respectively, and the symptomatology improved (8).

The pediatricians ***N. Gres and N. Arynchin*** compared the clinical manifestations caused by chronic, low-level ionizing radiation, with a children population from a spared region, between 1994 and 2001. The summary of the conference and the figures presented by Nika Gres are printed below (Attachment 2).

In conclusion the studies presented by these independent scientists confirmed the high level of children pathology in radioactively contaminated areas due the explosion of the Chernobyl nuclear power plant. It is highly disturbing that 80% of these children were judged to be ill in 2003.

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ATTACHMENT 2

SOME FEATURES OF DEVELOPING OF CHRONIC PATHOLOGY IN BELARUSSIAN CHILDREN, LIVING IN CONDITIONS OF PERMANENT LOW-DOSE RADIATION

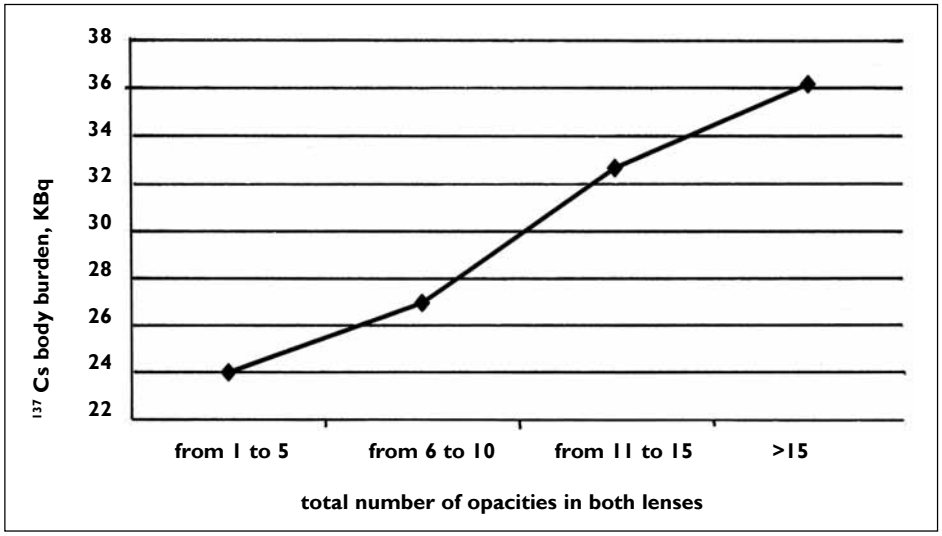
Nika A. GRES, A.N. ARINCHIN, L.A. OSPENNIKOVA

Key words: radiation, dose, children, lensopathy, cataract, chronic gastritis, atrophy, intestinal metaplasia.

The studied group included 137 children, aged 6-15 years, constantly living in South Polesie. The average total effective dose of radiation was 2.2 mSv/year (0.4 to 9.7 mSv). The total effective dose ranged from 3.2 to 71 mSv (average dose 15.4 mSv). The dose was due primarily from internal radiation (74%), due to incorporation of radiocaesium. The control group consisted of 92 children of the same age, living in areas of Northern Pooserie, not contaminated with radionuclides.

The eye is one of the radiosensitive organs, its most sensitive part is the lens. Initially, cataract was diagnosed in 3 children aged 11, 12, and 15 years respectively, in the exposed group. When the cataract was diagnosed, the total calculated dose of these children was 15.3, 17.1, and 25.9 mSv respectively. In addition to the full radiation cataract, there is probably a stage of lensopathy, with the development of lenticular opacities. During the systematic ophthalmic examination, lensopathies were diagnosed in 53.7 % of the group of 137 children. In the control group, lensopathies were found in 29.3%. The correlation between the number of lens opacities, on one hand, and the level of Cs137 activity in the organism of the children, on the other, is shown in figure 1. The number of lens opacities in both eyes increases with the level on the Cs137 specific activity in the body (fig. 1).

Figure 1
Correlation between the radiocaesium load of the organism and the number of opacities in both lenses.



To asses the tendency of developing lensopathies with age, we undertook an ophthalmic follow-up of 21 children during 3 years, with one year interval. The progression of the lensopathy was found in 42.9 % of the children.

Gastritis

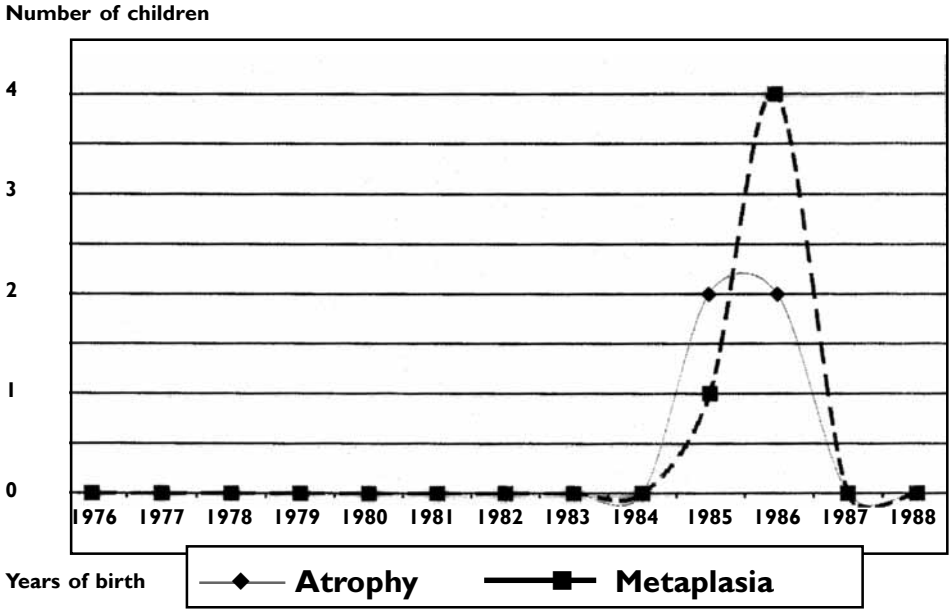
Besides the eye, the gastrointestinal tract can also be considered as very susceptible to internal radiation. In a representative group of 289 children, exposed to doses of 0.9 to 4.7 mSv, the source of radiation was estimated to be internal in 69-77 %. 72 % of these children showed clinical signs of chronic gastritis.

The microscopic examination of biopsies showed an atrophy of the mucous membrane in 16.1 %. This is significantly more than what was found in the control group : 2.7%. Mucous membrane metaplasia was found in 5.4 % and 2.7 % respectively.

These histology findings, atrophy and metaplasia, are morphological alterations encountered in elderly persons. In children, such changes can be considered as a predisposition for precancerous changes.

A follow-up of these children during 8 years, showed atrophic processes in 12.5% of the cases. The number of children with metaplasia increased up to 20.8%. It is interesting to note that among these children, those born in 1986-1987, and exposed to radiation during the Chernobyl disaster, at a critical period of their life (in *utero*, and early postnatal period), atrophy of the mucous membrane and metaplasia remained unchanged (Figure 2).

Figure: 2
New cases of gastritis in children, with atrophy and metaplasia of the mucous membrane, depending on the date of birth.



Chronic-recurrent infections in children of 0 to 14 years of age
A comparative analysis showed that children exposed to radiation have significantly higher incidence ($p<0.05$) of chronic recurrent bronchitis and chronic urinary tract infections, when compared with republican levels of Belarus. Figure 3 and 4 show the differences between children from radiocontaminated areas, and the republican levels from Belarus, for these two different chronic infections.
Analysis of presented data, leads us to think, that a probability of high damaging effects due to ionizing radiation of internal exposure, still exists.

Figure 3:
Comparison of the number of the first manifestations of chronic recurrent bronchitis, among children from the radiocontaminated areas, versus the Belarussian republican levels, between 1993 and 2000

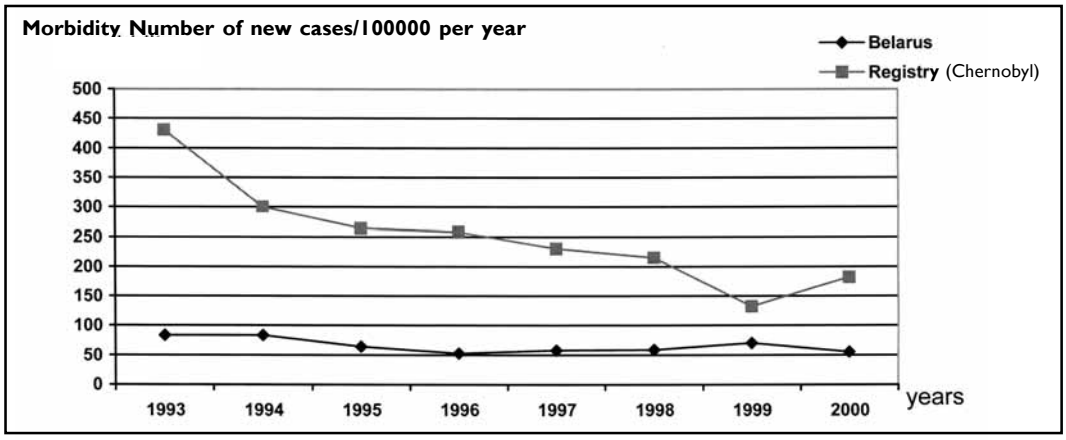


Figure 4
Comparison of the number of first manifestations of chronic recurrent urinary tract infections among children from the radio-contaminated areas, versus the Belarussian republican levels, between 1993 and 2000

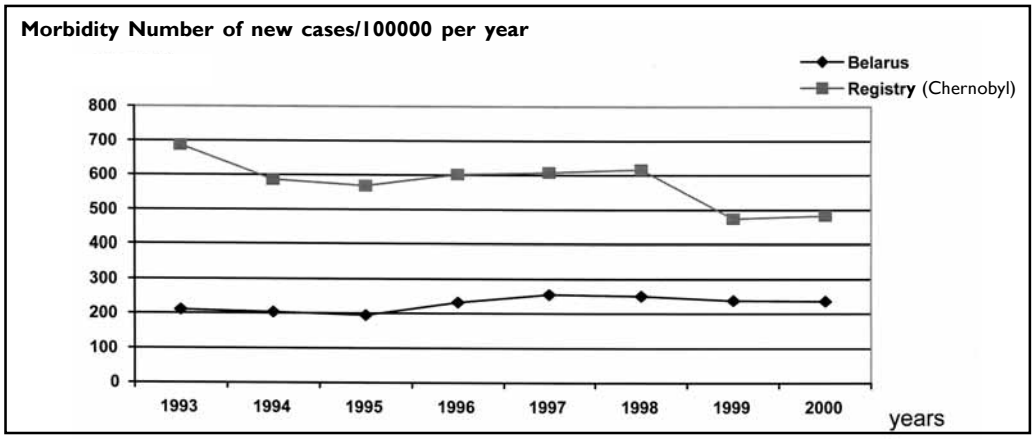
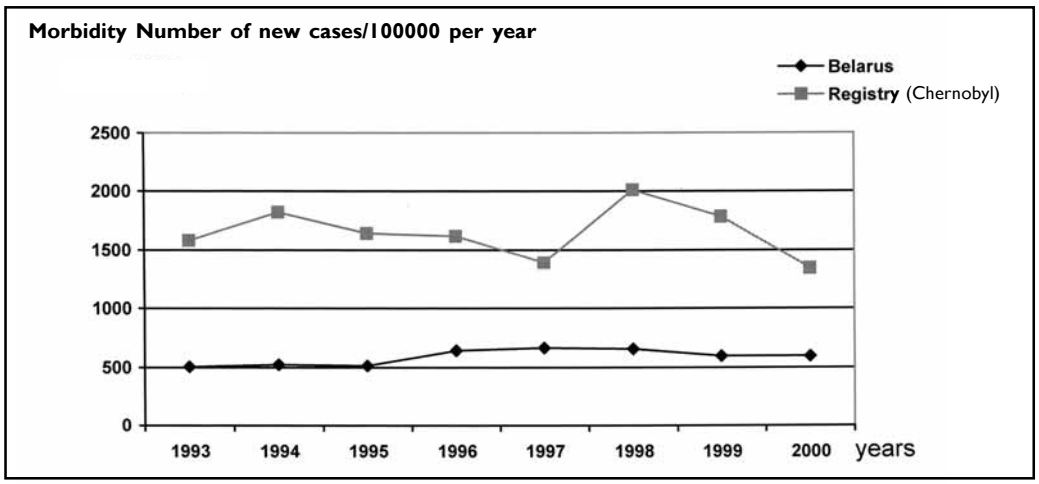


Figure 5
Comparative dynamics of primary morbidity of the circulatory system diseases in children's population (0 – 14).



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