

MINISTRY OF HEALTH  
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**ORGANIZATION AND MANAGEMENT OF THE  
ELIMINATION OF THE CONSEQUENCES OF  
RADIATION CONTAMINATION OF THE  
POPULATION AS A RESULT OF A TERRORIST  
ACT AND OTHER RADIATION INCIDENTS**

**DISSERTATION SUMMARY**

for obtaining a PhD degree

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## CONTENTS

1. INTRODUCTION .....	4
2. PURPOSE, TASKS, MATERIALS AND METHODS .....	5
3. RESULTS AND DISCUSSION.....	7
3.1. Organization and management of emergency medical care in case of radiation contamination .....	7
3.2. Survey to assess the readiness of doctors working in hospitals to provide medical care in case of radiation contamination of the population as a result of a terrorist act.....	16
3.3. Model (algorithm) of organization and management of work processes in the Department of Hematology at the University Hospital „St. Ivan Rilski ”(Sofia) in providing first medical aid in case of sudden disturbances in the functioning of the hematopoietic system of large groups of people caused by nuclear pollution. ....	41
3.4. Psychological support and action plan for providing assistance to the population due to radiation contamination, terrorist act and other radiation incidents.....	48
4. CONCLUSIONS, RECOMMENDATIONS, CONTRIBUTIONS, CONCLUSION .....	57
5. PUBLICATIONS RELATED TO THE DISSERTATION .....	60

## 1. INTRODUCTION

The problems of the organization and management of the work processes of the medical services have always been in the center of attention of the Bulgarian academic and professional community. Many publications on one occasion or another suggest ideas, models and solutions that show how the effectiveness of this management can be increased and the methods and tools that can be used for this. At the same time, the possibilities for their improvement have been poorly studied. There are no extensive studies of the organization of the management process to reveal the possibilities for its optimization in emergency situations. The need for new knowledge in this area increases with the pace of change in the environment. Thanks to the works of a number of prominent Bulgarian scientists, a solid theoretical and methodological basis was created for conducting research in the field of organization and management of pre-hospital medical care. This basis gave the necessary motivation to conduct research in a specific area, namely - the elimination of the consequences of radiation contamination of large groups of people as a result of a terrorist act.

There are currently instructions for dealing with, generally speaking, a nuclear incident, for the military, for those working with systems involving nuclear and radioactive components (for example, NPP workers, X-ray technicians, etc.), but it is not known to have a developed algorithm for action in the event of an apparent injuries of large groups of people unemployed in areas directly involved in nuclear equipment or protection against nuclear weapons. The introduction of a unified model of work processes in the elimination of the consequences of radiation exposure opens wide opportunities for mass use of good practices in this field and for equalization and integration of the qualifications of specialists working in this field. With the growing danger of a terrorist act using radioactive materials, the development and implementation of such a model (algorithm) for observability and risk management in the providing of first aid to contaminated persons are particularly relevant.

The main motive for conducting the present study is to fill a gap in the knowledge of the organizational behavior of specialists involved in eliminating the consequences of radiation contamination of large groups of people as a result of a terrorist act. Gaining this knowledge will open up new opportunities for conducting future research and training specialists to work in such situations.

## 2. PURPOSE, TASKS, MATERIALS AND METHODS

**The aim** of the study is to create an algorithm of the organizational behavior of the specialists engaged in first aid in case of sudden disturbances in the functioning of the hematopoietic system of large groups of people caused by nuclear pollution.

**The tasks** that are solved to achieve the goal of the study are:

- Drawing the boundary between the known and the unknown based on a detailed analytical review of all relevant publications on the topic. Analysis of the current state of knowledge and regulations determining the organizational behavior of specialists involved in first aid for sudden disorders of the hematopoietic system of large groups of people caused by nuclear pollution and selection of the necessary knowledge for the development of the architectural model of knowledge.
- Comparative analysis and classification of the known models of organizational behavior of specialists engaged in providing first aid to large groups of people injured as a result of a terrorist act and selection of good practices in this field
- Development of an algorithm for organizational behavior of specialists engaged in first aid in case of sudden disturbances in the functioning of the hematopoietic system of large groups of people caused by nuclear pollution.
- Expert assessment and implementation of the developed algorithm in the Department of Hematology at the University Hospital „St. Ivan Rilski” in Sofia.
- Formulation of conclusions and recommendations for the modeling and optimization of the organizational behavior of the specialists engaged in first aid in case of sudden disturbances in the functioning of the hematopoietic system of large groups of people caused by nuclear pollution.

**The working hypothesis** of the study is that if we analyze the theoretical sources and the accumulated knowledge about the models of first aid to large groups of people in emergencies, the theoretical prerequisites for constructing a specific model (algorithm) of organizational behavior of specialists involved in first aid for sudden disturbances in the functioning of the hematopoietic system of large groups of people caused by nuclear pollution, will be revealed.

**The research methodology** is formed taking into account its interdisciplinarity. This determines the use of a diverse set of methods and tools, such as: observations, document analysis, expert evaluations, conducting structured interviews, case studies, extensive research of information sources and architectural approach. The main source of information about the

research are the personal observations of the author, his practical experience, acquaintance with the available documentation and the digital Web resource. The architectural modeling provides an objective basis for verification and validation of the created algorithm and verification of the working hypothesis in the conditions of a specific medical ward. On this basis, theoretical summaries, conclusions and recommendations are made, which have rational and reference value.

**The object of the research** is the organization and management of the work processes of prevention and pre-hospital care in cases of irradiation of a large number of people, which led to damage to their hematopoietic system.

**The subject of the research** is the model (algorithm) of organizational behavior of the specialists engaged in first aid in case of sudden disturbances in the functioning of the hematopoietic system of large groups of people caused by nuclear pollution.

**The scope of the research** includes all radiation-induced damage to the hematopoietic system, regardless of the characteristics of the radiation source.

The research efforts are focused on the organization and management of work processes in the Department of Hematology at the University Hospital „St. Ivan Rilski” in Sofia. Based on the analysis of the specific normative documents and the established organization of work in the ward, a model of the organizational behavior of the specialists engaged in first aid in case of sudden disturbances in the functioning of the hematopoietic system of large groups of people caused by nuclear pollution has been developed. The scientific questions that remain out of this focus are precisely formulated and are defined as directions for future scientific work.

**The criterion for the success** of the research is the positive expert evaluation of the developed algorithm, given by proven experts and scientists working in this field.

**The final scientific product** of the development is an algorithm for organization and management of work processes in the Department of Hematology at the University Hospital „St. Ivan Rilski” in Sofia, in providing emergency medical care in case of sudden disturbances in the functioning of the hematopoietic system of large groups of people caused by nuclear pollution.

**The users of the scientific product** will be all students, specialists, graduates, doctoral students and experts engaged in first aid in case of sudden disturbances in the functioning of the hematopoietic system of large groups of people caused by nuclear pollution.

**The implementation** of the obtained algorithm will be done in the organization and management of the work processes in the Department of Hematology at the University Hospital „St. Ivan Rilski” in Sofia.

### **3. RESULTS AND DISCUSSION**

#### **3.1. Organization and management of emergency medical care in case of radiation contamination**

The analysis of the organization and management of emergency medical care is limited within the activities in response to sudden disturbances in the functioning of the hematopoietic system of large groups of people caused by nuclear pollution.

Emergency physicians play a crucial role in responding to any terrorist incident involving radioactive materials. According to Ordinance № 25 of 4 November 1999, issued by the Ministry of Health, emergency medical care is provided by all medical establishments registered under the terms and conditions specified in the Medical Establishments Act. Medical establishments whose main activity includes the provision of emergency medical care must have qualified medical specialists, as well as equipment for emergency diagnosis, therapy and monitoring of vital functions of the body. Like emergency medical centers, they must have specialized vehicles equipped with the necessary equipment for emergency medical care.

In case the patient is initially sought help from a GP or other outpatient facility, the latter are obliged to provide the possible range of medical activities to maintain the patient's vital functions until the arrival of an emergency medical team.

The Centers for Emergency Medical Care (CEMC) provide qualified emergency medical care at the scene, perform emergency diagnostic tests according to the capabilities and available equipment, monitor the patient's condition until hospitalization, conduct the necessary treatment and specific resuscitation activities until hospitalization, provide specialized transport, etc.

Emergency medical centers provide emergency medical care at the scene of the accident, during transport and in the emergency department. Emergency departments are opened on the territory of multidisciplinary hospitals. The patient's stay in them cannot exceed twelve hours. If the patient's condition requires continued treatment in a hospital setting, the CEMC team directs emergency hospitalization in a specialized hospital ward. The doctor on

duty in the latter is obliged to accept urgently for examination, examination and diagnosis proposals for hospitalization of a patient.

The role of emergency medical care for the implementation of radiation protection is regulated in a number of regulations. First of all, the Health Act determines the place of emergency care in the health care system.

The Minister of Health manages the national health care system and exercises control over the activities.

The state health policy on the territory of the district is implemented and organized by a Regional health inspectorate. The Regional health inspectorates carry out activities on the territory of the respective district, including planning and organizing the health activities in case of disasters, accidents and catastrophes and preparation of a wartime plan for the territory of the respective district.

Bodies of the state health control are the Chief State Health Inspector of the Republic of Bulgaria, the Regional health inspectorates and the National Center for Radiobiology and Radiation Protection (NCRRP). NCRRP and Regional health inspectorates designated by the Minister of Health carry out state health control to comply with the requirements for protection of persons from the effects of ionizing radiation.

Other bodies in the system of the Ministry of Health, carrying out activities for protection of persons from the action of ionizing and non-ionizing radiation, are the National centers for problems in public health.

The protection of individuals from the effects of ionizing radiation is carried out in compliance with the principles of radiation protection in accordance with the Health Act and the Safe Use of Nuclear Energy Act.

The NCRRP consists of several structural units, all of which have functions in counteracting nuclear accidents and nuclear terrorism. For example, the State Health and Radiation Control Department must carry out state health control to comply with the requirements for protection of persons from the effects of ionizing radiation sources, conduct an investigation of emergencies and incidents with ionizing radiation sources and provide dosimetric control when eliminating the consequences of a radiation accident.

The Research and Development Department develops, publishes and distributes information materials and programs related to radiobiology and radiation protection, and maintains a website with specialized information.

The Radiation Protection Department organizes and monitors the radiation factors of the working and living environment to assess the exposure of the population, performing



radiometric measurements, analyzes and assessments of radionuclide pollution of the environment and the living environment in radiation accidents.

The Radiobiology Department conducts biomonitoring and biodosimetry of ionizing radiation, such as:

- assesses the ingested dose of persons injured in radiation accidents and incidents;
- develops and applies appropriate biological indicators in human peripheral blood lymphocytes to assess and characterize the type of radiation exposure.

The Radiation Safety and Medical Assurance Department provides medical provision to persons in the event of a radiation accident, such as:

- provides specialized diagnostic and expert assistance to persons exposed in radiation accidents;
- performs final assessments of the type of irradiation and radiation exposure of the population after the completion of the liquidation works in the event of a radiation accident;
- maintains a register of victims of a radiation accident;
- carries out long-term medical monitoring of the persons irradiated in case of radiation accidents;
- participates in the preparation and implementation of programs for counteracting terrorist threats.

For the implementation of the National Disaster Protection Plan by order of the Prime Minister of the Republic of Bulgaria a national headquarters is established with authorized head and members: ministers, deputy ministers, heads of departments or their deputies and others.

The main coordinator of the activity in case of an emergency or terrorist incident is the Ministry of Interior. Instruction № 8121h-953 of 8.12.2014 of the Ministry of Interior states that radiation protection includes providing assistance to victims in:

- an accident at a nuclear power plant related to the release of radioactive substances into the environment and potentially dangerous exposure of the population;
- accident in sites using or storing sources of ionizing radiation;
- radiation emergency situation during transportation of fresh or spent nuclear fuel, radioactive sources and materials or radioactive waste on the territory of the country;
- radiation emergency situation in the metallurgical enterprises that process scrap and the places where scrap is stored;

- a radiation emergency that has occurred in another country, creating a risk of cross-border transmission of radioactive substances;
- radiation emergency situation with sources of ionizing radiation at the border checkpoints;
- radiation emergency situation related to illegal use of nuclear and radioactive materials in public places and subsequent radioactive contamination.

Upon receipt of initial information on a radiation emergency situation, the emergency center of the Nuclear Regulatory Agency (NRA) notifies the duty officer at the National oncological center, Ministry of Health and the Institute for Nuclear Research and Nuclear Energy - Bulgarian Academy of Sciences, if necessary.

The Ordinance on Emergency Planning and Emergency Preparedness in the Event of a Nuclear and Radiation Accident requires the availability of emergency planning. The central executive bodies, within their competence, should jointly develop and participate in the implementation of an external emergency plan. The Council of Ministers implements the general management for the protection of the population and the environment in case of emergency. In the event of an emergency situation for operational management and coordination of protection activities, the Prime Minister by order establishes a National Headquarters for Coordination and Control (NHCC) and headquarters for coordination and control to ministers and departments, whose composition is determined by order of the Minister or by the Head of the Institution. The National Headquarters for Coordination and Control is headed by the Prime Minister or a Minister appointed by him and by members - heads of ministries and institutions.

The Minister of Health:

- determines health norms for protection of persons in cases of emergency;
- ensures personnel, technical and financial functioning of the structural units for emergency planning;
- maintains a team of specialists available for action in case of radiation emergency;
- together with the Ministry of Interior performs radiation control of people passing through the checkpoints of the emergency planning zones and the state border;
- in order to save human life or to prevent greater exposure in a nuclear or radiation emergency, the state health control authorities may exceptionally allow the performance of activities by volunteers in excess of the established exposure limits under the Health Act;

- in making a decision on application of protective measures in coordination with the Chairman of the NRA proposes additional criteria, secondary levels and temporary norms for emergency exposure, including approves temporary additional norms for limits of radioactive contamination of food;
- performs a final assessment of the type of irradiation and radiation exposure after the completion of the liquidation works, including the final identification of the source, region, type and degree of nuclear or radiation emergency;
- develops a long-term forecast for the possible radiation consequences, assesses the radiation risk and proposes preventive measures for protection of the population;
- collects, processes and evaluates the data from the radiation measurements and submits the results to the Council of Ministers, the Ministry of Interior and to the Chairman of the NRA, including:
  - measurements of the radiation background and the contamination of drinking water with radioactive substances, providing an expert assessment of their suitability for consumption;
  - the content of iodine isotopes in the thyroid gland and the whole body activity of representative and risk groups of the population;
  - assessment of the effective dose received by individuals, groups and the general population;
- performs registration, medical examination and dispensary monitoring of those irradiated as a result of a nuclear or radiation emergency;
- organizes the supply of medical and health establishments with medicines for the treatment of radiation-affected people;
- exchanges information in a nuclear or radiation emergency situation with the World Health Organization and the European Union Health Security Committee.

In view of the organization of medical protection in the event of a radiation accident, the role of the Minister of Defense as the principal of the Military Medical Academy is also important. From this point of view, the Instruction envisages the Minister of Defense to maintain specialized units for assistance in carrying out rescue and emergency recovery operations in case of emergency according to the external emergency plan and to plan and organize the admission and treatment of irradiated and injured persons in military hospitals in accordance with the external emergency plan.

The emergency response, according to the Instruction, is to take actions to limit and reduce the consequences of an accident on the health and safety of personnel and the

population, quality of life, material values and the environment, and is the basis for restoring normal conditions for social and economic life after elimination of the consequences of the accident.

Among the practical goals of the emergency response are:

- prevention of the occurrence of deterministic effects for the staff and the population;
- timely and appropriate treatment of irradiated persons;
- reducing the likelihood of the occurrence or limitation, as far as practicable, of the occurrence of stochastic health effects for the population.

Ordinance № 28 of 3.10.2006, issued by the Ministry of Health, regulates the terms and conditions for medical insurance and health norms for protection of persons in case of radiation accident and aims to prevent the determined effects on the health of staff and the population and to limit, as far as practicable, the risk of stochastic effects.

Medical provision includes the providing of medical assistance by specialized medical teams from health and medical institutions and the intervention of state health control authorities to reduce the impact of the radiation accident on health and ensure the safety of the population.

Medical provision in the event of a radiation accident is applied in case of unplanned exposure (which results directly from the radiation accident), as well as in case of planned exposure of persons involved in actions to reduce the consequences of the radiation accident.

The activity of planning and conducting medical provision in case of radiation accident at the district level is carried out by the council for medical provision in case of disasters, accidents and catastrophes to the director of the respective Regional health center. The heads of the health and medical establishments and the bodies for state health control, within their competence, shall prepare emergency plans for the implementation of medical insurance in case of a radiation accident. These plans include information on:

- the type of ionizing radiation sources and their location on the territory for which the medical provision is planned;
- the analysis of the possibilities for occurrence, the type of the radiation accident, as well as its impact on the environment;
- the number of persons who may be affected by the radiation accident;
- the expected health effects and the likelihood of radioactive contamination of the victims;
- the medical and health establishments in which the victims of the accident will be directed for examination and treatment;

- specialized medical institutions for the treatment of radiation burns and/or other acute radiation injuries;
- information data for contact with the central and local authorities;
- special equipment for medical teams, equipment and specialized medical and/or sanitary transport.

The heads of the health and medical establishments provide and train specialized teams for assessment of the emergency situation and providing of emergency medical aid in case of radiation accidents.

The actions of the specialized medical teams in case of a general radiation accident at sites are carried out in compliance with the following order:

1. providing emergency medical aid to all victims and determining the order for their medical care;
2. application of life-saving measures to injured persons;
3. undertaking measures for reduction of the irradiation.

After the announcement of a general accident in the area for preventive protective measures, the heads of the health and medical establishments shall immediately put into effect the emergency plan for medical provision. First aid in the area for preventive protective measures is provided by prepared and trained teams for pre-medical care of the enterprise and specialized teams for emergency medical care in accordance with the procedure specified in the National Emergency Plan. These specialized teams take the following actions:

- carry out an assessment of the health condition of the injured persons and apply, if necessary, life-saving medical activities;
- take measures to limit the radiation dose to the affected persons and order the immediate evacuation of all victims from the accident area;
- establish the presence of radioactive contamination of the victims;
- take measures for initial and partial decontamination of the victims, if there is a practical possibility;
- take measures to prevent the spread of radioactive contamination if there is a danger or there is a suspicion of contamination;
- apply, if necessary, measures for protection of the thyroid gland of the victims;
- collect data on the persons who came to the scene of the accident in order to provide medical supervision and/or treatment if necessary;
- fill in an emergency form for each injured person;

- direct with specialized transport the persons who have been seriously injured in the accident to the admission-sorting department of the designated medical establishment, notifying it of: the number of injured persons; the health and radiological status of the victims; the approximate time for arrival at the medical institution.

Emergency medical teams leave the scene of the accident after radiation control and decontamination.

The victims of the accident receive medical assistance from medical institutions designated by the National Emergency Plan. Upon admission to the medical institution, the persons are referred to a admission-sorting department, where an assessment of the health condition of each injured person is performed; emergency assistance to stabilize the condition of the victim; assessment of the radioactive contamination of the victims; decontamination of wounds of the victims; external decontamination in the absence of medical contraindications; assessment of internal contamination.

The injured are divided into groups, depending on the type of injuries. Medical care is given priority to the victims, who need to take urgent measures on vital signs, regardless of which group they are distributed.

In the case of a radiation accident with a source of ionizing radiation, the Chief State Health Inspector instructs the specialists from the Radiation Control Departments of the Regional Health Inspectorates and/or the specialists from the NCRRP to:

- participate in the establishment of the radiation situation at the site of the accident and assess the radiation doses and/or the presence of radioactive contamination of the affected persons;
- make a prognosis for the possible health consequences that may occur in the persons affected by the accident, the population and the specialized emergency teams;
- register all participants in the accident for subsequent medical monitoring;
- conduct preliminary briefings on the issues of radiation protection and the need to apply individual measures for protection of the emergency response teams;
- provide medical provision of the participants in the emergency teams during the emergency activities;
- if necessary, perform decontamination of wounds and parts of the body of the victims of the accident and/or persons from the emergency team.

When they ascertain the presence of severely injured persons, the specialists shall immediately notify the specialized medical teams from the respective center for emergency medical aid for bringing the victims to a medical establishment for providing hospital care.

Medical examinations and tests of those affected by the radiation accident, as well as of the emergency teams are carried out by specialists from the NCRRP through:

- a detailed survey of the person affected by the accident;
- clinical examination by a doctor - specialist in radiobiology or radiation hygiene;
- clinical and laboratory tests;
- conducting specialized biodosimetric tests - at the discretion of a doctor - a specialist in radiobiology or radiation hygiene;
- measurement analysis to assess the presence of external contamination and/or inflow of radionuclides.

The results of the medical examinations together with the data on the received radiation doses are reflected in the medical documentation of the person.

The control of the contamination with radioactive substances is carried out to prevent its spread on the victims of the radiation accident, the medical teams, the participants in the rescue activities and the equipment and other means used in the provision of medical care.

In cases where radioactive contamination is likely, medical teams shall immediately take measures to assess the contamination in accordance with the following principles:

1. perform the life-saving manipulations before the decontamination;
2. decontaminate persons with open wounds or with contamination in the area of the face and head before all other parts of the body.

To determine the degree of contamination with radioactive substances, operational levels of action are introduced: monitoring of the entrance and exit of the persons in the separate emergency zone; limited access of persons to the area; introduction of a buffer zone for secondary control; organization of separate collection of radioactive and non-radioactive waste from treatment of victims.

After the external decontamination procedures, repeated radiation monitoring is performed.

Victims who have not been found to have surface radioactive contamination are referred for treatment in the general order. Persons who are in good general condition and do not show clinical signs of radiation damage are registered for follow-up medical supervision.

### **3.2. Survey to assess the readiness of doctors working in hospitals to provide medical care in case of radiation contamination of the population as a result of a terrorist act**

For the purposes of the study, a questionnaire was prepared with 16 questions to assess the readiness of doctors working in hospitals to provide medical assistance in case of radiation contamination of the population as a result of a terrorist act.

The study was conducted by surveying 4 groups of doctors, whose specialty involves their inclusion in teams to provide initial assistance to victims of radioactive contamination. It was performed by personally filling in questionnaires (from 28 hematologists, 25 surgeons, 25 GPs, 31 oncologists). The total number of persons included in the survey is 109, which is a good statistical sample.

#### **Results analysis**

1. To the question „Do you think that the provision of medical care to persons exposed to radiation contamination carries a risk for the doctor?“ - 28 surveyed hematologists answered as follows: 10 people or 36% - „rather not“; 7 or 25% - „rather yes“; 6 or 21% „no“; 4 or 14% - „I cannot decide“, and 1 person or 4% - „yes“.

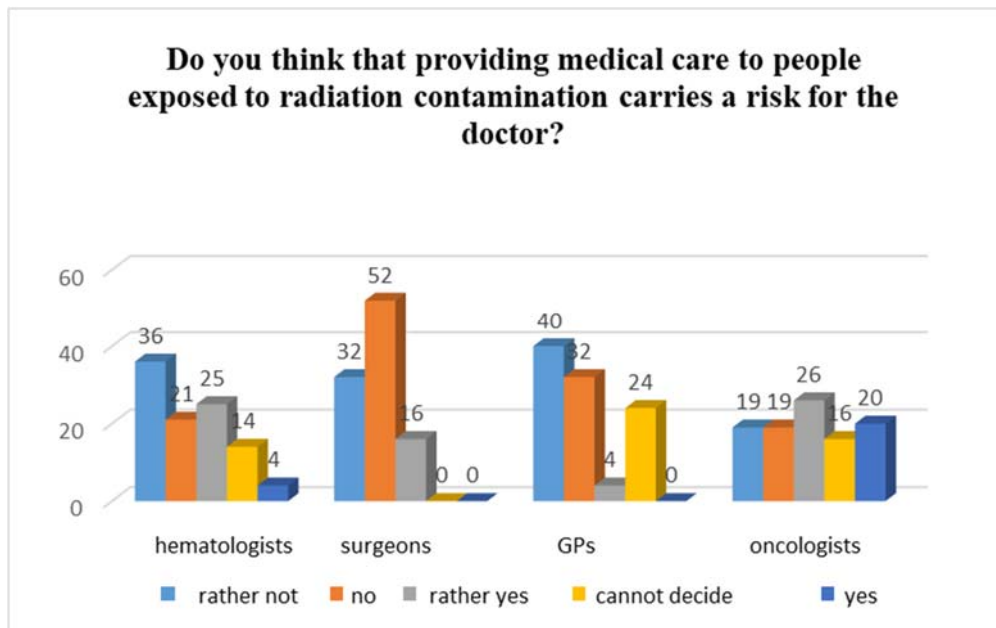
Surgeons answer the same question as follows: 13 persons or 52% - „no“; 8 or 32% - „rather not“; 4 or 16% „rather yes“; and the answers „yes“, and „I cannot decide“ - 0%.

The answers to this question of GPs are as follows - 10 or 40% - „rather not“; 8 or 32% - „no“; 6 or 24% - „I cannot decide“; 1 or 4% - „rather yes“, and 0% - „yes“.

Oncologists answered as follows: 8 or 26% - „rather yes“; 6% and 19% each answered „no“ and „rather not“; 6 or 20% answered „yes“ and 5 or 16% - „I cannot decide“.



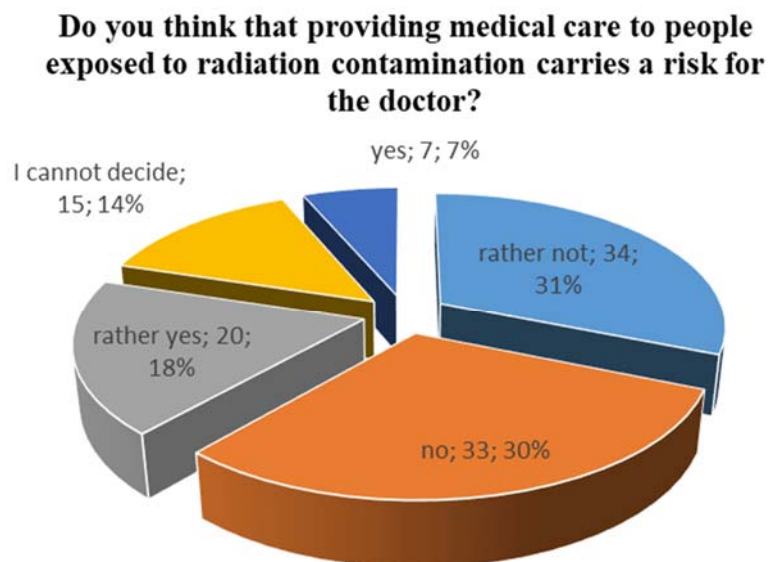
**Figure 7.** Presentation of the answers of all surveyed physicians by specialties to question №1 of the survey.



\* answers are given in%

All surveyed specialists answered as follows: 34 or 31% - „rather not“; 33 or 30% - „no“; 20 or 18% - „rather yes“; 15 or 14% - „I cannot decide“, and 7 or 7% - „yes“.

**Figure 8.** Summary of the answers of all surveyed physicians to question №1 of the survey.



The predominant answers to the question are „no“ and „rather not“.

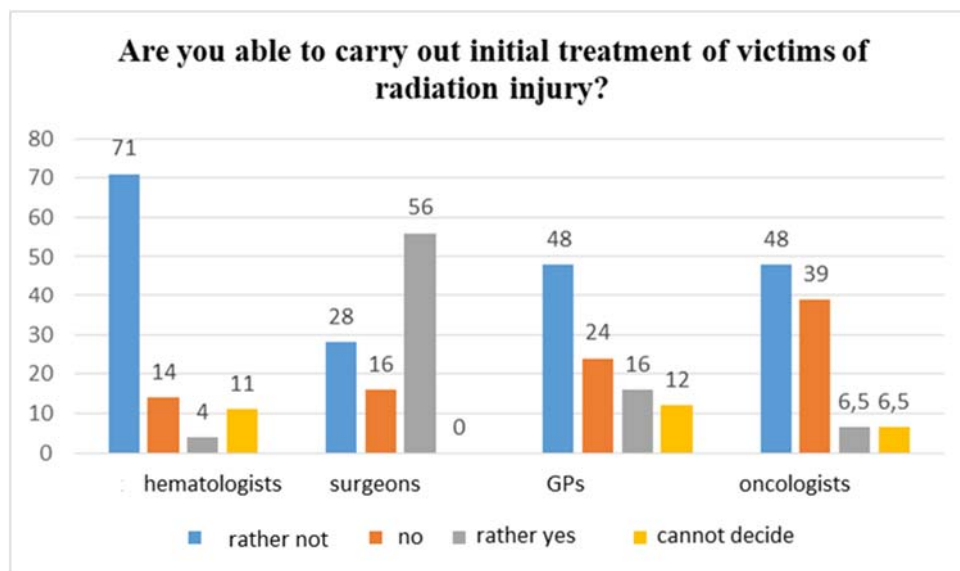
2. To the question „Are you able to carry out initial treatment of victims of radiation injury?“ hematologists answer as follows: 20 or 71% - „rather not“; 4 or 14% - „no“; 3 or 11% - „I cannot decide“; 1 or 4% - „rather yes“, and 0% - „yes“.

Surgeons answer as follows: 14 or 56% - „rather yes“; 7 or 28% - „rather not“; 4 or 16% - „no“, and 0% are the answers „yes“ and „I cannot decide“.

The answers to this question of GPs are: 12 or 48% - „rather not“; 6 or 24% - „no“; 4 or 16% - „rather yes“; 3 or 12% - „I cannot decide“ and 0% - „yes“.

The opinion of oncologists is as follows: 15 or 48% - „rather not“; 12 or 39% - „no“; two or 7% each said „rather yes“ and „I cannot decide“ and 0% answered „yes“.

**Figure 9.** Presentation of the answers of all surveyed physicians in by specialties to question №2 of the survey.

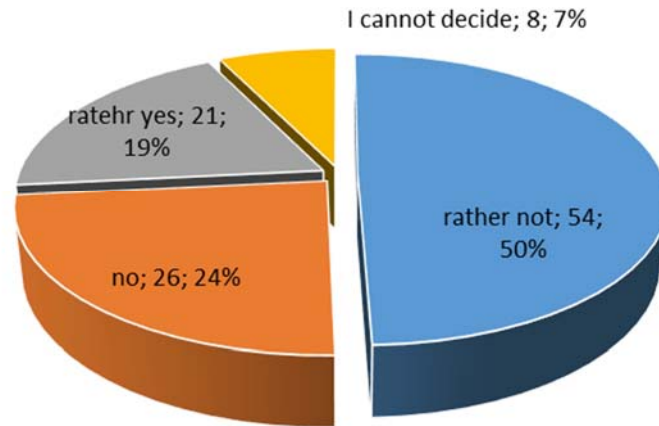


\* answers are given in%

The summarized answers of the surveyed specialists are: 54 or 50% - „rather not“; 26 or 24% - „no“; 21 or 19% - „rather yes“; 8 or 7% - „I cannot decide“ and 0% - „yes“.

**Figure 10.** Summary of the answers of all surveyed physicians to question № 2 of the survey.

**Are you able to carry out initial treatment of victims of radiation injury?**



In conclusion, it can be said that the dominant answers are „rather no“ and „no“.

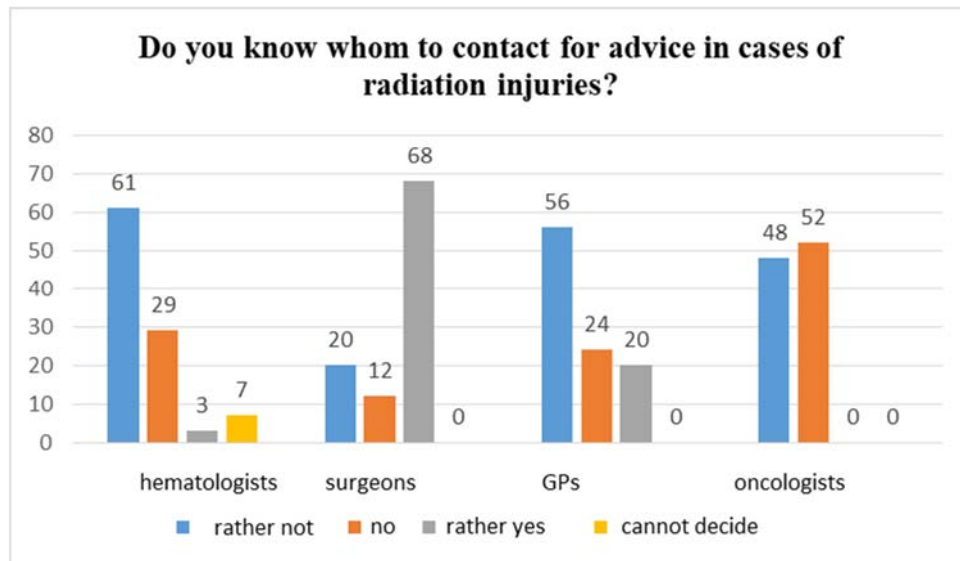
3. The question „Do you know whom to contact for advice in cases of radiation injuries?“ has the following answers: from hematologists - 17 or 61% - „rather not“; 8 or 29% - „no“; 2 or 7% - „I cannot decide“; 1 or 3% - „rather yes“ and 0% „yes“.

Surgeons answer as follows: 17 or 68% - „rather yes“; 5 or 20% - „rather not“; 3 or 12% - „no“; 0% - „yes“ and „I cannot decide“.

The answers of oncologists are: 16 or 52% - „no“; 15 or 48% - „rather not“; 0% - „yes“, „rather yes“ and „I cannot decide“.

The answers to the question of GPs are: 14 or 56% - „rather not“; 6 or 24% - „no“; 5 or 20% - „rather yes“; 0% - „yes“ and „I cannot decide“.

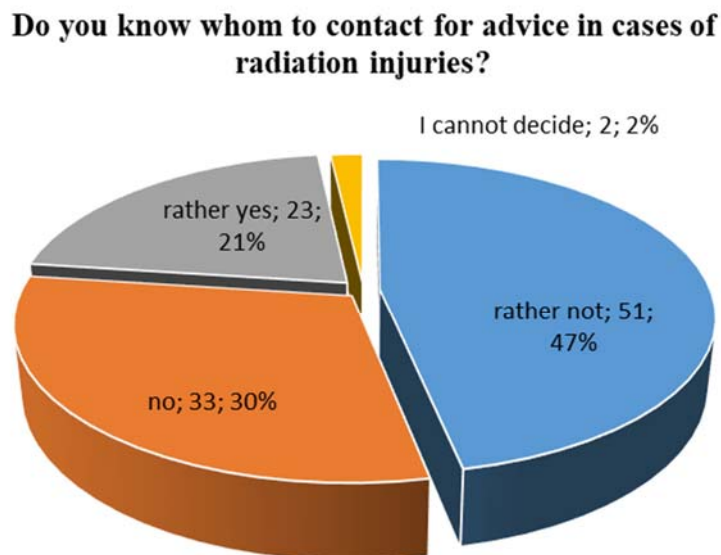
**Figure 11.** Presentation of the answers of all surveyed physicians by individual specialties to question №3 of the survey.



\* answers are given in%

All 109 respondents answered the question as follows: 51 or 47% - „rather not“; 33 or 30% - „no“; 23 or 21% - „rather yes“; 2 or 2% - „I cannot decide“ and 0% - „yes“.

**Figure 12.** Summary of the answers of all surveyed physicians to question № 3 of the survey.



Predominant answers are negative – „no“ and „rather not“

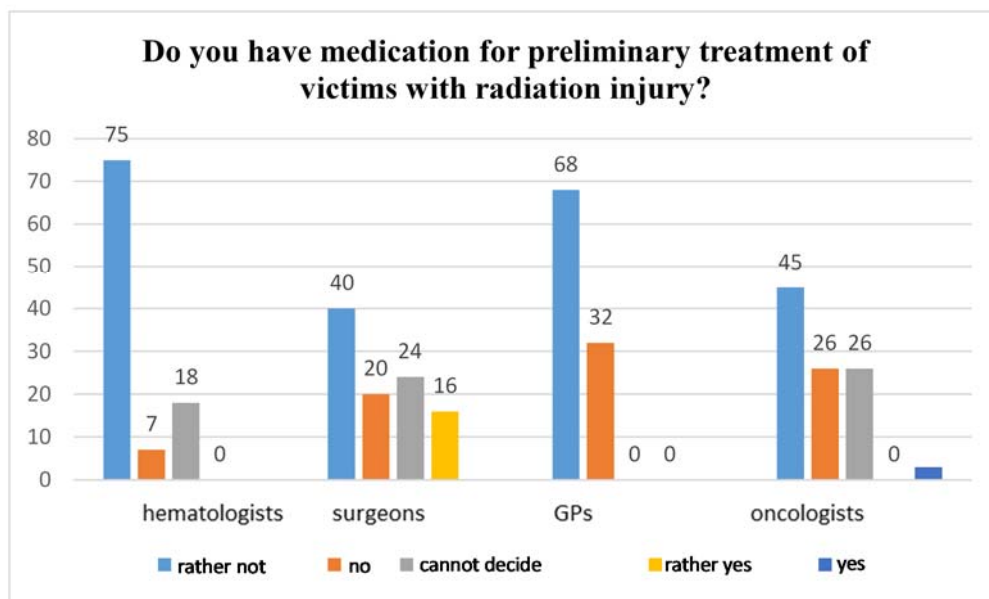
4. To the question „Do you have medication for preliminary treatment of victims with radiation injury?“ hematologists answer as follows: 21 or 75% - „rather not“; 5 or 18% „I cannot decide“; 2 or 7% - „no“ and 0% - „yes“ and „rather yes“.

Surgeons say: 10 or 40% - „rather not“; 6 or 24% - „I cannot decide“; 5 or 20% - „no“; 4 or 16% - „rather yes“ and 0% - „yes“.

The answers of the GPs are: 17 or 68% - „rather not“; 8 or 32% - „no“ and 0% - „yes“, „rather yes“ and „I cannot decide“.

Oncologists answer as follows: 14 or 45% - „rather not“; 8 or 26% - „no“ and „I cannot decide“; 1 or 3% - „yes“ and 0% - „rather yes“.

**Figure 13.** Presentation of the answers of all surveyed physicians by individual specialties to question №4 of the survey.

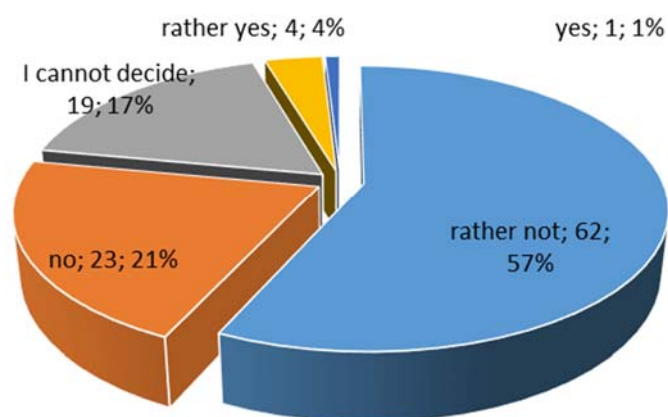


\* answers are given in%

All surveyed specialists answer this question as follows: 62 or 57% - „rather not“; 23 or 21% - „no“; 19 or 17% - „I cannot decide“; 4 or 4% - „rather yes“ and 1 or 1% - „yes“.

**Figure 14.** Summary of the answers of all surveyed physicians to question № 4 of the survey.

**Do you have medication for preliminary treatment of victims with radiation injury?**



The prevailing answers to this question are negative.

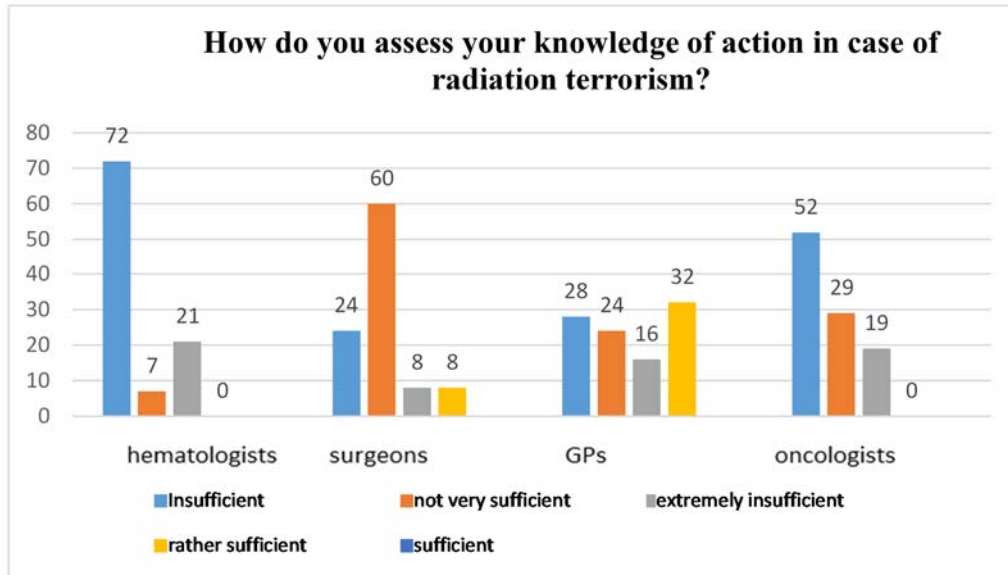
5. The question „How do you assess your knowledge of action in case of radiation terrorism?“ received the following answers: from hematologists - 20 or 72% - „insufficient“; 6 or 21% - „extremely insufficient“; 2 or 7% - „not very sufficient“ and 0% „sufficient“ and „rather sufficient“;

Surgeons answer as follows: 15 or 60% - „not very sufficient“; 6 or 24% - „insufficient“; 2 or 8% - „extremely insufficient“ and „rather sufficient“ and 0% - „sufficient“.

The answers of the GPs are: 8 or 32% - „rather sufficient“; 7 or 28% - „insufficient“; 6 or 24% - „not very sufficient“; 4 or 16% - „extremely insufficient“ and 0% - „sufficient“.

For oncologists, things are as follows: -16 or 52% „insufficient“; 9 or 29% - „not very sufficient“; 6 or 19% - „extremely insufficient“ and 0% - „sufficient“ and „rather sufficient“.

**Figure 15.** Presentation of the answers of all surveyed physicians by individual specialties to question № 5 of the survey.



\* answers are given in%

All specialists answer as follows: - 49 or 45% - „insufficient“; 32 or 29% - „not very sufficient“; 18 or 17% - „extremely insufficient“; 10 or 9% - „rather sufficient“ and 0% - „sufficient“.

**Figure 16.** Summary of the answers of all surveyed physicians to question № 5 of the survey.



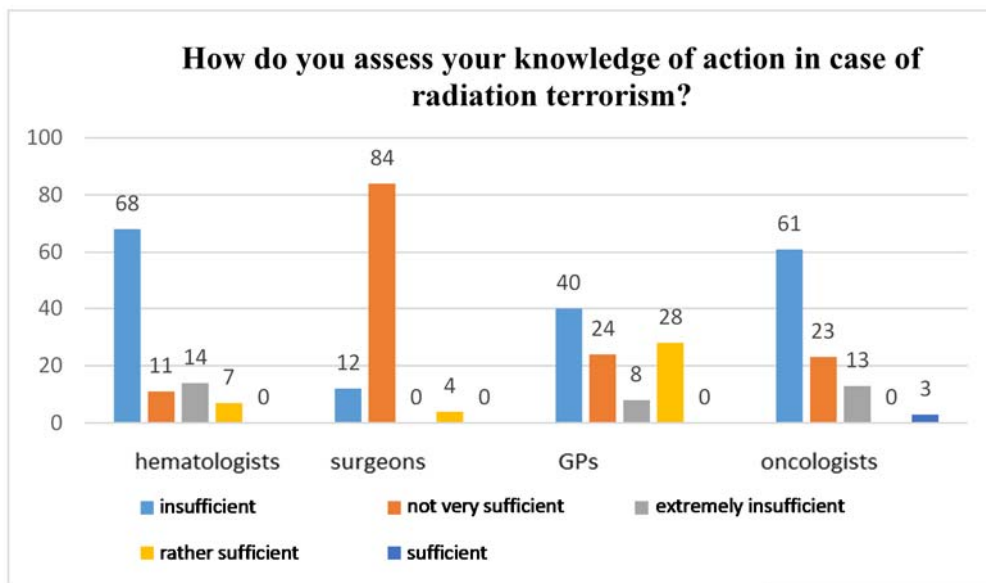
It turns out that the knowledge of action in case of radiation terrorism is not sufficient for all surveyed doctors.

6. The question „How do you assess your skills for action in case of radiation terrorism?“ received the following answers: hematologists - 19 or 68% - „insufficient“; 4 or 14% - „extremely insufficient“; 3 or 11% - „not very sufficient“; 2 or 7% - „rather sufficient“ and 0% - „sufficient“.

Surgeons - 21 or 84% - „not very sufficient“; 3 or 12% - „insufficient“; 1 or 4% „rather sufficient“ and 0% - „sufficient“ and „extremely insufficient“. GPs answer as follows: 10 or 40% - „insufficient“; 7 or 28% - „rather sufficient“; 6 or 24% - „not very sufficient“; 2 or 8% - „extremely insufficient“ and 0% - „sufficient“.

The answers of oncologists are: 19 or 61% - „insufficient“; 7 or 23% - „not sufficient“; 4 or 13% - „extremely insufficient“; 1 or 3% - „sufficient“ and 0% - „rather sufficient“.

**Figure 17.** Presentation of the answers of all surveyed physicians in individual specialties to question № 6 of the survey.

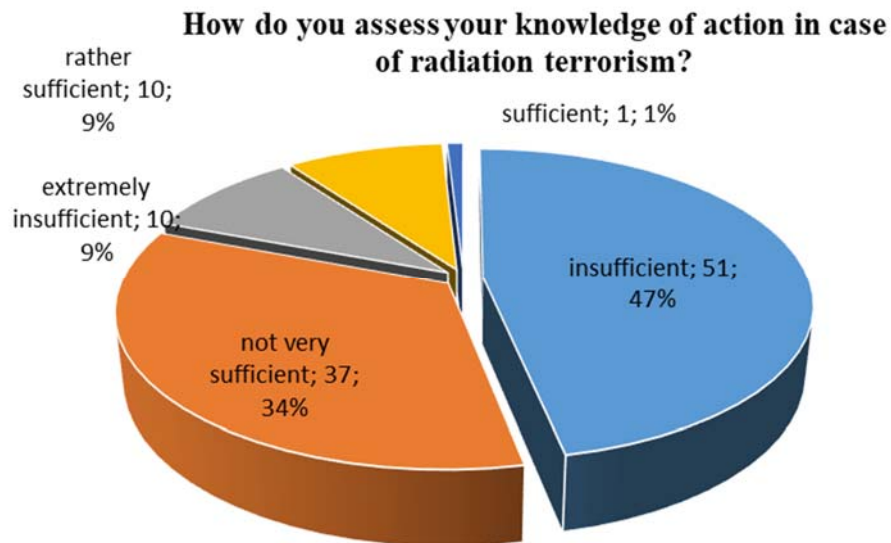


\* answers are given in%

The summarized results of all doctors on this issue are: 51 or 47% - „insufficient“; 37 or 34% - „not very sufficient“; 10 or 9% - „extremely insufficient“ and „rather sufficient“ and 1 or 1% - „sufficient“.



**Figure 18.** Summary of the answers of all surveyed physicians to question № 6 of the survey.



Again, this question is dominated by negative answers.

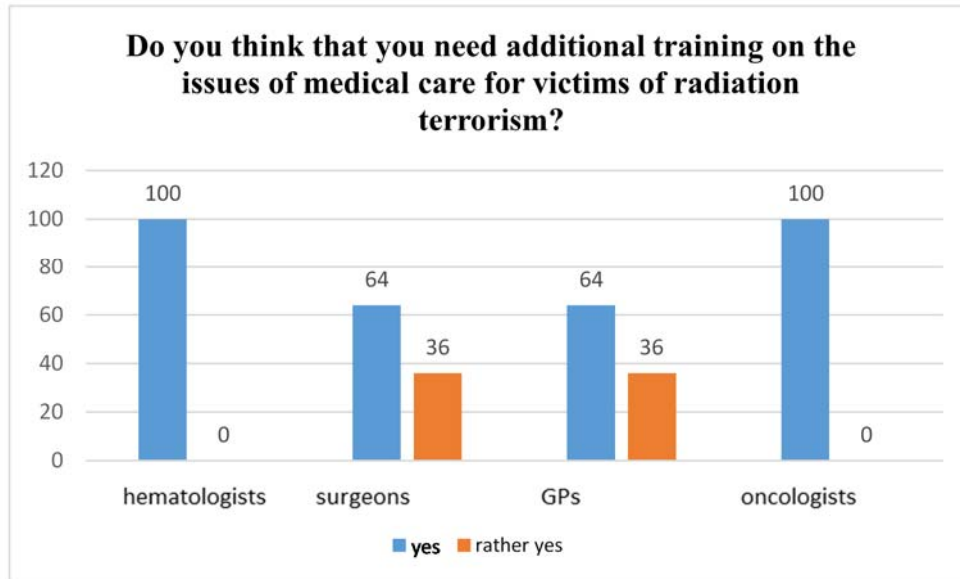
7. To the question „Do you think that you need additional training on the issues of medical care for victims of radiation terrorism?“ all 28 surveyed hematologists answered „yes“ and all others answer with 0%.

16 or 64% of surgeons answered „yes“ to this question; 9 or 36% - „rather yes“ and 0% are the answers „no“, „rather no“ and „I cannot decide“.

GPs - 16 or 64% - „rather yes“; 9 or 36% - „yes“ and 0% - „no“, „rather no“ and „I cannot decide“.

Oncologists answer as follows: - 31 or 100% of them answer „yes“, and all other answers are 0%.

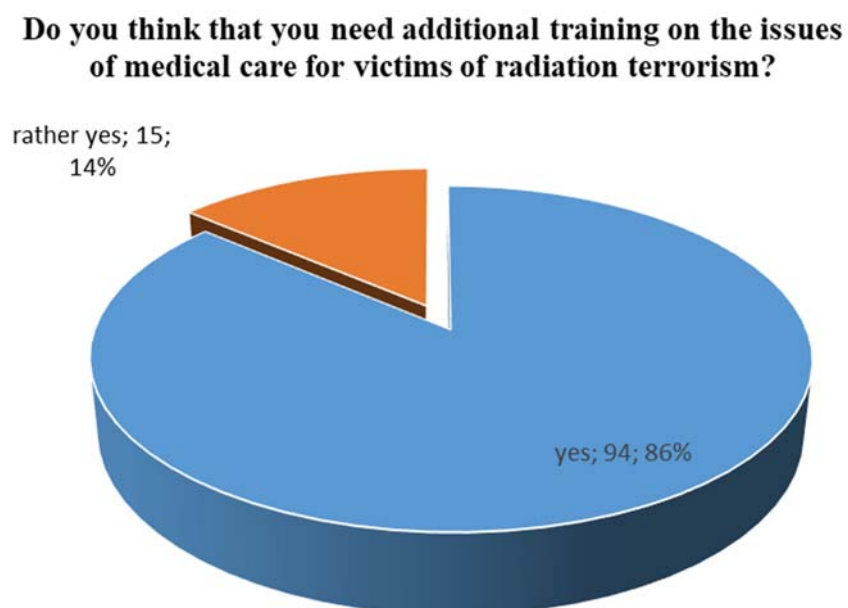
**Figure 19.** Presentation of the answers of all surveyed physicians by individual specialties to question № 7 of the survey.



\* answers are given in%

The results for all doctors are as follows: 94 or 86% say „yes“; 15 or 14% - „rather yes“ and all other answers are 0%.

**Figure 20.** Summary of the answers of all surveyed doctors to question № 7 of the survey.



In conclusion, it can be said that the results of the survey on this issue show that all doctors need additional training on the issues of medical care for victims of radiation terrorism.

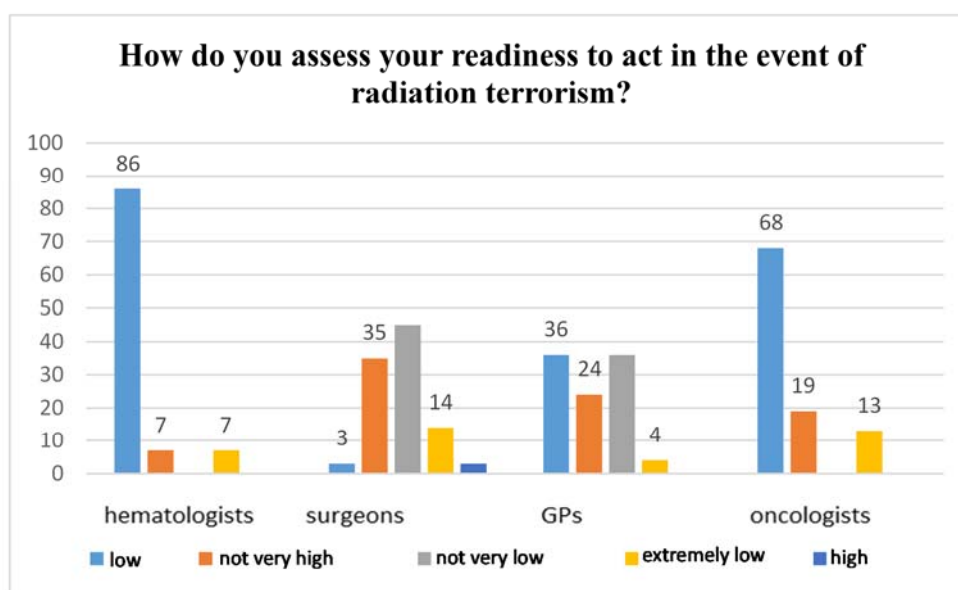
8. The answers to the question „How do you assess your readiness to act in the event of radiation terrorism?“ by hematologists is 24 or 86% - „low“; 2 or 7% - „extremely low“ or „not very high“ and „not very low“ and „high“ - 0%.

Surgeons - 13 or 45% - „not very low“; 10 or 35% - „not very high“; 4 or 14% - „extremely low“ and 1 or 3% - „low“ and „high“.

The answers of the GPs are: 9 or 36% - „not very low“ and „low“; 6 or 24% - „not very high“; 1 or 4% - „extremely low“ and 0% - „high“.

Oncologists answer as follows: 21 or 68% - „low“; 6 or 19% - „not very high“; 4 or 13% - „extremely low“ and 0% - „not very low“ and „high“.

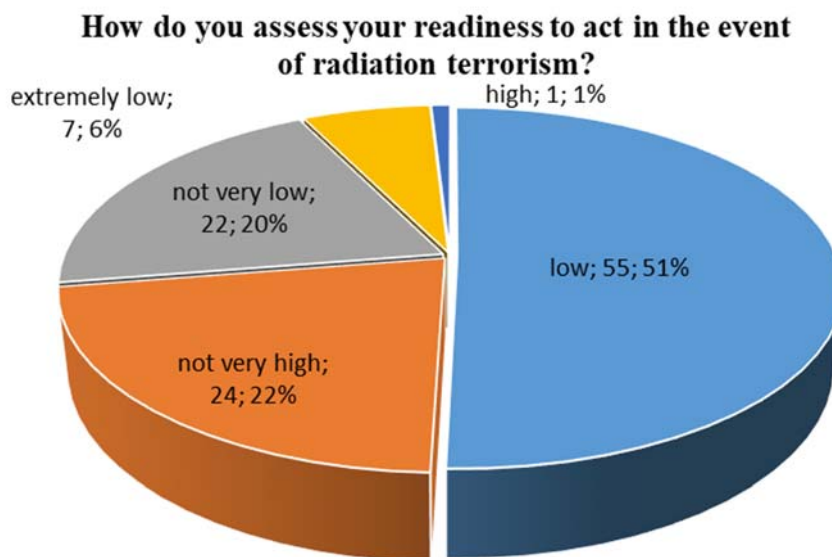
**Figure 21.** Presentation of the answers of all surveyed physicians by individual specialties to question № 8 of the survey.



\* answers are given in%

The answers to this question of all doctors are: 55 or 51% - „low“; 24 or 22% - „not very high“; 22 or 20% - „not very low“; 7 or 6% - „extremely low“, and 1 or 1% - „high“.

**Figure 22.** Summary of the answers of all surveyed physicians to question № 8 of the survey.



In general, the surveyed doctors believe that their readiness to act in the event of radiation terrorism is low.

9. To the question „Do you think that the fears of some specialists of possible radiation terrorism are reasonable?“ the hematologists answer: 20 or 72% - „rather yes“; 4 or 14% - „rather not“; 2 or 7% - „I cannot decide“ and „yes“, and 0% - „no“.

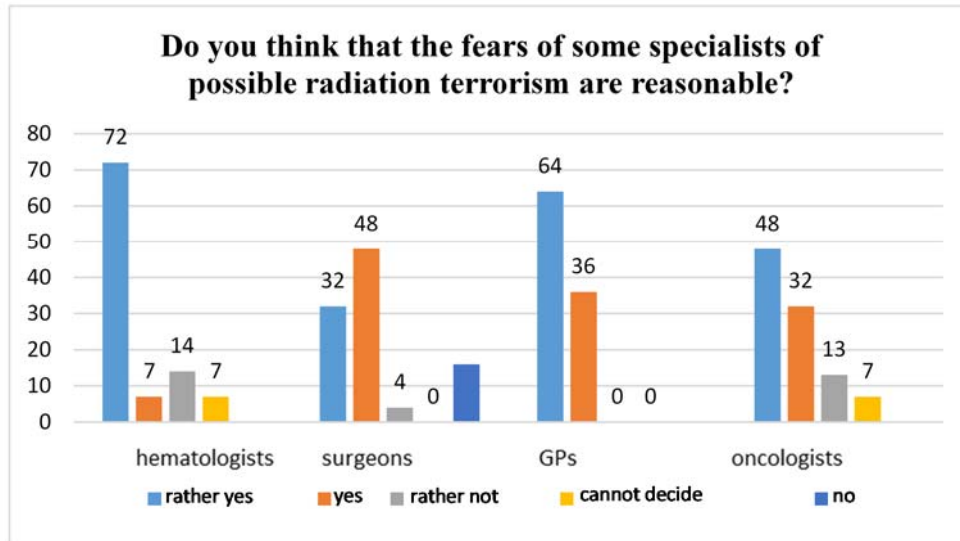
Surgeons answer as follows: 12 or 48% - „yes“; 8 or 32% - „rather yes“; 4 or 16% - „no“; 1 or 4% - „rather not“ and 0% - „I cannot decide“.

GPs: 16 or 64% - „rather yes“; 9 or 36% - „yes“, and „no“, „rather not“ and „I cannot decide“ - 0%.

The answers of oncologists are: 15 or 48% - „rather yes“; 10 or 32% - „yes“; 4 or 13% - „rather not“; 2 or 7% „I cannot decide“, and 0% - „no“.

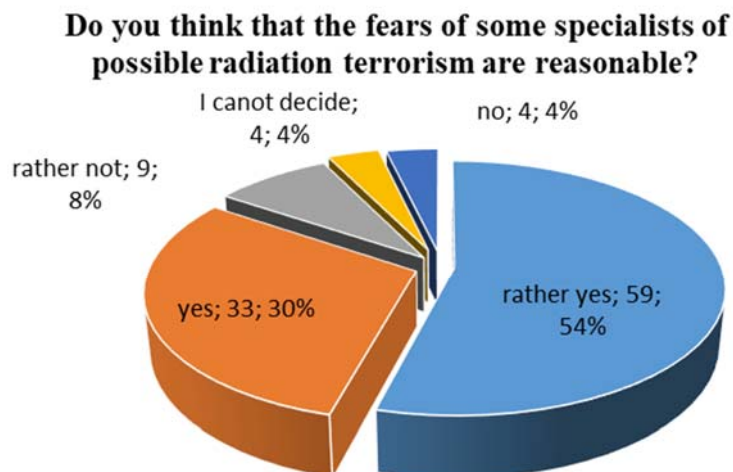
The summary for all doctors is: 59 or 54% - „rather yes“; 33 or 30% - „yes“; 9 or 8% - „rather not“; 4 or 4% „I cannot decide“ and „no“.

**Figure 23.** Presentation of the answers of all surveyed physicians by individual specialties to question № 9 of the survey.



\* answers are given in%

**Figure 24.** Summary of the answers of all surveyed physicians to question № 9 of the survey.



In conclusion, it can be said that according to the survey, the opinion is that there is a danger of radiation terrorism in our country.

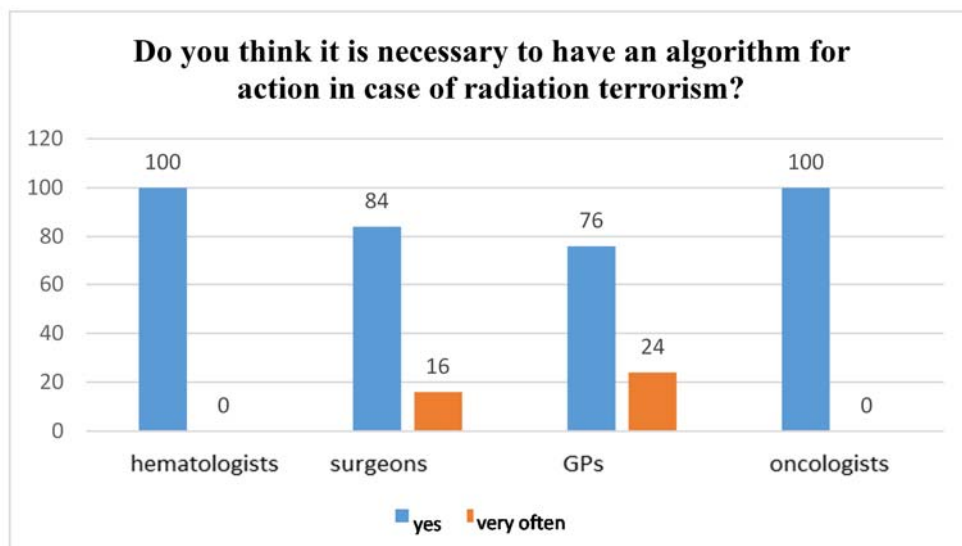
10. The question is „Do you think it is necessary to have an algorithm for action in case of radiation terrorism?“. To this question, all surveyed hematologists answered 100% with „yes“. The other answer options are 0%.

Surgeons: 84 or 84% - „yes“; 16% - „quite often“ and the other 3 possible answers - „quite rarely“, „almost never“ and „very often“ are 0% each.

GPs answer as follows: 76 or 76% answer „yes“; 24 or 24% - „quite often“ and all other answers, namely „almost never“, „quite rarely“ and „very often“ are 0%.

All 31 oncologists surveyed or 100% answered „yes“. The other answers „almost never“, „quite rarely“, „quite often“ and „very often“ have 0% each.

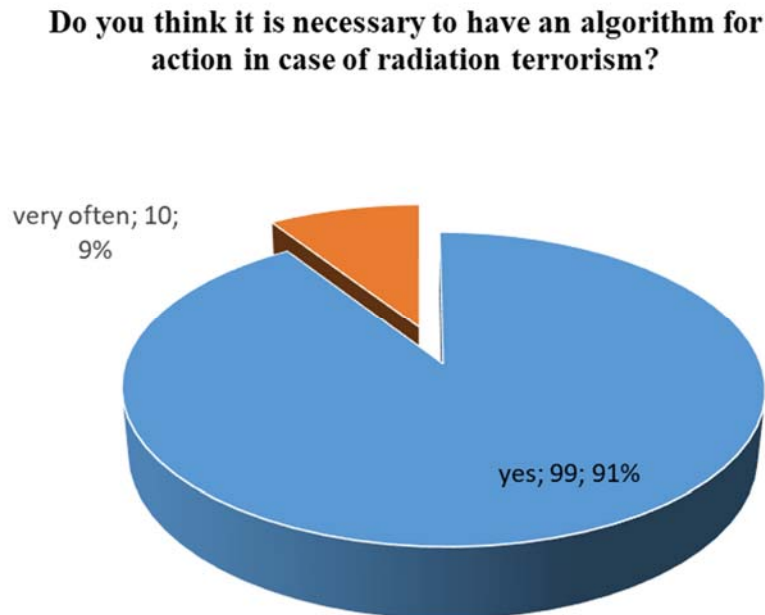
**Figure 25.** Presentation of the answers of all surveyed physicians by individual specialties to question № 10 of the survey.



\* answers are given in%

The answer of all doctors is as follows: 99 or 91% say „yes“; 10 or 9% „quite often“, and the other answers „almost never“, „quite rarely“ and „very often“ have 0% each.

**Figure 26.** Summary of the answers of all surveyed physicians to question №10 of the survey.



In summary, it can be said that the existence of an algorithm for action in radiation terrorism is a needed essential factor.

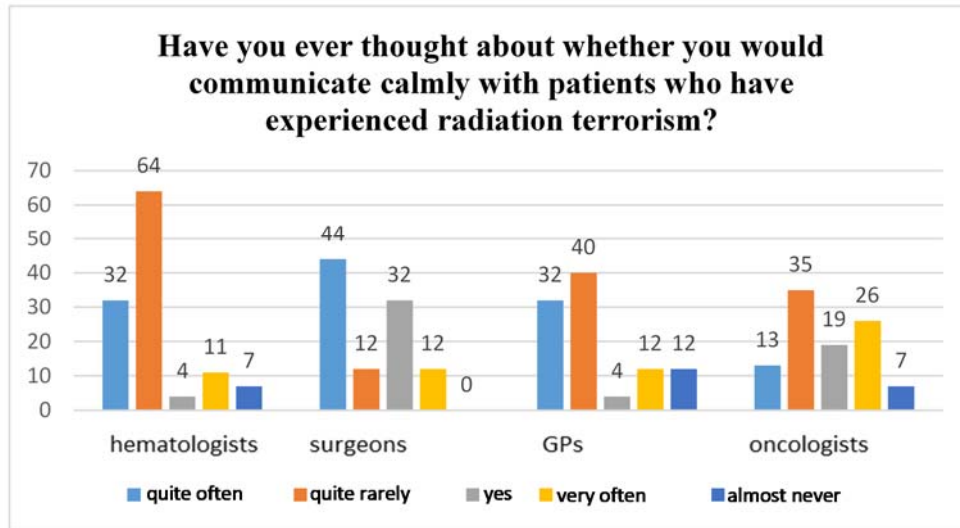
11. The question „Have you ever thought about whether you would communicate calmly with patients who have experienced radiation terrorism?“ received the following answers: 13 or 64% of hematologists - „quite rarely“; 9 or 32% - „quite often“; 3 or 11% - „very often“; 2 or 7% - „almost never“ and 1 or 4% - „yes“.

The answer of the surgeons is as follows: 11 or 44% - „quite often“; 8 or 32% - „yes“; 3 or 12% - „very often“ and „quite rarely“ and 0% - „almost never“.

GPs - 10 or 40% - „quite rarely“; 8 or 32% - „quite often“; 3 or 12% - „very often“ and „almost never“ and 1 or 4% - „yes“.

The opinion of oncologists on the question is: 11 or 36% - „quite rarely“; 8 or 26% - „very often“; 6 or 19% - „yes“; 4 or 13% - „quite often“ and 2 or 6% - „almost never“.

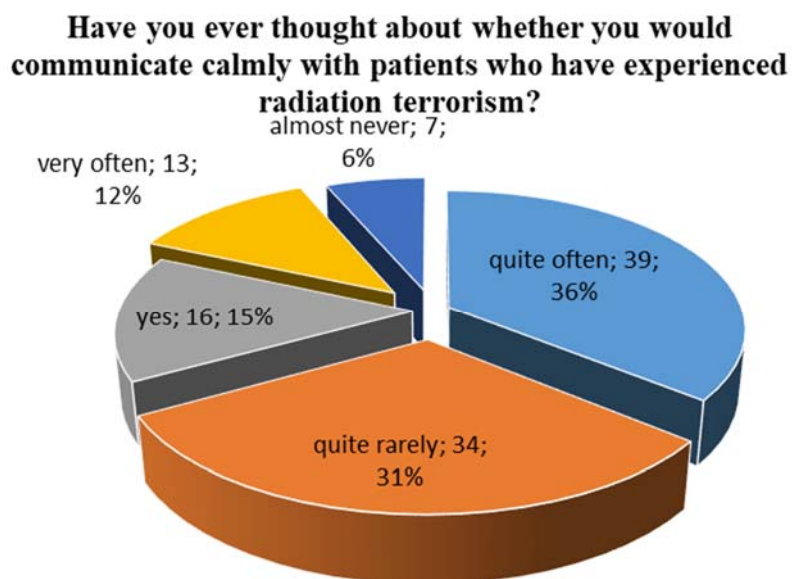
**Figure 27.** Presentation of the answers of all surveyed physicians by individual specialties to question № 11 of the survey.



\* answers are given in%

All doctors answer the following question as follows: 39 or 36% - „quite often“; 34 or 31% - „quite rarely“; 16 or 15% - „yes“; 13 or 12% - „very often“ and 7 or 6% - „almost never“.

**Figure 28.** Summary of the answers of all surveyed physicians to question №11 of the survey.





In conclusion, it can be said that the surveyed doctors almost never thought about whether they would be absolutely calm in contact with patients who have experienced radiation terrorism.

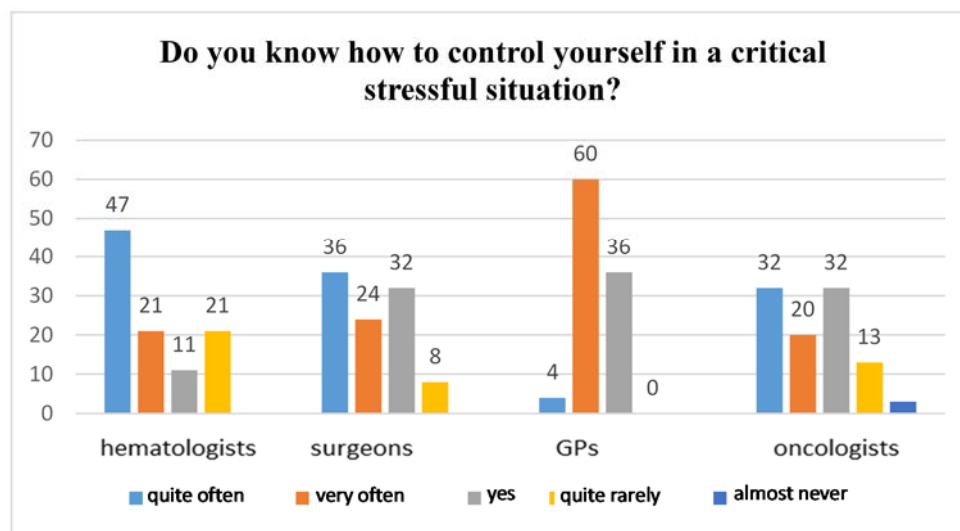
12. The next question is „Do you know how to control yourself in a critical stressful situation?“. Hematologists give the following answer: 13 or 47% - „quite often“; 6 or 21% - „very often“ and „quite rarely“; 3 or 11% - „yes“ and 0% - „almost never“.

Surgeons give the following answers: 9 or 36% - „quite often“; 8 or 32% - „yes“; 6 or 24% - „very often“; 2 or 8% - „quite rarely“ and 0% - „almost never“.

GPs answer this question with: 15 or 60% - „very often“; 9 or 36% - „yes“; 1 or 4% „quite often“ and 0% - „quite rarely“ and „almost never“.

Oncologists: 10 or 32% - „yes“ and „quite often“; 6 or 20% - „very often“; 4 or 13% - „quite rarely“; 1 or 3% - „almost never“.

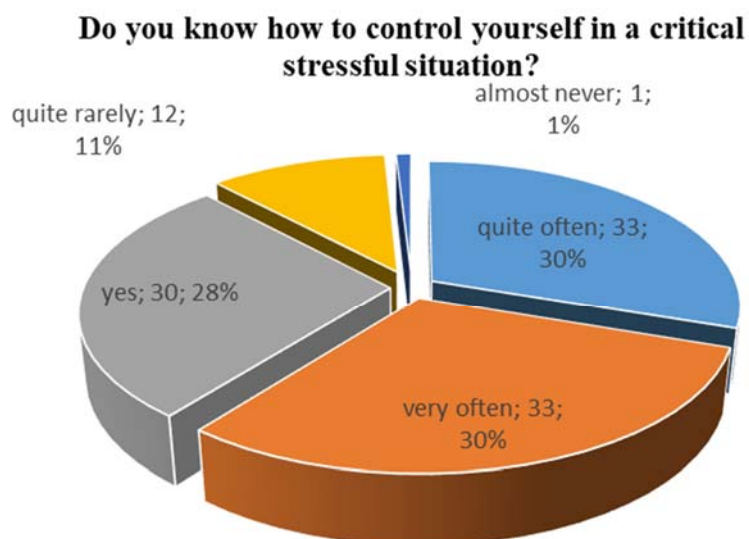
**Figure 29.** Presentation of the answers of all surveyed physicians by individual specialties to question № 12 of the survey.



\* answers are given in%

The summary for all doctors is as follows: 33 or 30% - „quite often“ and „very often“; 30 or 28% - „yes“; 12 or 11% - „quite rarely“ and 1 or 1% - „almost never“.

**Figure 30.** Summary of the answers of all surveyed physicians to question №12 of the survey.



In conclusion, it can be said that the surveyed doctors behave well in a critical situation.

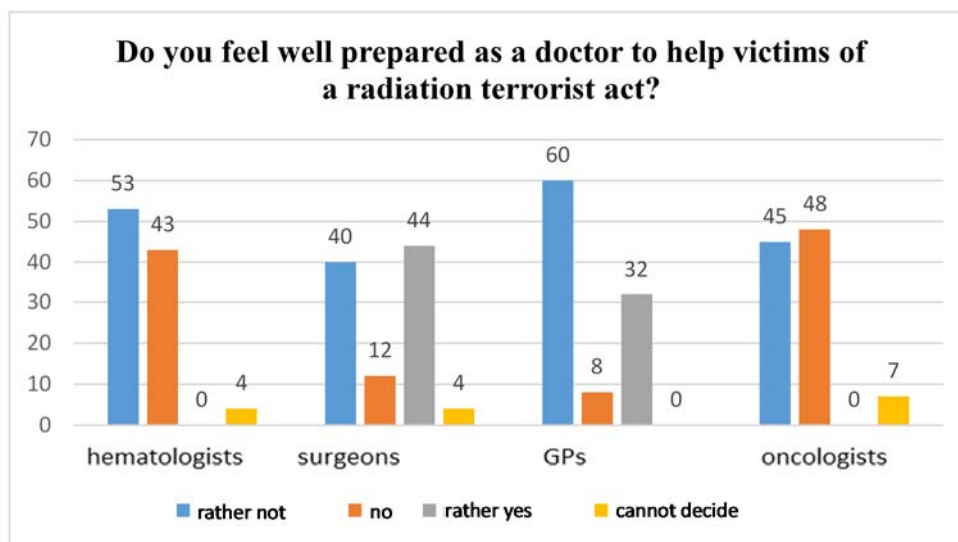
13. The question is „Do you feel well prepared as a doctor to help victims of a terrorist act?“. Hematologists answer that 15 or 53% - „rather not“; 12 or 43% - „no“; 1 or 4% - „I cannot decide“ and 0% - „rather yes“ and „yes“.

The responses of surgeons are 11 or 44% - „rather yes“; 10 or 40% - „rather not“; 3 or 12% - „no“; 1 or 4% - „I cannot decide“, and 0% - „yes“.

GPs answer as follows: 15 or 60% - „rather not“; 8 or 32% - „rather yes“; 2 or 8% - „no“ and 0% - „I cannot decide“ and „yes“.

Oncologists give the following answers: 15 or 48% - „no“; 14 or 45% - „rather not“; 2 or 7% - „I cannot decide“ and 0% - „yes“ and „rather yes“.

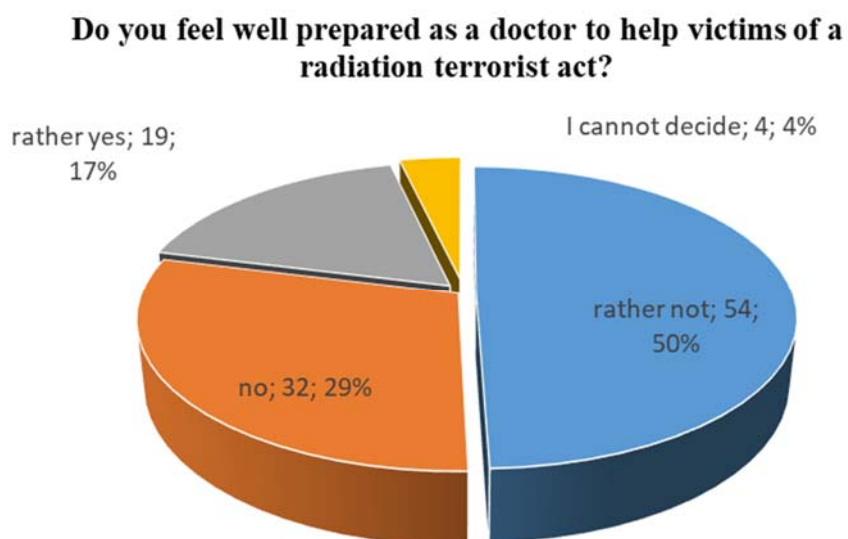
**Figure 31.** Presentation of the answers of all surveyed physicians by individual specialties to question № 13 of the survey.



\* answers are given in%

In total, the answers of all doctors that to this question are: 54 or 50% - „rather not“; 32 or 29% - „no“; 19 or 17% - „rather yes“; 4 or 4% - „I cannot decide“ and 0% - „yes“.

**Figure 32.** Summary of the answers of all surveyed physicians to question №13 of the survey.



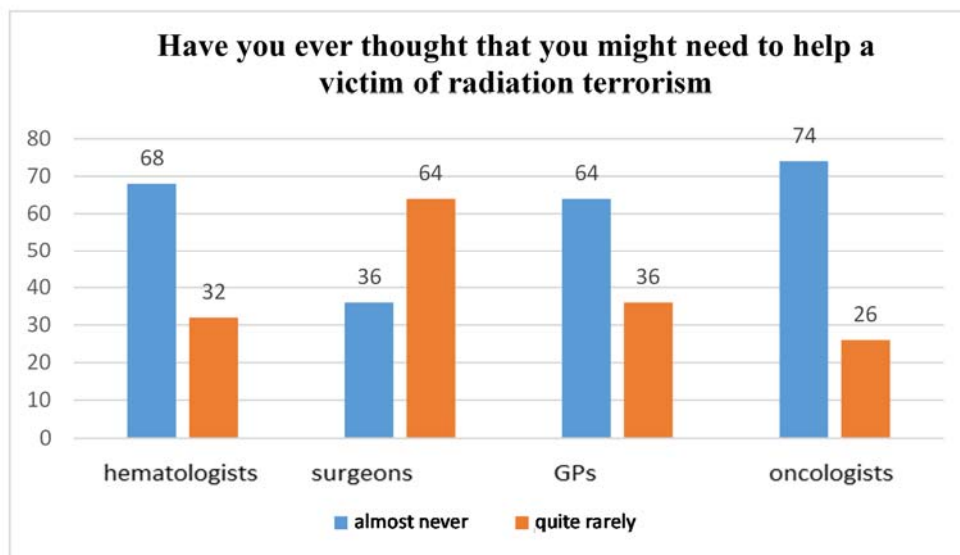
14. The answers to the question „Have you ever thought that you might need to help a victim of radiation terrorism?“ are as follows: hematologists - 19 or 68% - „almost never“; 9 or 32% - „quite rare“ and 0% - „quite often“, „very often“ and „yes“.

Surgeons - 16 or 64% - „quite rare“; 9 or 36% - „almost never“ and 0% - „quite often“, „very often“ and „yes“.

The results are similar for GPs: 16 or 64% - „almost never“; 9 or 36% - „quite rarely“ and 0% - „quite often“, „very often“ and „yes“.

For oncologists, the problem is the same again: 23 or 74% - „almost never“; 8 or 26% - „quite rarely“ and 0% - „quite often“, „very often“ and „yes“.

**Figure 33.** Presentation of the answers of all surveyed physicians by individual specialties to question № 14 of the survey.

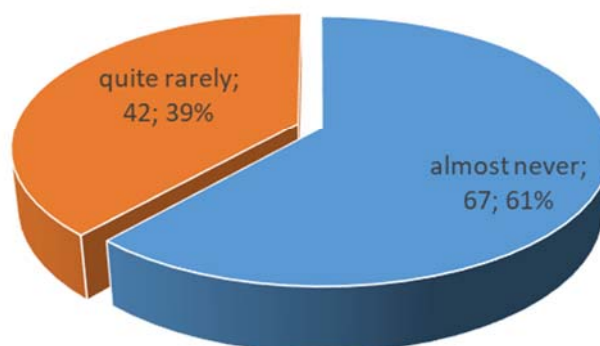


\* answers are given in%

All doctors answer this question as follows: 67 or 61% - „almost never“; 42 or 39% - „quite rarely“ and 0% - „quite often“, „very often“ and „yes“.

**Figure 34.** Summary of the answers of all surveyed physicians to question №14 of the survey.

**Have you ever thought that you might need to help a victim of radiation terrorism**



In conclusion, the answer to this question is definite - all surveyed specialists very rarely or almost never thought that they may need to provide assistance to a victim of radiation terrorism.

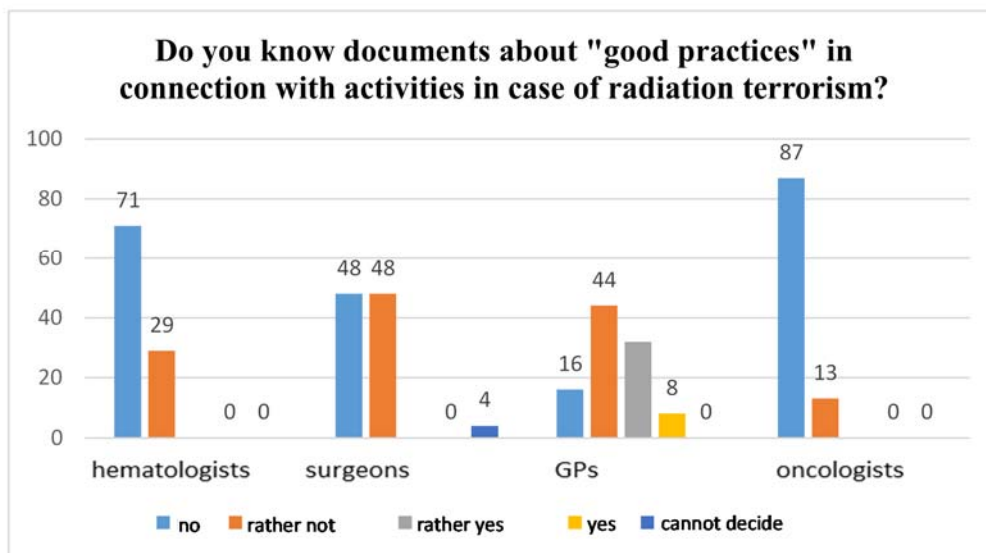
15. The question is: „Do you know any documents on 'good practice' in connection with activities to radiation terrorism?“. Hematologists give the following answers - 20 or 71% - „no“; 8 or 29 percent - „rather not“ and 0% - „rather yes“, „I cannot decide“ and „yes“.

Surgeons - 12 or 48% - „no“ and „rather not“; 1 or 4% - „I cannot decide“ and 0% - „yes“ and „rather yes“.

The survey of GPs gives the following answers: 11 or 44% - „rather not“; 8 or 32% - „rather yes“; 4 or 16% - „no“; 2 or 8% - „yes“ and 0% - „I cannot decide“.

Oncologists: 27 or 87% - „no“; 4 or 13% - „rather not“ and 0% - „rather yes“, „yes“ and „I cannot decide“.

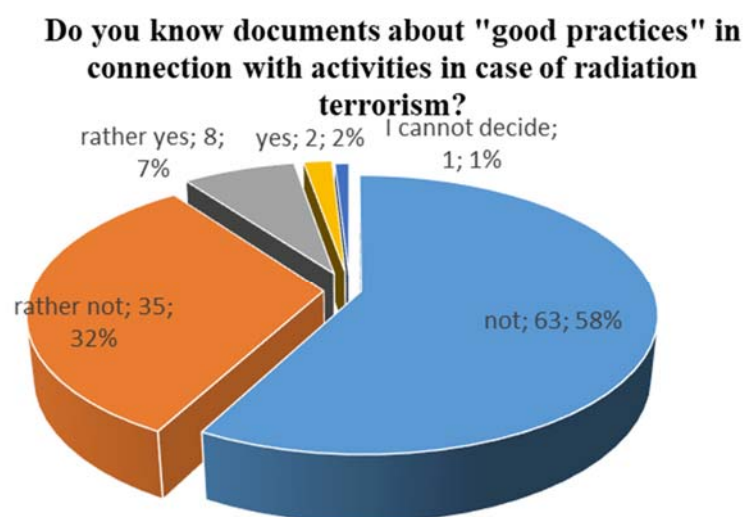
**Figure 35.** Presentation of the answers of all surveyed physicians by individual specialties to question № 15 of the survey.



\* answers are given in%

The answers of all doctors are as follows: - 63 or 58% - „no“; 35 or 32% - „rather not“; 8 or 7% - „rather yes“; 2 and 2% - „yes“ and 1 or 1% - „I cannot decide“.

**Figure 36.** Summary of the answers of all surveyed physicians to question №15 of the survey.



To summarize the answers to the question, the majority of surveyed doctors do not know good practices in relation to radiation terrorism activities.

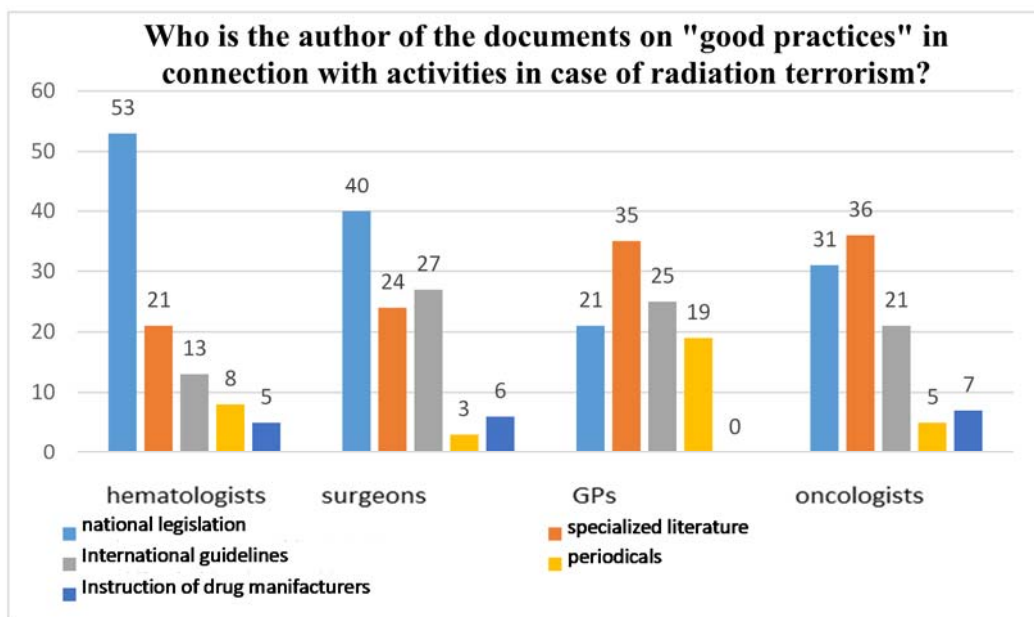
16. The last question from the survey is „Who is the author of the documents on good practices „in connection with actions in radiation terrorism?“. Hematologists respond to it as follows - 20 or 53% - „national legislation“; 8 or 21% - „specialized literature“; 5 or 13% - „international guidelines“; 3 or 8% - „periodicals“ and 2 or 5% - „instructions of drug manufacturers“.

Surgeons: 13 or 40% - „national legislation“; 9 or 27% - „international guidelines“; 8 or 24% - „specialized literature“; 2 or 6% - „instructions of drug manufacturers“ and 1 or 3% - „periodicals“.

The answers of the GPs are: - 18 or 35% - „specialized literature“; 13 or 25% - „international guidelines“; 11 or 21% - „national legislation“; 10 or 19% - „periodicals“ and 0% - „instructions of drug manufacturers“.

Oncologists - 15 or 36% - „specialized literature“; 13 or 31% - „national legislation“; 9 or 21% - „international guidelines“; 3 or 7% - „instructions of drug manufacturers“ and 2 or 5% - „periodicals“.

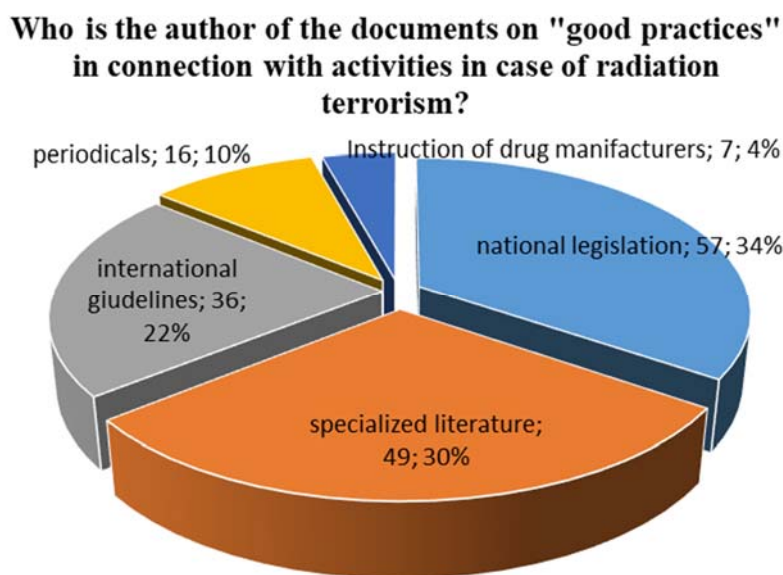
**Figure 37.** Presentation of the answers of all surveyed physicians by individual specialties to question № 16 of the survey.



\* answers are given in%

The synthesized answers of all doctors to the question are: 57 or 34% - „national legislation“; 49 or 30% - „specialized literature“; 36 or 22% - „international guidelines“; 16 or 10% - „periodicals“ and 7 or 4% - „instructions of drug manufacturers“.

**Figure 38.** Summary of the answers of all surveyed physicians to question №16 of the survey.



In conclusion, it can be said that the surveyed doctors are informed from different places about the authorship of the documents for „good practices“ in connection with actions in case of radiation terrorism.

### **Summarized results from the analysis of the conducted survey**

1. Doctors consider that there is no risk for them in providing the medical care of radiation-injured persons.
2. However, they are unable to provide initial treatment to the victims.
3. They do not know whom to turn to for consultations in case of radiation injuries.
4. They do not have the necessary medication for treatment.
5. They consider that their knowledge of how to act in the event of radiation terrorism is insufficient.
6. They are unsure of their skills for dealing with in case of radiation terrorism.
7. All surveyed doctors are unanimous that they need additional training on medical provision on the subject.
8. Their readiness for action in case of radiation terrorism is low.



9. They support the opinion of some experts that radiation terrorism is possible in our country as well.

10. They are unanimous about the need for an algorithm to describe the actions in case of terrorism with the consequences of radiation contamination of the victims.

11. Most of the surveyed doctors almost never thought about whether they would be absolutely calm in contact with patients who have experienced radiation terrorism.

12. The prevailing opinion is that doctors behave well in critical situations.

13. As a summary of the answers above, it can be said that doctors do not feel well prepared to provide medical assistance in the event of a radiation terrorist act.

14. All respondents say that it has rarely come to mind to them that they may need to provide medical assistance on the subject.

15. They are not aware about good practices in relation to medical actions in radiation terrorism.

16. The author of good practices is considered to be the national legislation and the specialized literature.

### **3.3. Model (algorithm) of organization and management of work processes in the Department of Hematology at the University Hospital „St. Ivan Rilski ”(Sofia) in providing first medical aid in case of sudden disturbances in the functioning of the hematopoietic system of large groups of people caused by nuclear pollution.**

As pointed out in previous chapters, the likelihood of a terrorist act involving nuclear or radioactive material is substantial. The developed national plan for disasters and accidents, as well as the external emergency plan of Kozloduy NPP give an idea for the possible organization of the measures, as well as the structures and institutions involved in these activities. Not all aspects of the possible problems are fully clarified, such as the question of the resources that will be able to provide medical care to victims of radioactive materials or ionizing radiation. The hierarchical structure envisaged according to the national action plan for the management of the processes for liquidation of the consequences of radioactive contamination has all grounds for success, in case of a relatively small number of victims. With mass casualties, however, this is unlikely to happen. The designated teams and specialists from

the specialized institutions could not ensure the entire process of implementing the measures for dealing with the consequences of this disaster, mainly due to the lack of sufficient resources.

This is especially true for the problems of medical provision for victims of radioactive contamination. The envisaged Center for Radiation Injuries, located on the territory of the Military Medical Academy-Sofia, cannot provide **medical provision for more than 50-100 people, but in terms of first aid in case of sudden disorders of the hematopoietic system of large groups of people caused by from nuclear contamination** this would be possible for no more than 20-30 people, given the current bed capacity of the MMA Clinic of Hematology, consisting of about 30 beds. The reserve in this respect is represented by the other municipal, state and private medical establishments on the territory of the country. However, it is unlikely that any medical institution has created such an organization to respond adequately to the needs in the event of such cataclysms. Therefore, the idea for the present development is to propose a **Model (algorithm) of organization and management of work processes in the Department of Hematology at the University Hospital „St. Ivan Rilski ”in Sofia, in providing first aid in case of sudden disturbances in the functioning of the hematopoietic system of large groups of people caused by nuclear pollution.** If it is considered rational, this model could be applied in other medical institutions with hematology structures. This, in turn, would allow a much more adequate response by the Ministry of Health in cases of sudden disturbances in the functioning of the hematopoietic system of large groups of people caused by nuclear pollution as a result of a terrorist act.

The Clinic of Clinical Hematology at the University Hospital „St. Ivan Rilski“ has 55 beds located on the ground and basement floors of the hospital. The basement floor has a separate entrance and it has two hospital wings with 15 and 12 beds, respectively, and a day hospital with 10 beds, which allows for medical care for at least 37 victims. There are 28 more beds on the ground floor, which will be used for admission and specific care of patients who need specialized hematological care after they have been decontaminated, they have received first aid in the basement or in other emergency departments of the Military Medical Academy, or other hospitals.

The clinic itself is located in close proximity to the Military Medical Academy, namely the Emergency Department and the Medical Institute of Psychiatry of the Military Medical Academy. The University Hospital „St. Ivan Rilski“ has Departments of Imaging and Radiation Therapy, which have specialists in radiology, X-ray technicians, radiotherapists and physicists. These specialists will be extremely valuable in the management of victims of radioactive contamination, as they will advise and participate in the processes of triage, measurement of

the individual radiation dose received from the victims and other activities. It is envisaged that a team consisting of hematologists and radiologists will be established at St. Ivan Rilski University Hospital, which will be trained in a timely manner to act in the event of a nuclear accident, and an organization will be established to operate within 6- 12 hours after the eventual occurrence of such an event. Victims of radioactive contamination would come in several different ways:

1. Reassigned from the emergency unit of the Military Medical Academy or from the provided Center for radiation affected to the Military Medical Academy after exhaustion of its capacity;
2. Directed by GPs;
3. Directed by the emergency departments of other hospitals;
4. Self-directed;

It is planned to create a admission-sorting point at the side entrance from Company Maimex on the ground floor of the Hematology Clinic, where will be applied triage of the victims, measurement of the individual radiation dose of each, providing of emergency first aid, if necessary, and decontamination, if necessary, and referral of patients sorted by groups to the next unit. Several options are expected:

1. Patients in need of emergency care, in case they are self-referred or sent by GPs - these patients are referred to the emergency department of the Military Medical Academy, after which they can be re-admitted for follow-up.

2. Patients in severe mental shock, but receiving relatively little or no radiation are examined by a psychologist from the Clinic of Hematology and possibly referred for specialized care to the Clinic of Psychiatry of the Military Medical Academy, which is less than 100 meters from the site.

3. Patients in need of decontamination are directed to the basement, which is adjacent to the Admission and Sorting Point, where there are currently changing rooms for staff of the Clinic of Hematology and the Department of Abdominal Surgery, as well as other premises, as an archive, etc.

4. Patients in need of milder measures, such as analgesia, infusions of saline solutions, etc. are directed to the Day Hospital of the Clinic or to both wings of the basement, and patients who need blood transfusions, application of growth factors and other specialized hematological procedures are directed to the ground floor for follow-up activities. Thus, the Clinic of Hematology at the University Hospital „St. Ivan Rilski“ could provide medical care for 60-70 patients at a time and provide medical care in different amounts several times more.

**Preparation of the response team in case of radioactive contamination of people as a result of a terrorist act:**

Experience has shown that radiologists, and even less hematologists or other specialists, have an idea of the effects of a nuclear situation. However, the extent to which additional training is needed can be seen from our own survey:

**The actions of the medical provision team in the event of a radiation incident as a result of a terrorist act:**

1. Providing emergency medical care to all victims and determining the procedure for their care;
2. Implementation of life-saving measures for injured persons;
3. Taking measures to reduce radiation.

Upon admission to the University Hospital „St. Ivan Rilski“ the members of the specialized team perform the following actions:

1. Carry out an assessment of the health condition of the injured persons and apply, if necessary, life-saving medical activities;
2. Take measures to limit the radiation dose to the affected persons and order the immediate removal of all victims from the accident area;
3. Establish the presence of radioactive contamination of the victims;
4. Take measures for initial and partial decontamination of the victims, if there is a practical possibility;
5. Take measures to prevent the spread of radioactive contamination if there is a danger or there is a suspicion of contamination;
6. Apply, if necessary, measures for protection of the thyroid gland of the injured persons;
7. Collect data on the persons who came to the place of the accident in order to provide medical supervision and/or treatment if necessary;
8. Fill in an emergency form for each injured person;
9. Direct with specialized transport the persons, who have been severely injured by the accident, to the admission-sorting department of the determined medical establishment, notifying it of:
  - (a) the number of victims;
  - b) the health and radiological status of the victims;
  - c) the approximate time for arrival at the medical establishment.

Upon admission to the medical institution, the victims are directed to the admission

and sorting department. The following activities are carried out in the admission and sorting department:

1. Assessment of the health condition of each injured person;
2. Emergency assistance to stabilize the condition of the injured person;
3. Assessment of the radioactive contamination of the victims;
4. Decontamination of wounds of the victims;
5. External decontamination in the absence of medical contraindications;
6. Assessment of internal contamination.

The injured are divided into the following groups, depending on the type of injury:

1. With symptoms of radiation combined with severe injuries and/or burns;
2. No symptoms of radiation, but with severe combined injuries;
3. With potential radiation symptoms;
4. No injuries but contaminated with radioactive substances;
5. No injuries and probably no radiation.

Medical care is given priority to the victims, who need to take urgent measures on vital signs, regardless of which group they are distributed.

The treatment of persons with external contamination with radioactive substances shall be carried out in accordance with the procedure specified in Annex № 3 of Ordinance 28/03/10/2006:

#### **External decontamination procedure**

1. Intact skin is decontaminated by washing. Complete decontamination is not always possible, so it is necessary to reach a reasonable practical level.

2. Washing is done with water, mild soap, soft brush or surgical sponge. The water should be lukewarm - never hot or cold.

3. The skin area is rubbed for 3-4 minutes, then rinsed for 2-3 minutes and dried. If necessary, the procedure is repeated.

4. Avoid rubbing or breaking the integrity of the skin in any way.

5. In the cases when the 2-3-fold treatment of the skin does not give the desired result, and also in case of significant residual activity, specialized decontamination solutions are applied alone or in combination.

6. Radiation monitoring is performed after each wash.

7. Decontamination procedures shall be terminated if there is no difference as a result of two subsequent measurements.

8. Hairy areas of the head are washed several times with shampoo.
9. If this washing is ineffective, the hair is cut.
10. Avoid shaving.
11. When washing the head, do not allow water to get into the ears, eyes, nose or mouth.
12. In the presence of contaminated large parts of the body, the victims are decontaminated by bathing, taking care not to get water in the eyes, ears, mouth or nose.
13. The decontamination procedures shall be repeated until reaching a level below the one specified in Annex № 4 of the Ordinance.

### **Treatment of contaminated wounds**

1. Wounds are covered with waterproof bandages to prevent the spread of radioactive contamination while decontaminating the rest of the body.
2. Decontamination is performed by gentle rinsing with saline or water several times.
3. Wounds are measured for contamination after each wash.
4. Bandages and washings and bedding shall be collected in containers.
5. After decontamination, the wounds are treated as normal.
6. If the procedures preceding the decontamination are insufficient and the level of contamination is high, incision of the wounds can be performed.
7. The separated tissues are also collected in containers for subsequent measurement.
8. If large radioactive particles are seen in the wound, they are separated by long-handled tweezers.
9. Puncture wounds, especially on the fingers, are decontaminated by a thin-layer biopsy.
10. After decontamination of the wound, a bandage is made with a waterproof bandage.
11. Before suturing or other treatment is required, the area around the wound is carefully decontaminated.
12. Contaminated burns - chemical or thermal, are treated like any other burn.

### **Decontamination of body openings**

1. Body openings (mouth, eyes, ears, and nose) are decontaminated first.
2. Brush your teeth with toothpaste and rinse your mouth several times.
3. Gargle with 3% oxygenated solution.
4. Gastric lavage shall be performed at the discretion of a specialist in radiobiology or radiation hygiene.
5. Rinse the eyes from the inner to the outer corner with a liquid to avoid contamination of the tear duct.
6. Contaminated ears - external washing and subsequent rinsing of the ear canal is performed after checking the tympanic membrane.

Medical examinations and tests of those affected by the radiation accident, as well as of the emergency teams are carried out by specialists from the NCRRP.

Actions include:

1. Detailed survey of the person affected by the accident;
2. Clinical examination by a doctor - specialist in radiobiology or radiation hygiene;
3. Clinical and laboratory tests;
4. Conducting specialized biodosimetric tests - at the discretion of a doctor - a specialist in radiobiology or radiation hygiene;
5. Studies to assess the presence of external contamination and/or inflow of radionuclides.

The results of the medical examinations together with the data on the received radiation doses are reflected in the medical documentation of the person.

Upon admission of the injured persons to the admission-sorting department of the medical institution, the medical specialists conduct a survey, which aims to establish the facts related to the accident and to provide information about the probability that the person has been irradiated.

Clinical and laboratory tests and tests for biological dosimetry are performed on the persons injured in a radiation accident on the prescription of a doctor with a recognized specialty in radiobiology or radiation hygiene.

Persons in whom no radioactive contamination has been detected shall be referred to the relevant departments of the medical establishments for other examinations or treatment, depending on their condition.

The treatment of persons with radioactive contamination is carried out in a separate area of the medical institution.

After identifying victims with hematopoietic syndrome or a tendency to develop such, they are accommodated in separate rooms with the possibility of maximum sterility. The necessary diagnostic tests are performed, including blood, urine, and bone marrow. If necessary, blood and blood products are transfused, infusions with antibiotics, antifungals, antiviral drugs, antiemetics, analgesics, aqueous saline solutions. Growth factors such as GM-CSF, G-CSF are applied. Allogeneic hematopoietic stem cell transplantation is considered at the discretion and availability of a compatible donor. This activity is carried out in the centers that have this opportunity, namely - National Specialized Hospital for active treatment of hematological diseases in Sofia, as well as in the University Hospitals in Plovdiv and Varna.

### **3.4. Psychological support and action plan for providing assistance to the population due to radiation contamination, terrorist act and other radiation incidents**

The psychological protection of the population in case of radiation contamination, terrorist act and other radiation incidents should be carried out with continuous provision of psychological support, through the organization of a system of training (clinical, social psychologists) to work with different segments of the population, through providing reliable and accessible information to people (including clear rules of action).

Psychological help is provided by various specialists:

- psychiatrists;
- psychotherapists;
- and psychologists, with close interaction between them.

The first thing to keep in mind is that they are not alone in the crisis, and everyone else is in the same situation. The thing is, everyone reacts differently at critical moments. Here we must pay attention not to the situation, but to the person's reaction to the situation, the event.

“People are in a state of crisis when they face an obstacle to important life goals—and obstacle that is, for a time, insurmountable by the use of customary methods of problem-solving.” (Caplan, 1961)

In case of radiation contamination, terrorist act and other radiation incidents, psychological assistance should be provided through the following units (and if necessary new ones are opened):



- hotline - separate telephone numbers are created specifically for working with affected persons;

- online consultations and support - a website / mobile application is created with the possibility to join a chat, providing access to qualified specialists in providing psychological assistance;

- offices for social psychological assistance - open outside the affected areas, but in close proximity to them (in schools, hospitals, etc.);

- teams for specialized medical and psychological assistance - evacuate the population from the affected areas, providing primary psychological support and diagnosis. They combine treatment and rehabilitation measures. Timely detection of persons in decompensation is important for controlling panic among the population.

The main principles in the organization of psychological assistance are:

- accessibility;
- timeliness;
- continuity.

### **3.4.1. Defining the target groups**

All victims of the situation take part in the psychological rehabilitation, but medical workers, rescuers, etc. can also be included.

In general, the population can be divided into the following groups, which require specific (qualified) psychological help:

1) according to age:

- children;
- adolescents;
- adults.

2) according to the state of health:

- healthy;
- physically ill;
- pregnant women (the consequences of information stress in these persons may have a negative impact on fetal development);
- persons with mental disorders.

3) according to the need for psychological help:

- urgently in need of psychological help;
- persons in need of monitoring and further assistance and support.

Also, the content of psychological help depends on the following factors:

- the number of those affected;
- the extent of the injury (s);
- the type and nature of the accident;
- the scale of the accident;
- from geographical conditions (locality, climate);
- from the living conditions;
- from the available psychological resources;
- others.

At different stages of the extreme situation, different factors will have different effects on people.

### **3.4.2. Informing the population**

Informing the population in case of radiation infection, terrorist act and other radiation incidents is an extremely important first step, which is directly related to the mental state of people. Only timely and unambiguous information about the disaster, which contains clear, concise and simple rules of action in the situation can reduce the damage to the mass psyche in the affected areas. Therefore, public awareness of radiation safety is based on the following three factors:

- 1) public trust in the source of information;
- 2) the presence of the presentation form, ie. the language must be simple enough to make the information clear to people with primary and secondary education;
- 3) the presentation of information must be emotional in form.

The questions about evacuation methods, the impact of radiation on human health and possible protective measures often remain the most confusing. These issues are of paramount importance, which is why they need to be announced through the available means of information at the beginning of the radiation incident.

Conditions should be created for effective exchange of views between radiation safety experts and the population, the main conditions being:

- high competence of the persons reporting the information on the radiation risk and the possibility to make it accessible to the audience;
- adequate level of education of the audience for understanding the received information.

It should be clearly understood that even the most truthful information about past or present events related to radiation exposure cannot be adequately accepted by a population that does not have a certain level of knowledge about such situations. Therefore, for successful work with people it is necessary to organize preliminary basic training on how the population should react in such situations.

**The most important tasks of the information and psychological safety system in the context of the risk of radiation damage are:**

- protection of the population, the various social groups and of the separate subjects from the destructive information-psychological impact of the information-psychological environment;

- increasing the psychological stability of all groups of the population at risk of radiation damage by strengthening personal, microsocial and macrosocial resources to deal with coping with stress.

Three main stages of remote consultation of the population in case of radiation contamination, terrorist act and other radiation incidents can be distinguished:

**First stage (preparatory) - contains the following activities:**

- creation of an expert group, development and approval of a Comprehensive Plan for remote counseling, which outlines the necessary actions for coordination of the efforts of all participants in the process;

- development, coordination and approval of regional schedules of information events - seminars, meetings, round tables, etc.;

- preparation by experts of information materials for primary specialists and media, formation of a database with normative, reference and methodical manuals. Preparation and publication of information materials for distribution to primary specialists during information events.

**The second stage - „training“, provides:**

- organizational and technical work on the preparation of information events in accordance with the Comprehensive plan for remote counseling;

- conducting regional information events for primary specialists with the participation of members of the expert group;

- organizational and preparatory work to provide feedback (tel., e-mail, website) to primary specialists, etc. stakeholders with members of the expert group;

**Third stage - „remote“ (feedback), includes:**

- implementation of the interaction between expert scientists and primary specialists, using the website of the information center;
- providing the primary specialists with the necessary normative, reference and methodical manuals;
- maintenance of the information center website;
- analysis of the information needs of the primary specialists, taking into account their requests, registered on the website of the information center;
- development of programs for information events, taking into account „feedback“;
- making corrections and additions to the Complex plan for remote consulting.

**3.4.3. Stages of psychological help**

The social rehabilitation and the information-psychological protection of the population must be carried out in accordance with the following stages:

**First stage.** Identification of the specifics and causes of socio-psychological tension related to radiation contamination, the terrorist act and / or other radiation incidents. The personality features of the person, the specifics of his environment, as well as his/her current state are determined.

**Second stage.** Creating conditions for people with socio-psychological tensions related to the consequences of radiation accidents and disasters to be included in individual and regional (group, social) information and psychological protection programs.

**Third stage.** Coordination of the implementation of individual and regional programs for information and psychological protection, in the implementation of which other social services, state, municipal and non-state bodies, media, organizations and institutions participate (health, education, internal affairs, migration service, etc.).

**Fourth stage.** Implementation of the developed individual and regional programs for information and psychological protection of the population with the help of various, including innovative, forms of work by the experts.

**This complex includes:**

- psychodiagnostics of stress factors;
- psychological counseling and psychological correction of the participants with the help of methods for socio-psychological rehabilitation and adaptation, aimed at increasing the psychological stability of the population at risk of radiation damage, by strengthening personal, microsocial and macrosocial resources to deal with overcoming stress;

- training classes on the formation of active human strategies and attitudes to improve the quality of life in conditions of radiation risk;
- training seminars with heads of local authorities, doctors and teachers, social workers on information and psychological support of the population, raising the level of their special knowledge on the problems of life.

#### **3.4.4. Measures to provide psychological assistance**

The Minister of Labor and Social Policy, through the regional structures of the Agency for Social Assistance and the Agency for Child Protection, plan and organize activities for search, reception, accommodation and psychological services for persons removed from the disaster area.

The President of the Bulgarian Red Cross opens points for providing first psychological and first medical aid to the victims.

„Intervention criteria“ are all factors that influence the decision to intervene, including levels of intervention, forecasts of accident development or results from the application of various protective measures, health, psychological, technical, geographical, economic and social factors.

1). Control the sources from which you receive information. Do not allow unreliable sources to affect your condition, and also determine for yourself the optimal amount of input information.

2). Create your position on this issue and be guided by it when making additional decisions

3). Choose people around you to communicate with about the situation and your feelings. Find a circle of communication where you are supported, share information, help your emotional survival, encourage, and take care. Refrain from contact with people with whom your condition worsens after talking.

4). Find adequate ways to get out of your anxiety. Find something you can distract yourself

5). Take back control of the situation. The state of loss of control puts us in a helpless position. But take a closer look: there are still many areas where you can maintain influence: home, family, education, relationships, etc.

6). Use the experience of previous difficult situations in the past: natural disasters, famine and disease epidemics.

7). If, however, the level of your anxiety is high enough to be seen and interfere with your normal life, seek the help of a psychologist, do not be afraid and do not be ashamed to get professional help. Talk to your doctor: he/she may prescribe sedatives or antidepressants.

**The system of socio-psychological rehabilitation and adaptation of the population must include:**

- conceptual issues of the perception of radiation risk by the population, including those involved in the elimination of the consequences of radiation accidents and disasters, related to:  
a) people's feelings towards social and other factors that are deteriorating in the current socio-political conditions of the country, b) with the perception of radiation risk;
- permanent system for social and psychological assistance of the population in territories exposed to radiation pollution.

This will provide information and psychological protection for the population.

**Achieving the goals of overcoming the socio-psychological consequences of accidents and disasters is currently carried out through an extensive system of social services, the following areas should be included in the number of activities carried out by employees of these services to ensure information and psychological security of population:**

- organization of the admission of the population in order to identify the information needs of the people living in the territory affected by the impacts and consequences of radiation accidents and disasters;
- creating a database of persons who have applied for assistance, exchange of necessary information with interested state and public organizations and institutions;
- analysis and forecasting of the social processes on the territory, preparation of proposals for improvement of the system for social and psychological assistance of the citizens, affected by the impacts and consequences of radiation accidents and disasters;
- advising on the vital functions of people affected by the effects and consequences of radiation accidents and disasters;
- assistance in resolving legal and information issues falling within the competence of the social protection bodies;
- providing psychological assistance, including emergency assistance, through the „helpline“;
- advice for solving individual problems (of the population and the participants in the liquidation of the consequences of accidents and disasters) related to the lack of information;

- providing advice on radiation danger;
- organizing information support for the population in stress due to insufficient information from the media and official sources of information;
- organization of social and psychological adaptation of the population to life in conditions of increased risk, under changing social conditions;
- gradual implementation of individual rehabilitation programs and information support in connection with healthcare, education, physical education and sports;
- implementation of social and psychological monitoring of the population and reporting of the results of the monitoring in the adoption and correction of decisions and programs;
- organization of a permanent system for direct and feedback of the administration with the population;
- analysis of the possibilities for improving the dialogue between the authorities and the population (this refers to the direct flow of information from the authorities to the population and feedback from the population to the bodies at all levels);
- psychological verification of administrative decisions regarding the impact of these decisions on the psychological stress of the population;
- analysis and forecasting of social processes and development of proposals for improvement of the system for information and psychological protection of the population affected by the impacts and consequences of radiation accidents and disasters;
- creation of a permanent system of information support for psychological protection from traumatic information, assistance to the population, including information support in areas exposed to radiation pollution and in the settlements where persons displaced from the infected places and participants in liquidation of the consequences of accidents and disasters;
- development, publication and dissemination of information materials on the characteristics, rules, dangers and benefits of life in areas affected by radiation pollution (in the media, on radio and television);
- synthesis and application of modern types and forms of informing the population affected by the impacts and consequences of radiation accidents and disasters;
- organizing advanced training for the leading staff and social workers in the region, serving the population affected by the impacts and consequences of radiation accidents and disasters.

### 3.4.5. Children and adolescents

- First, you need to show understanding, not eliminate the child's fears. Next, you need to find out to what extent this fear occupies him/her, how the child understands about radiation, whether he/she independently searches for information about it on the Internet.

- Second, talking about fears will reduce concerns about radiation contamination and help shift attention. Talking about radiation contamination can be tolerated, but it should not be allowed to become obsessive.

- Third, it is advisable to discuss not only the problem but also the emotions in general. We need to talk about things that are important to the child, not focus on fears of radiation, contamination, disease and death.

- Fourth, explain that radiation contamination may not always be a serious danger if you take all necessary measures to avoid it and take care of yourself.

- Fifth, perhaps many children are upset that they have to sit at home and experience the limitations associated with it. Explain that the restrictions are temporary and that everything will soon be the same. If the child suffers from relatives and friends, use the video link to communicate with them.

Underestimation of the measures for information and psychological safety of the population living at risk of radiation damage often leads to mistakes in the choice of tactics and forms of social work, the emergence of distrust in management and socio-psychological tension among the population. Information impact and psychological support, including psychotherapeutic help, significantly increase the effectiveness of all rehabilitation measures.



#### 4. CONCLUSIONS, RECOMMENDATIONS, CONTRIBUTIONS, CONCLUSION

**The main conclusions of the dissertation are the following:**

1. The medical management of patients exposed to intentional or accidental radiation is complex and requires a lot of resources.
2. The main responsibility for optimizing the result lies with the hospital staff, doctors and other health institutions.
3. Careful documentation of clinical signs and symptoms and assessment of individual radiation dose is necessary for medical triage.
4. Although the number of lost human beings in a nuclear detonation can be huge, the survival of others depends very much on the quality of modern supportive care.
5. Effective care requires the implementation of well-organized disaster plans. Disaster planning should include contingency planning for a scenario that involves loss of infrastructure.
6. Our organization as a nation will be a tool to combat the radiation threat in the country and around the world.
7. The preparation of a sample scenario is necessary for the adequate response in case of accidents, as well as in case of radiation syndrome, and periodic updating is necessary.
8. Adequate treatment of hematopoietic syndrome involves compliance with an appropriate algorithm, consistent with the specifics of each patient, as well as with the specific clinical situation, i.e. correct triage.
9. It is necessary to develop a psychological plan for the general algorithm for prevention and treatment in patients with radiation and hematopoietic syndrome.
10. It would be extremely important to prepare a logistical plan for exemplary actions with the Ministry of Defense/Civil Protection and the Red Cross in nuclear and wartime nuclear accidents.

**Contributions** to the dissertation can be broadly defined as the acquisition of new knowledge, revealing, supplementing and proving the existence of significant new aspects of an existing scientific field. In particular, these contributions are:

- A detailed analytical review, systematization and structuring of knowledge about the organization and management of prevention and pre-hospital care in cases of exposure

of a large number of people, leading to damage to their hematopoietic system, are prepared.

- A model (algorithm) has been created for the organizational behavior of the specialists engaged in first aid in case of sudden disturbances in the functioning of the hematopoietic system of large groups of people caused by nuclear pollution.
- Useful conclusions and recommendations for modeling and optimizing the organizational behavior of specialists engaged in first aid for sudden disorders of the hematopoietic system of large groups of people caused by nuclear pollution are formulated.
- An original methodology for research and obtaining new scientific results in an important area for social practice has been created.
- The obtained results are original structured learning content, which is applicable in the process of modeling and optimizing the organizational behavior of specialists engaged in first aid in sudden disorders of the hematopoietic system of large groups of people caused by nuclear pollution.
- The dissertation will be useful to all public and private universities, where disciplines are taught, dealing with the organizational behavior of specialists involved in providing first aid in sudden disorders of the hematopoietic system of large groups of people caused by nuclear pollution.

From the conclusions and contributions made, the following **recommendations** can be inferred:

- Based on our research on this global problem, we believe that on a national scale there should be collaboration between the various state structures for action in the event of accidents and disasters.
- It is necessary to prepare the population in peacetime conditions mainly for personal and collective protection.
- It is desirable to permanently update in scientific and practical terms the current state of protection against nuclear accidents and natural disasters.
- It is necessary to constantly optimize the technologies, as well as the knowledge of the relevant specialists engaged in specific tasks and actions in the event of nuclear accidents and natural disasters.
- Of great importance is psychoprophylaxis and specific psychological assistance to people involved and affected by accidents.

**Conclusion:**

Most people believe that a terrorist attack in some form is inevitable. When using chemical or biological weapons, it will be necessary to perform imaging of the victims of these attacks and imaging specialists must be prepared for the findings in these terrorist scenarios. Terrorism involving the use of radioactive material is considered to be one of the most likely due to the enormous adverse effects on the economy and the disruption of people's normal lives. A thermonuclear explosion would have the most devastating effect on the nation, but it is relatively more difficult to carry out. The use of a „dirty bomb“ is more technically feasible, and this scenario is of the greatest concern to nuclear terrorism experts. Therefore, radiologists and other nuclear specialists must prepare themselves as well as their institutions to deal with the problems of the huge number of victims and the adverse effects on society as a whole in the event of nuclear terrorism.

## **5. PUBLICATIONS RELATED TO THE DISSERTATION**

1. Radinov A. Health effect of psychological stress in radiological incident. Bulgarian Journal of Public Health. 2020, vol. 12, No. 3, pp. 64-74.
2. Buchinska-Simeonova N., Radinoff A., Nikolova D. Are doctors in Bulgaria ready to professionally assist victims of radioactive contamination in a terrorist act? Bulgarian Journal of Public Health. 2020, vol. 12, No. 2, pp. 54-65.
3. Nikolova D., Buchinska-Simeonova N., Radinoff A. Are doctors in Bulgaria ready to professionally assist victims of radioactive contamination in a terrorist act? (second part) Bulgarian Journal of Public Health. 2020, vol. 12, No. 3, pp. 15-26.
4. Tsenev, I., Radinov, A., Buchinska-Simeonova, N. and Shirkova, M. Risk assessment in the organization and management of the consequences of radiation contamination of the population in a terrorist act. Journal of Mechanical Engineering and Electrical Engineering, 2017, № 12, pp. 42-47. (in Bulgarian)
5. Buchinska-Simeonova, N., Radinov, A. Anxiety in people with cancer. Bulgarian Journal of Public Health. 2020, vol. 12, № 4