AGREED
by Vice Minister of Healthcare of the Republic of Kazakhstan

_____ O.A.Abishev

dated _____ "___", 2019

APPROVED
by Chairman of the Management Board of
National Research Oncology Center LLP

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dated _____ "___", 2019

Strategic Plan
for National Research Oncology Center
2020-2024

Nur-Sultan, 2019

Section 1. Mission and Vision

NROC mission: reduction in cancer mortality through increased access to high-tech methods of prevention, early diagnosis and treatment of malignant neoplasms in line with international standards.
NROC vision: a leading oncology research centre in the CAR, with an exemplary infrastructure and integration of scientific, clinical and educational practice.

Section 2. Current situation analysis and risk management

Strategic orientation 1. Cancer care according to international standards, coordination of the cancer service
For the purpose of implementation of the Address of the First President of the Republic of Kazakhstan N. Nazarbayev to the people of Kazakhstan "New Opportunities for Development in the Fourth Industrial Revolution" dated January 10, 2018, one of the priority areas of social policy "Cancer control through providing highly effective early diagnosis and treatment of cancer based on the best international practices, as well as establishment of a research oncology center":

- NROC with 100% state participation, subordinated to the Ministry of Healthcare of the Republic of Kazakhstan, was established (*approved by the RoK Government Decree No.255 dated May 11, 2018*);
- Cancer Control Integral Plan for 2018-2022, which defines the coordinating role of NROC in the development and monitoring of the country's cancer service was approved by the RoK Government Decree No. 395 dated June 29, 2018;
- the interdepartmental Roadmap for implementation of the NROC Construction Project, which includes the construction of a new treatment and diagnostic facility and the reconstruction of the existing building, was approved by Order of the Minister of Healthcare of the Republic of Kazakhstan No. 586 dated October 17, 2018.

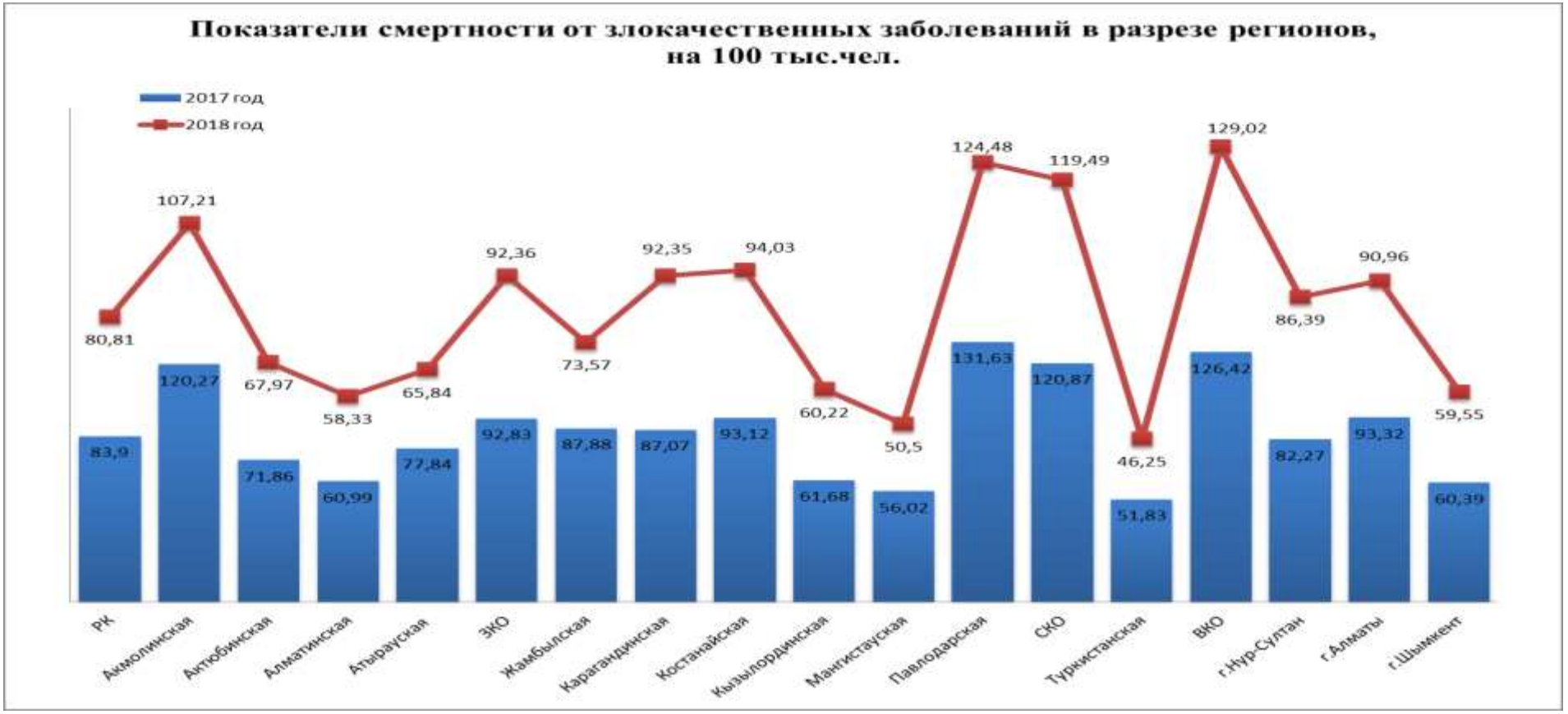
Cancer care is provided in the country:

- by NROC, operating as a health care provider since May 01, 2019 in the former NOTRC (National Oncology and Transplantology Research Centre);
- by KazNIIOiR (Kazakh Research Institute of Oncology and Radoiology);
- by 16 oncological dispensaries, 4 oncological departments at multidisciplinary hospitals in Aktobe, Zhezkazgan, Kokshetau and Shymkent and 405 oncologist rooms.

In 2019, the implementation of the "Densaulyk" State Healthcare Development Programme of the Republic of Kazakhstan for 2016-2019 is completed.

The main achievement under this programme is the reduction in MN mortality rate.

Measures aimed at the early detection of MN, the provision of chemotherapeutic agents and the improvement of the material and technical base of healthcare organisations enabled the mortality rate due to malignant neoplasms to fall from 88.16 per 100,000 population in 2016 to 83.9 in 2017 and to 80.81 in 2018.



Over 2018, MN mortality rates have declined for most locations. The most significant rate of decline in the observed mortality rate was in the following locations: lip cancer (46.6%), nasopharyngeal (41.6%), esophageal (11.3%), rectal (9.2%), liver (3.9%), trachea, bronchus, lung (5.4%), connective and soft tissue (10.7%), other skin MN (47.4%), uterine body (8.9%), ovary (12.9%), prostate (12%), bladder (20.4%), thyroid (10.2%), malignant lymphoma (13.4%) and leukaemia (15%).

A measure of the improved quality of lifetime diagnosis of cancer is the decrease in the proportion of MN cases registered post-mortem in 2018 - 752 patients (2017 - 819 patients). Among the 752 cases registered post-mortem, autopsy was performed in 642 cases or 85.4% (2017 - 82.1%), in 110 cases the MN diagnosis was made clinically, without autopsy (147 cases).

In 2018, the nationwide one-year MN mortality rate is stable at 22.4% (2017 - 22.5%).

Kazakhstan is one of the countries with a moderately high incidence and mortality rate due to MN, according to international Global cancer statistics (2012).

Based on the results of 2018 the number of people diagnosed with MN for the first time in the Republic of Kazakhstan was 35758, the incidence rate of MN was 195.7 per 100,000 population. The structure of oncological pathology: breast cancer (12.6%) is in the first place, followed by lung cancer (9.9%), stomach cancer (7.4%), cervical cancer and colorectal cancer (4.7%). Moreover, women were more often affected (a share of 55.7%) than men (44.3%).

Within the age structure, about 60% of cases are persons of working age between 18 and 63 years old. The age structure of the region's population, specifically the percentage of the elderly population, directly impacts the MN incidence rate, the ability to diagnose it and the effectiveness of treatment.

Analysis of the MN incidence in this age group showed that in 2018 a total of 15483 cases (43%) were first detected in the population of age 65 and over (2017 - 12670 cases or 40%), including women - 8116 cases or 40.6% (2017 - 6307 cases - 49.8%) and men - 7367 cases - 46.8% (6363 cases - 50.2%) (based on data f.7 for 2018 - information provided by KazNIIOiR).

There are three levels of cancer care within the integrated model.

Cancer Care Level I is provided by general medical services (GMS).

The main objective of Level I is the early detection of MN and the provision of outpatient services, both at the time of diagnosis and during follow-up.

Cancer Care Level II is provided by 16 regional oncology centres and four oncology departments at multidisciplinary hospitals in Aktobe, Zhezkazgan, Shymkent and Kokshetau. In 2018, the number of beds available for the treatment of cancer patients was 3,543 (2017 - 3,533). As part of the development of hospital-replacing care, day patient facilities operate in KazNIIOiR and in all oncology centres in the republic.

The number of day-care beds was 765 (2017 - 755). The coverage of cancer patients with specialised treatment was 88.5% (2017 - 88.5%). Specialised anti-tumour treatment for first-time MN patients consists of the main methods: surgical (40.3%), complex (25.4%), radiation (11.6%), medication (9.7%), combination (9.0%) and chemoradiotherapy (4.0%).

Cancer Care Level III is provided by HTROC in five regions (Nur-Sultan, Almaty, Aktobe, Semey, Karaganda cities), KazNIIOiR and NROC.

Level III (KazNIIOiR, HTROC) provides high-tech radiotherapy: stereotaxis, IMRT, IGRT, brachytherapy, organ and tissue biotransplantation, minimally invasive surgery.

There are currently only five high-energy linear accelerators (LA) operating in Kazakhstan. As part of the Integral Plan 10 LAs are to be installed in Karaganda, Akmola, Zhambyl, Kostanai, Kyzylorda, Mangistau, North Kazakhstan regions, Shymkent city and KazNIIOiR (under public-private partnership) and in Pavlodar region within the national budget.

Radionuclide diagnostics remains an inaccessible method in Kazakhstan. Compared with other research methods, PET diagnostics detects 18% more tumours at early stages, substantially improving the expected response to treatment. As recommended by foreign experts, each PET device accounts for 0.5-1 million of the population. Therefore, there should be no less than 18 devices in Kazakhstan. As of today:

- The first nuclear medicine centre in Kazakhstan, equipped with PET and SPECT/CT units, operates at the RDC. The cyclotron (18 MeV) is used to produce two radiopharmaceutical agents (hereinafter referred to as RPAs): 18F-FDG (fluorodeoxyglucose) and 18F-NaF (sodium fluoride);
- PET/CT and SPECT/CT are available at the HMC AD PK. The RPAs for PET is supplied from the RDC and for SPECT/CT from the Nuclear Physics Institute (Alatau village, Almaty region).
- KazNIIOiR is also equipped with PET.

Radionuclide therapy is planned to be provided at the Semey Nuclear Medicine and Oncology Centre, which is not yet commissioned. There are no proton therapy centres in Kazakhstan or in the CAR countries. This high-tech method of treatment allows efficient treatment of MN of various locations, with particular efficacy in paediatric practice.

Analysis of key issues

Considering the increase in life expectancy and the detection of MN with the implementation of early detection programmes, as well as the environmental deterioration through the impact of harmful environmental factors on humans, the morbidity rate in the country is increasing.

In Kazakhstan, about 15,000 people die of cancer every year, 42% of whom are of working age. In 2018, 14,369 people died of cancer, of whom 53.4% were of working age.

The mortality rate for MN of tongue, mouth, palate (0.2%), laryngeopharynx (119.8%), colon (0.9%), larynx (0.3%), bones and articular cartilages (13.4%) and skin melanoma (8.7%) has increased.

MN mortality rate is higher than republican level in: Akmola region (107,21), Pavlodar region (124,48), North-Kazakhstan region (119,49) and East-Kazakhstan region (129,02) per 100 thousand people.

The overall structure of causes of death from MN compared to 2017 for both sexes of the population is practically stable, except for the colorectal and rectal cancer and cervical cancer positions:

	Lung cancer	Stomach cancer	Breast cancer	Pancreatic cancer	Colon cancer	Esophageal cancer	Rectal cancer	Hematopoietic and lymphatic tissues	Cervical cancer	Liver cancer
2017	16,5%	11,5%	8,4%	5,4%	4,9%	5,2%	5,0%	5,1%	4,0%	4,0%
2018	16,5%	12%	8,7%	5,6%	5,3%	4,9%	4,8%	4,6%	4,2%	4,1%

Global practice shows that treatment of MN patients includes a wide range of services, where in addition to medication therapy the radiotherapy with modern LAs forming a beam that precisely follows the shape of the tumour is used. However, the number of high-energy LAs available is: in the Republic of Kazakhstan - 1 LA per 3.0 million people, in the Russian Federation - 1 LA per 1.5 million people, in the USA - 1 LA per 500,000 people, and in Japan - 1 LA per 157,000 people.

Thus, in the Republic of Kazakhstan, the coverage of high-tech radiotherapy for primary cancer patients averages 20%, which is lower than international standards (in OECD countries 60-75%).

However, it should be noted that oncological practice in Kazakhstan does not apply or lacks any:

A radioembolisation method where microspheres containing the radioactive material Yttrium-90 are delivered directly to the cancer tissue through vessels. In this process, the radiation energy hits the cancer tissue. Radioembolisation has been

scientifically proven to increase life expectancy and quality of life.

Proton therapy is a type of particle therapy. It works by targeting accelerated ionising particles (particles accelerated in an accelerator) at the tumour to be irradiated. These particles damage the DNA of the cells, causing eventual cell death. Through the unique distribution of the dose of ionising radiation in the patient's body tissues, allowing healthy organs and tissues to be completely protected from radiation and thus eliminating the possibility of occurrence of secondary cancers.

Proton therapy, if available, is the unequivocal method chosen for the radiotherapy of paediatric tumours of any location.

Laser therapy (laser vaporisation), where treatment is carried out by exposing the tumour to light of a certain wavelength and high intensity, causing its destruction.

Advantages of laser cancer therapy:

laser removal of tumours is bleeding-free, the vessels are "welded" together;
laser surgery is highly aseptic, because the microorganisms in the wound are killed;
good cosmetic effect without formation of rough scars;
rapid wound healing;
no adverse effects on the organism and no side effects.

To increase the availability of surgical treatment, the Integral Plan through PPP provides for the installation of 10 units for minimally invasive surgery and 35 units for innovative treatment in the regions. Currently, robotic surgery, which is widespread in the world, is underdeveloped in Kazakhstan and the use of this technology allows performing many operations that were previously thought to be impossible.

Risk management

Risks that may affect the achievement of the objectives	Risk management measures
Low tariffs for high-tech diagnostics and treatment for MN, which may have a negative impact on their further adoption and development	Proposals to the MoH for revision of tariffs for modern high-tech methods of diagnostics and treatment of MN.
Lack of modern medical equipment. Citizens are forced to travel	Inclusion in the organisation's budget request for

abroad to receive high-tech methods of diagnostics and treatment for MN, which entails high financial costs for patients and an outflow of money from the country's economy.	additional expenditure on the purchase of the required equipment. Wide implementation with subsequent extension of the high-tech methods of diagnostics and treatment of MN in the regions
Incomplete integration of medical information systems to enable full monitoring of diagnosis, treatment and follow-up of MN patients.	Initiate the modernisation of the Electronic Cancer Patient Register (ECPR) and the integration of medical information systems with regard to the creation of an electronic health record
No effective system for the maintenance and repair of expensive medical equipment.	Creation of an in-house equipment service or outsourcing.

Strategic orientation 2.

Development and implementation of personalised cancer prevention, diagnostics and treatment methods

The National Screening Programme is under improvement in order to increase efficiency and quality.

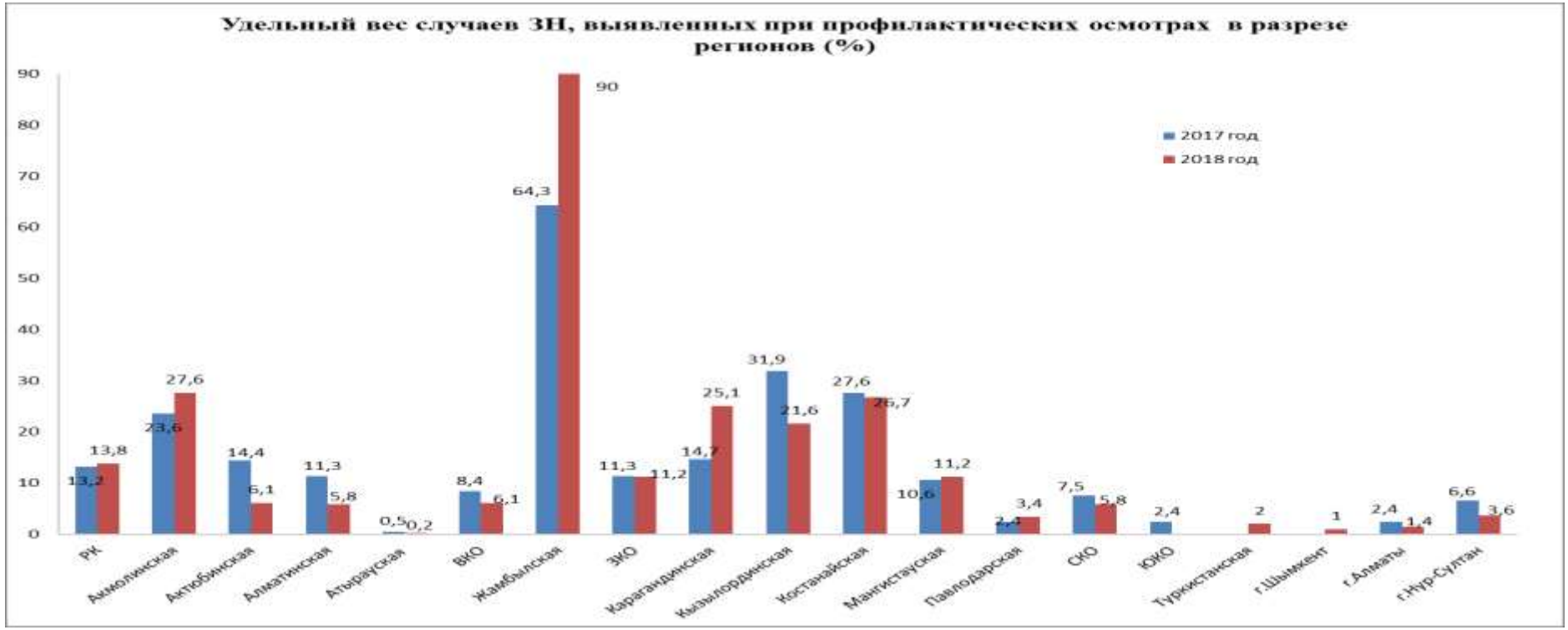
The awareness of the population has increased considerably during the period of implementation of the screening programme. The systematic training of medical personnel involved in GMS screening, methodological support for the programme has resulted in an improvement in the quality of screening of the target population at all stages.

Cancer care efficiency depends on the organisation of preventive measures. In Kazakhstan, expenditure on prevention measures is 4%, whereas in OECD countries up to 10% is allocated.

The WHO country assessment found a high prevalence of tobacco smoking and alcohol use as risk factors for the development of MN. In the Republic of Kazakhstan, 35758 new MN cases were detected in 2018, alongside non-melanoma skin cancer (2017 - 36695), including 377 primary multiple MN cases (2017 - 377) and 752 post-mortem cases (2017 - 819). The number of detected cases decreased by 937 or 2.6%. In 2018, a total of 34629 people (2017 -34499) were registered with MN diagnosed for the first time, with an increase of 130 people or 0.4% compared to 2017.

The absolute number of patients with MN registered for the first time decreased due to six regions (Almaty, East Kazakhstan, Zhambyl, Kyzylorda, Pavlodar regions and Almaty city). The highest decrease in the number of diagnosed patients was in East

Kazakhstan oblast - by 307 people or 8%. In the remaining 10 regions, there was an increase in the number of diagnosed patients, the largest increase in Aktobe oblast - 174 people or 11%.



In the course of preventive examinations of the population, 4,792 patients or 13.8% of the number of diagnosed patients were identified for the first time (in 2017, 4,556 patients or 13.2%). Overall in the country, the number of patients diagnosed during check-ups increased by 236 or 4.9%. In Akmola, Zhambyl, West Kazakhstan, Karaganda, Kostanay, Mangistau, Pavlodar regions and Shymkent the number of patients diagnosed by medical examinations has increased. The most significant increase is in Zhambyl region (+395 people) and Karaganda region (+382 people). Herewith, the proportion of patients diagnosed through medical examinations for 2018 is the highest in Zhambyl region - 90%.

The lowest rate of cancer detection during check-ups for the second consecutive year was in the Atyrau region - 0.2% or 2 patients (in 2017 - 0.5% or 4 patients).

In order to detect cancer early, three types of cancer screening are implemented in the country: BC, CerC and ColC.

The efficiency of screening programmes has increased in the form of increased detection of early (0 - I) stage cancers, e.g. cervical cancer screening by 4.5%, breast cancer screening by 6.3%, colorectal cancer screening by 2.3%.

At the end of 2018, there were 929,465 women screened with cervical cancer cytology - 96.0% of the planned volume (2017 - 409,124 - 100%). 22,061 women (2.4%) with various cervical pathologies were identified (2017 - 19,586 women - 4.8%). There were 330 cases of cervical cancer diagnosed (0.04% of coverage), of which: in Stage I - 58.4%. - 58.4%, Stage II - 38.9%, Stage III - 2.7%, and Stage IV - none.

In 2018, in mammography screening, 754,465 women were examined (98.6% of the planned volume). There were 172,676 women (22.9%) identified with various breast pathologies. Benign breast tumours were detected in 171,166 (22.7 per cent) women. A total of 77.6 per cent (133,991 women) were followed up. A total of 1,625 breast cancer cases were detected (0.22% of coverage) including: Stage I - 738 cases (45.4%), Stage II - 813 (50.0%), Stage III-IV - 63 (4.0%).

In 2018, as part of colorectal cancer screening, 860,612 persons were screened (97.6% of the plan). The number of patients with various benign colorectal pathologies was 1,204 (0.14%) (2017 - 1,383 patients - 0.2% of coverage). The proportion of positive haemocult test was 1.3% (10,903 cases) of which in 8,289 cases (76.0%) colonoscopy was performed.

According to GMS organisations the number of patients diagnosed with colorectal cancer was 309. There is a positive trend in early detection of colorectal cancer: 73 cases (23.6%) in Stage I, 200 cases (64.7%) in Stage II and 36 cases (11.6%) in Stages III-IV.

To improve the efficiency of monitoring and quality control of cancer care, the cancer service is being further computerised: the ECPR is being updated, and integration with other information systems (AIS Polyclinic, Dispensary Patient Register etc) is being carried out.

ECPR IS consists of financial and production block.

The production unit of the system is a unified system for data entry of cancer patients throughout the republic. Furthermore, the unit monitors acquisition of expensive chemotherapy agents, consumption and planning of pharmaceuticals. Inpatient and outpatient movement of cancer patients is recorded.

The financial block of the system covers all payment documents of the dispensaries providing health care to patients with socially significant diseases, contracts between organisations providing health care to patients with socially significant diseases and SHIF branches.

Analysis of key issues

Notwithstanding improvement of measures aimed at early diagnosis in some regions the rate of early cancer detection was less than 73.5%: Atyrau region - (50%) 1 case out of 2 (2017 - 4 out of 4, 100%), Zhambyl region - 57.1% (62.2% in 2017), Karaganda region - 72.8% (69.5% in 2017), Turkestan region - 62.2% (80.8% in SKR). Moreover, with decrease to 2017 indicators, except for Karaganda region, which indicates low quality of organization and conduct of medical examinations of the population.

According to statistical and analytical data of KazNIIOiR the detection rate of 10 locations out of 25 locations of cancer decreased: for MN of lip, esophagus, colon, bones and articular cartilage, connective and other soft tissues, female breast, cervix, uterine body, ovary and prostate gland.

Since 2016, the early detection rate for stages I-II has been changed to a more sensitive indicator for early detection of stages 0-I, as recommended by international experts.

The early detection rate for MN patients with stage 0-I increased in 2018 to 26.2% (2017 - 24.7%, 2016 - 21.8%), with stage I-II up to 60.5% (2017 - 59.6%).

A sufficient number of clinical errors in the assessment of the extent of tumour progression in the patient and inadequate recording is evidenced by an index of the ratio of one-year mortality to neglect (stage IV) above 1.

The highest deviation was observed in Atyrau region - 5 - the worst result (in 2017 - 3.9), Kyzylorda region - 4.1 (in 2017 - 3.5), Zhambyl region - 3.3 (in 2017 - 3.6), West Kazakhstan region - 2.8 (in 2017 - 2.6) and Mangistau region - 2.5 (in 2017 -2.6). The high ratio indicates that there are problems with the organisation of prevention and therapeutic and diagnostic care for cancer patients in these regions.

The proportion of patients under observation in oncology centres for more than 5 years was only 50.8% of the total number of patients based on the results of 12 months of 2018 (in 2017 - 49.6%).

A slight downward trend in mortality and an increase in the 5-year survival rate among cancer patients requires improving the quality of the implementation of the screening programme, preventive examinations of the population, and increasing the availability of clinical and diagnostic services. For example, in 2018 the mammography service waiting time (in 4 projections) exceeded 30 days in 22.9% of cases.

The development of personalised prevention, which consists of searching for a genetically determined predisposition to the progression of MN, the body's so-called 'weak points', is necessary. To decide whether an individual's characteristics are important for treatment from the point of view of predictive medicine, research is needed.

Personalised diagnosis is an essential area of molecular medicine. One of the areas is diagnostics based on biomarkers (biological compounds) indicating the existence of a specific disorder or susceptibility thereto. Combination of such "indicators" will allow determining individual health status of a person, predicting the risk of cancer development and its course.

In Kazakhstan, molecular-genetic methods of MN detection contributing to the early diagnosis, differential diagnosis, prescription and monitoring of the therapy of hematoblastosis and malignant neoplasms and taking into account the biological features of the tumor at the molecular level with high sensitivity, specificity and reliability are not widely available.

With the aim of creating an information structure for healthcare in the Republic of Kazakhstan, the informatization of the healthcare sector has continued, and web-applications in relevant areas (registers of socially significant diseases, the portal of the Bureau of Hospitalization, human resources, etc.) have been developed and implemented.

However, the existing databases are fragmented and not integrated into a single information space, which makes it difficult for different levels and services of health care to interact, does not ensure the continuity of information, and restricts the possibilities for operational analysis. An electronic document management system is not being implemented in healthcare organisations.

Risk management

Risks that may affect the achievement of the objectives	**Risk management measures**
Insufficient coverage of the target population with screening tests for early MN detection.	Raising public awareness of MN, the latest methods of diagnosis and treatment, and prevention methods

Low public access to high-tech diagnostics and innovative treatments, including radiotherapy	Consistent transfer of expensive new technologies (pharmaceuticals, medical devices and equipment) from abroad
Lack of professionals and equipment to carry out molecular genetic tests for the early MN detection. High cost of molecular genetic methods for diagnosis of MN	Training of professionals (targeted order for universities) to train and educate specialists in molecular genetics laboratories. Allocation of budgetary funds to establish and equip these laboratories in the regions.
No connection to ECPR and Single Reporting Point	Carrying out procedures to connect to ECPR and the Single Reporting Point to monitor the amount of cancer care provided, etc.

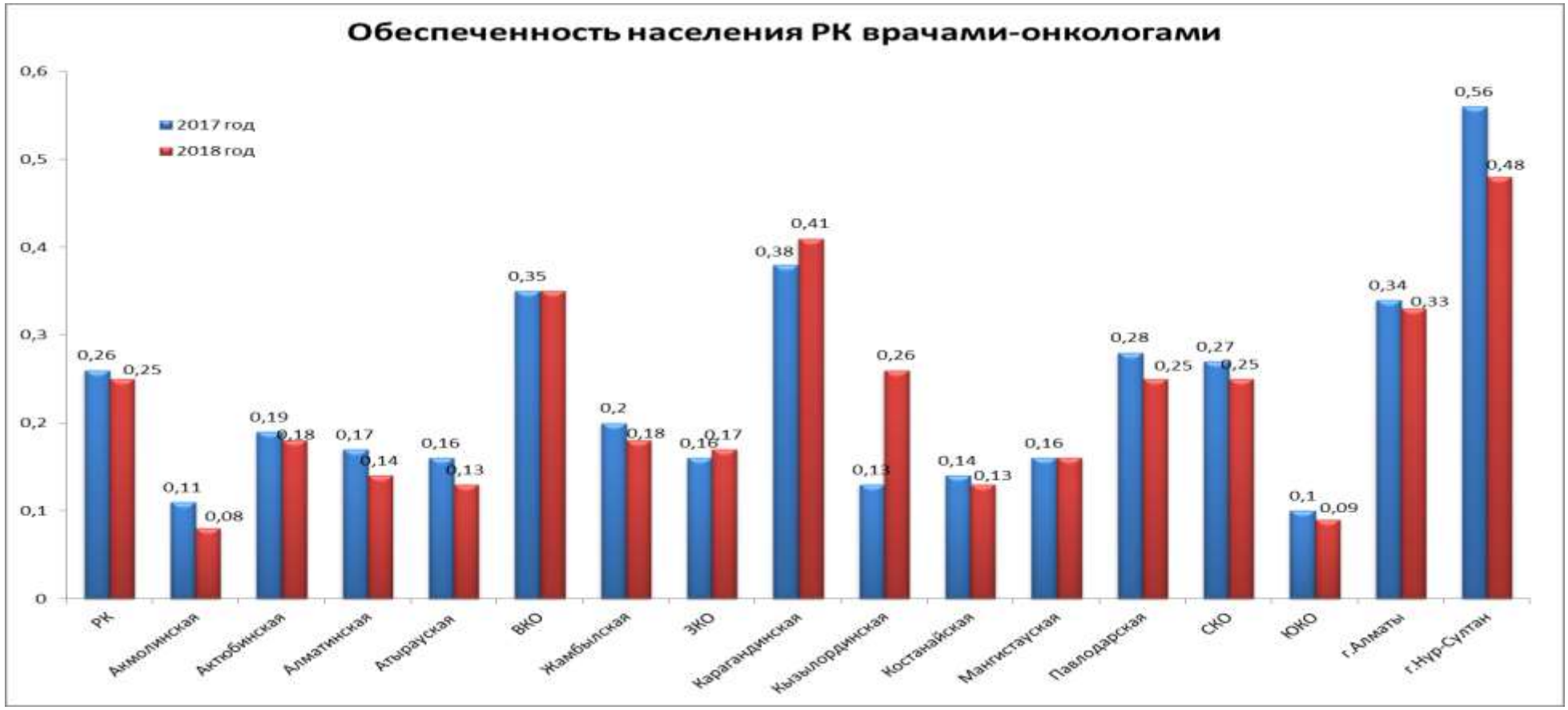
Strategic orientation 3.

Development of human resources and research activities

As of today, Kazakhstan is at the same level as OECD countries with regard to the number of oncologists per 10,000 people. The number of radiologists is insignificantly lower than what is recommended by the OECD.

The number of oncologists in oncology organisations of the republic has decreased by 2% (from 470 in 2017 to 460 in 2018) and by 13% of radiologists (from 101 to 88 doctors). There is a shortage of staff at all levels of cancer care.

Nationwide, the staffing level of oncologists has decreased from 0.26 to 0.25 per 10,000 population. The lowest indicator is in Akmola region - 0.08 per 10,000 people (in 2017 - 0.11 per 10,000 people), South Kazakhstan region - 0.09 per 10,000 people (in 2017 - 0.1 per 10,000 people), Kostanay region - 0.13 per 10,000 people (2017 - 0.14 per 10,000 people) and Atyrau region - 0.13 per 10,000 people (2017 - 0.16 per 10,000 people).



As of today NROC staff consists of 154 doctors (58 with higher qualification category, 35 with the Ist qualification category, 24 with the II qualification category), 285 nursing staff (110 with the higher qualification category, 35 with the Ist qualification category, 40 with the II qualification category), 16 nursing staff with higher education.

In order to provide opportunities for continuous professional development of specialists in cancer service, the Ministry of Healthcare of the Republic of Kazakhstan is implementing a number of complex measures. Each year, the national budget allocates funds for training within the country and abroad.

During the period from 2014 to 2018, more than 3,000 specialists from the cancer service were trained on advanced training courses, of which 347 were trained abroad. A total of 900 medical professionals were trained in prevention and early diagnosis of cancer.

The modernisation of nursing education on the basis of the Finnish Applied Baccalaureate model is continuing. In the NROC, of the nursing staff (295 actual number at 428 units), there are 112 employees with the highest category, 38 with the first category and 40 with the second category.

The current situation in system of continuous professional development of human resources of healthcare, new challenges facing the industry indicates the need to develop a modern Kazakh medical school, noninferior to the international universities. The indicator of efficient solving of the set task will be adherence to principles of integration of educational, clinical, scientific process, providing comprehensive approach to continuous professional development of human resources of healthcare, based on upgraded, world-class training clinics.

The NROC structure provides for the establishment of a research centre with scientific laboratories to conduct research in the field of oncology. As of 1 November 2019, the NROC has established two departments: the Education Department and the Research Department. The work of the departments is coordinated by the managing director for research and education activities..

In the NROC employs: 5 DSc, 12 Candidates of Sciences, 3 PhDs, 1 PhD in the field, including: 3 professors and 4 associate professors.
The implementation and dissemination of the results of research activities is carried out in three areas, through:

1) educational technologies - lectures, seminars, master classes;
2) dissemination of educational and scientific results in rendering HTMS (High-Tech Medical Services);
3) commercialisation of the results of research products

Analysis of key issues
Qualified human resources in the field of healthcare remain a serious problem.

There is still a shortage of qualified medical personnel in oncology, radiation oncology, haematology, pathological anatomy, etc. Such areas as medical rehabilitation in oncology, medical psychology in oncology should be developed. One of the important aspects of human resource capacity building is the training of nurses with skills in the care, management and rehabilitation of cancer patients.

There is a low competitiveness of scientific research and a lack of significant innovative achievements in the field of healthcare, which is associated with the existence of a number of factors hindering the development of medical science, including the poor material and technical base of medical science organizations, inefficient management of scientific research, insufficient capacity of researchers, lack of adequate incentives to enhance their motivation for self-development.

The low competitiveness of scientific research, its poor practical relevance, insufficient funding for applied research in the field of healthcare and the shortage of staff with advanced degrees continue to be topical issues.

One of the main activities of the NROC will be the training and development of human resources in the cancer service of the country. The specific nature of the cancer service provides for the training of qualified medical and non-medical specialists.

The training of qualified specialists will be based on modern principles of diagnosis and treatment of cancer and will include a wide range of postgraduate residency programmes in the specialties: "oncology", "radiotherapy", "radiodiagnosis", "nuclear medicine" as well as the development and improvement of areas of advanced education in oncology such as: oncologists, surgeons, obstetric gynaecologists, vascular surgeons (angiosurgeons), urologists, radiotherapists, medical physicists, engineers, chemists and nurses.

Over the last five years, the approach to training oncology professionals has changed dramatically. The principles of a multidisciplinary approach to the treatment of cancer patients, as well as the application of modern treatment methods and technologies, require specialists to have the skills and knowledge based on the latest achievements in science and medicine.

In this regard, NROC specialists will be trained in medical and non-medical areas under the Bolashak programme through the Centre for International Programmes of the Ministry of Education and Science of the Republic of Kazakhstan (MES of the RoK). In 2020, this programme is planned to train 83 specialists abroad in leading oncology clinics. In subsequent years, there are plans to train up to 40-50 NROC specialists per year to build up human resource capacity.

The programmes of advanced medical education in the field of oncology will include modern principles of diagnosis, treatment and early and late rehabilitation of cancer patients.

Educational programmes will be offered to residency trainees, medical practitioners, nurses and other non-medical oncology professionals (physics engineers, chemists, dosimetrists).

A reference centre will be established at the NROC to develop and train specialists in advanced radiotherapy techniques.

The simulation centre will also be based at the NROC to practise skills such as chemoembolisation, hysteroscopy and other skills needed in a modern oncology centre.

Educational programmes will also cover screening and early detection of MN for GMS doctors.

As part of the collaboration with the World Bank, it is planned to train specialists in proton, radiotherapy and nuclear medicine. International partners in the staff training for the NROC and oncology service as a whole, will be the leading overseas clinics.

Risk management

Risks that may affect the achievement of the objectives	Risk management measures
Insufficient human resource capacity. Outflow of qualified staff from NROC to organisations with more attractive conditions (high wages, favourable working conditions, fixed working hours, etc.)	NROC policy to ensure an environment for efficient work practices, encouraging staff development
Low employee motivation for research work Insufficient implementation of international standards	Integration of medical education, science and practical healthcare services. Introduction of international standards for the training of healthcare professionals, adapted to the needs of the NROC
Shortage of specialized equipment and professional staff. Equipment downtime due to lack of specialised staff. The results of scientific developments may not be in demand in the clinical and educational units.	Engaging professional, experienced staff when addressing the issues of procurement and operation of equipment. Staff training. Close coordination with the clinical unit. Involvement of professional staff in science and education departments. Development and implementation of mechanisms aimed at increasing the financial and non-financial motivation of physician-researchers in carrying out research work. Establishment and functioning of a professional commercialisation office.

Insufficient number of teaching staff with academic degrees to implement educational programmes. Lack or low level of skills of pedagogical experience in teaching residents and doctors. Insufficient level of skills in working with literary sources on educational programmes.	Enhancing academic excellence through doctoral training, including overseas. Gaining teaching experience through financial and non-financial motivation. Hosting the oncology departments of a medical university at the clinic. Development of joint educational programmes. Establishment of a modern library with professional staff consultants to acquire skills of working with information sources.

Section 3. Priority areas of the NROC

Strategic orientation 1. Cancer care according to international standards, coordination of the cancer service

For the implementation of the Integral Plan, the NROC Development Guidelines were approved (Order of the Ministry of Healthcare of the Republic of Kazakhstan No. 420 dated August 01, 2019).

Cancer care at NROC will be provided in accordance with international standards.

In the structure of NROC, a nuclear medicine centre will be established where RPAs will be used for diagnosis and treatment.

Radionuclide diagnostics will involve the use of SPECT to detect gamma rays and PET scanners, and the treatment will be dominated by radioiodine therapy.

In the course of the NROC project, it is planned to launch its own 18F-fluorine, 11C-carbon and 68Ga-gallium based RPA production, with quality control, sterile packaging in hot chambers, to produce finished RPAs that comply with international Good Manufacturing Practice (GMP) standards.

A method of radioembolisation using RPA, which is planned to be implemented at the Institute of Nuclear Physics, is envisaged. Radioembolisation will be used: in the treatment of liver cancer (hepatocarcinoma, cholangiocarcinoma); in secondary metastatic liver damage (primary colorectal tumour, breast cancer, melanoma, etc.) where the patient does not respond to standard systemic chemotherapy and/or where the case is inoperable; as first-line therapy in some patients; in cases where chemoembolisation may be unacceptable or dangerous (portal vein thrombophlebitis, massive tumours, etc.).

The NROC plans to introduce proton radiotherapy as the unequivocal method that minimises the risks of irradiation of healthy organs and tissues to treat: paediatric tumours of any location; advanced forms of MN: lung cancer, prostate cancer, head and neck cancer, esophageal cancer, liver cancer, lymphoma, sarcoma.

Within the NROC structure, a radiotherapy centre will be established that will be equipped with modern high-energy LAs. Considering the world practice where modern modifications of LA are used to treat tumours of different location, stages and spread of tumour process, NROC is planned to be provided with different types of modern LA equipped with:
- an image-guided visual inspection system for remote irradiation;
- a robotic system for irradiating "moving" tumours;
- a system for the irradiation of long-range tumours;
- a mobile system for tumour irradiation during the intraoperative period;
- a system capable of precise therapy without damage to healthy tissue.

The NROC plans to introduce new technologies in cancer treatment using lasers (krypton, argon, neodymium, ruby, carbon dioxide). Laser therapy will be used for the following purposes:

- removal (vaporisation) of tumours;
- tumour size reduction;
- recovery of the patency of hollow organs (bronchi, intestines);
- pain reduction through the effect on nerve endings.

Each type of laser has specific features and will be selected individually for a particular type and stage of tumour.

In the future, the NROC plans to introduce robotic surgery using a robot during surgery. This will allow to:

- minimise post-operative pain;
- reduce the risk of wound infection;
- reduce the need for blood transfusions;
- accelerate recovery and achieve a shorter post-operative period;
- minimise the risk of complications typical of traditional surgery;
- improve the cosmetic effect by eliminating large postoperative scars;
- eliminate the risk of infection to the surgeon.

The robotic operations will be carried out using laparoscopic access.

The NROC will play a leading role in the development, improvement, coordination and monitoring of cancer services in the Republic of Kazakhstan. The NROC will be the national focal point in improving the integrated model of cancer care.

As part of the implementation of this area, the main tasks of the NROC will include:

- coordinating the activities of the Republican cancer service;
- organisational and methodological assistance to healthcare providers involved in the diagnosis and treatment of cancer patients;
- improving the regulatory framework in the field of oncology;
- drafting a development strategy for the cancer service;
- elaborating, monitoring and evaluating the implementation of national programmes to combat MN;
- elaborating and implementing modern methods of prevention, early detection, treatment and rehabilitation of cancer patients;
- managing ECPR;
- developing educational programmes in the area of oncology.

The NROC will provide organisational and methodological support to regional oncology centres, which includes:
- improving the organisation of cancer care for the population;
- enhancing the effectiveness of cancer care provision to the country's population;
- modern technologies and communications to provide accessible information to the population on the possibilities of diagnosis and efficient treatment of MN;
- improving the principles of registration, record-keeping and clinical examination of cancer patients;
- interaction and continuity in activities with the authorized body in the field of healthcare, as well as state bodies, organizations of national and regional level in the field of health protection.

Implementation measures:

- standardisation of clinical activities - national accreditation and accreditation in accordance with JCI international standards for quality and safety of medical care;
- establishment of a nuclear medicine centre;

- launch of RPA production based on 18F-fluorine, 11C-carbon and 68Ga-gallium;
- implementation of the proton radiotherapy method;
- establishment of a radiotherapy centre.

Strategic orientation 2.
Development and implementation of personalised cancer prevention, diagnostics and treatment methods

To increase the availability of surgical treatment, the Integral Plan through PPP provides for the installation of 10 units for minimally invasive surgery and 35 units for innovative treatment in the regions. Currently, robotic surgery, which is widespread in the world, is underdeveloped in Kazakhstan and the use of this technology allows performing many operations that were previously thought to be impossible.
There are services for determining various biological markers in clinical practice (immunohistochemistry, molecular genetic studies), which allows providing personalised treatment of cancer patients and extends the opportunities for a more detailed study of the molecular and biological features of malignant neoplasms.

In 2018, reference centres provided counselling to 1,556 patients (2017 - 1,440) for lung cancer, lymphoma, breast cancer, gastric cancer and other forms of malignant neoplasms.

In 2002, KZT 800 mln was allocated for medication treatment, the list of medicines consisted of 35 chemotherapeutic agents, with no targeted medicines. From 2013 to 2018, an average of around KZT 20 bln was allocated annually to provide medication therapy. As of today, 87 chemotherapeutic agents are in use, of which 15 are targeted medicines. Among the 181,000 patients registered for dispensary treatment, 35.3 per cent were treated with chemotherapy.

In 2019, there were 30 new protocols reviewed for the diagnosis and treatment of cancer, which include 25 new targeted and immuno-oncological medicines, for which additional funding of between KZT 5.6 and 8 bln annually, according to preliminary calculations, is required.

In order to ensure the safety and rational use of chemotargeted medicines and cytostatics, the Integral Plan envisages the installation of equipment for centralized automated cytostatics dilution rooms in 15 regions.

The other underlying factor for ensuring high quality services will be an adequate and effective investment policy aimed at introducing and using the most advanced and efficient medical technologies, including medications and equipment, in the NROC.

A molecular genetics laboratory (hereinafter referred to as the Laboratory) will be envisaged within the structure of the NROC.

The laboratory will specialize in the performance of medical laboratory diagnostics that meet modern international quality standards, provide access to high quality service, unbiased and reliable information in the field of laboratory diagnosis. It is expected that the material, technical and reagent base will be provided by leading European and world producers. The Laboratory will implement and widely use methods of polymer chain reaction, molecular sequencing, fragment analysis, flow cytofluorimetry, nephelometry, fluorescent in situ hybridisation, mass spectrometry, high performance liquid chromatography and other methods. The production unit will focus on the development of diagnostic reagent kits, standards and calibrators for molecular genetic research, oligonucleotide synthesis, recombinant constructs, etc.

The QMS will be in line with international best practice to ensure that deficiencies in the delivery of healthcare services are rectified.

The implementation of universal quality and safety standards in the NROC will increase the proportion of HTMS - services provided by specialised professionals for diseases that require the use of innovative, resource-intensive and/or unique diagnostic and treatment methods. HTMS are provided in the form of hospital-replacement services and inpatient care.

The experience of developed countries in MN treatment will be phased into the NROC, and then translated and integrated into all levels of cancer care.

The countries' experiences in the treatment of the main MN locations are as follows:

Breast cancer - Germany, Italy;
Cervical cancer - Germany, France;
Gastro esophageal cancer - Japan, Great Britain;
Colorectal cancer - South Korea, Israel;
Liver cancer - South Korea, Mongolia;
Lung cancer - Japan, USA.

The leading countries using innovative technologies in the diagnosis and treatment of MN are:

Proton therapy - USA, Germany, Japan;
Radionuclide therapy - Germany, Italy, USA, Israel
High-tech radiotherapy - USA, Israel, EU countries;
Intraoperative radiotherapy - Italy, Germany, Israel
Biotransplantation of organs and tissues - all developed countries over the world;
Minimally invasive surgery - USA, Japan, South Korea, Israel.

Implementation measures:

- introduction of new methods of laboratory and instrumental diagnosis of precancerous and cancerous conditions;
- introduction of new principles and methods of personalised and combined treatment of cancer patients;
- development of measures aimed at the prevention and early detection of MN (campaigns, roundtables, conferences, etc.);
- further implementation of screening programmes.
- establishment and operation of a molecular genetic laboratory for carcinogenesis
- enhancing a multidisciplinary approach to the diagnosis and treatment of cancer patients
- introduction of tertiary prevention methods in oncology, including day-care and outpatient centres.

Strategic orientation 3.
Development of human resources and research activities

To develop the cancer service in line with international standards, such areas as proton and nuclear medicine will be introduced for the first time in Kazakhstan.

Training and staffing of oncological organisations of the republic with highly qualified medical and non-medical personnel is one of the key issues of the healthcare system. In order to implement modern methods of prevention, diagnosis, treatment and rehabilitation of cancer patients the systematic and regular training of specialists in the leading foreign cancer centres of the world is required. Medical technology transfer from abroad should be carried out to the national clinics, with further transfer to the regional oncological organizations.

Trained and skilled specialists should be involved in:

- evaluation of medical technologies (in Republican Center for Healthcare Development);

- integration of these techniques into the national protocol for the diagnosis and treatment of MN;

- development of tariffs for new methods;

- further transfer of technologies to the regions.

Proton therapy, radionuclide diagnostics, radionuclide therapy with its own cyclotron-production complex, high-tech radiotherapy, and laser therapy centres are planned to be established within the NROC structure. For the successful establishment of the above-mentioned structural units, in addition to equipping them with the relevant high-tech equipment, the training of medical personnel and engineering-physical personnel is required. The involvement of these specialists is planned during the design and construction phase of the centre. For example, the training of specialists in proton therapy takes from 1.5 to 2 years.

In addition to the training of clinical specialists, it is planned to train technical staff: physicists, chemists, dosimetric technicians, and other specialists for work in nuclear medicine, proton therapy and radiotherapy.

The modernisation of nursing education on the basis of the Finnish Applied Baccalaureate model is continuing. In the NROC, of the nursing staff (295 actual number at 428 units), there are 112 employees with the highest category, 38 with the first category and 40 with the second category

Qualified specialists will be trained in modern principles of diagnosis and treatment of cancer and will include postgraduate training (oncology, radiodiagnosis, radiotherapy, haematology, anaesthesiology and intensive care) for two to three years.

Training of specialists in modern international standards of oncological care organisation, the principles of early diagnosis and treatment of MN is planned.

Jointly with the Centre for International Programmes JSC (Bolashak) organization of educational activities, which provides for training of NROC specialists abroad, is carried out. International partners in the training of human resources for the NROC will be the leading foreign clinics in Germany, England, Belgium, Korea and Japan.

Currently, the task of integration of science, education and clinical activities as one of the decisive factors in the development of cancer care for the population of the Republic of Kazakhstan is of great importance. The relevance of this problem is also noted in the Address of President Nazarbaev N.A. to the people of Kazakhstan "New Kazakhstan in the new world" (2011), where the leader of the nation emphasized, that one of the directions of state policy at the new stage of development of our

country has to be improvement of the quality of medical services and development of high technology healthcare system. The quality of medical services is a complex concept and depends on many factors, such as material and technical equipment of healthcare organizations, level of professionalism and motivation of clinical specialists to enhance it, introduction of modern technologies in managing the processes of organization and delivery of medical care.

Under current conditions in Kazakhstan, solving the problem of integration of science and clinical practice means establishing efficient and sustainable interaction of medical universities with research institutes, research centres, clinical bases, as well as with enterprises releasing science-intensive and high-tech products.

Standardisation of quality and ensuring general principles of hospital safety are the only way to minimise risks in the hospital process. There are internationally recognised quality standards.

To this end, the Quality Management System for Medical Services (QMS), focused on motivating staff to achieve a high level of service quality, including economic incentives, will be created and implemented. Results-based remuneration principles will be developed and implemented.

Medical oncology science is constantly evolving, due to the introduction of new scientific and technological advances into practice, the development of scientific thought, the achievement of certain results in the treatment of patients, and the emergence of new areas for scientific research.

The current state of oncology science involves a comprehensive approach to understanding the causes, mechanisms of development and the response of both the body and the tumour to intervention.

In the future, consideration will be given to applying for an NROC designation as a WHO Collaborating Centre in the field of oncology (an institution designated by the WHO Director General, being a part of an international collaborative network). This will allow for scientific and technical collaboration directly with WHO in the field of oncology and other centres around the world with similar status.

Implementation measures:

- Development of the core research areas of the NROC Research Centre (identification of profile experts for the five science laboratories headed by an expert co-ordinator).
- Registration of the NROC as a scientific organisation in WebOfScience.
- Carrying out interdisciplinary scientific research together with Nazarbayev University, University medical centre.
- Training of medical specialists in Good Clinical Practice (GCP), Good Laboratory Practice and Good Scientific Practice standards with awarding certificates.
- Obtaining accreditation for clinical studies, and conducting clinical studies, including through participation in international multicenter studies.
- Conducting all phases of clinical studies.
- Development of scientific and technological policy for participation in competitions of MES of the RoK/ MoH of the RoK on "Development of new ways of diagnostics, treatment and rehabilitation in transplantation of organs and tissues: Liver, Kidney, in Oncohematology, Tissue and Vascular Cell Bank".
- Commercialisation of scientific products, prioritisation, capitalisation and scaling up of the scientific achievements of the NROC staff.
- The NROC is to be a driving force for cancer care in the country based on quality research and development, the products of which will be in demand internationally, thereby contributing to a process of continuous increase in the number of high-tech medical services and educational cycles at all levels of professional activity.
- Obtaining a licence for educational activities (residency)
- Involvement of resident clinical mentors and practitioners in clinical studies and research programmes together with trainees
- Training of NROC specialists abroad under Bolashak programme, form of training - 1 year internship.
- Hosting the Department of Oncology of medical universities at the clinic.
- Development and publication of methodological recommendations for practitioners on the priority areas of the centre.

Section 4. The architecture of the strategic and budgetary planning linkage

Nationwide country indicators
Strategic Development Plan of the Republic of Kazakhstan 2025
Key target indicators Improved accessibility, quality, safety, efficiency, sustainability and patient-centred healthcare will be based on a comprehensive digitalisation of data and processes. Projects on the implementation of telemedicine, robotic methods and artificial intelligence in health care, the use of mobile digital applications, and the transition to "paperless" hospitals will be supported. The possibility of introducing genetic research and personalised medicine will be considered for the purpose of targeted prevention and early disease control. A scientific oncology centre will be established. However, the focus will be on providing highly efficient early diagnosis and treatment of cancer based on international best practice.
State Healthcare Development Programme of the Republic of Kazakhstan for 2020 - 2025
Target indicators: In 2025: - **increased life expectancy of** citizens **to 75 years**; - **reduced risk of premature mortality** from 30 to 70 years of age from cardiovascular diseases, cancer, chronic respiratory diseases and diabetes to **15.43%.**
Strategic Plan of the Ministry of Healthcare of the Republic of Kazakhstan for 2020 - 2024
Target indicators: In 2024: - **increased life expectancy** at birth to **74.58 years;**; - **reduced** the standardised death rate from malignant diseases to **81.90** per 100,000 population - **increased** patient satisfaction with the quality of medical care to **63%**

NROC strategic orientations

Strategic orientation 1. Cancer care according to international standards, coordination of the cancer service	**Strategic orientation 2.** Development and implementation of personalised cancer prevention, diagnostics and treatment methods	**Strategic orientation 3.** Development of human resources and research activities

NROC objectives

Objective 1.1 Improved accessibility and quality of cancer care	**Objective 1.2** Coordination and monitoring of cancer service development	**Objective 2.1** Strengthening disease prevention and early MN detection	**Objective 2.2** Implementation of innovative technologies and a personalised approach to diagnosis and treatment of MN	**Objective 3.1** Researches in the field of oncology	**Objective 3.2** Enhancing the NROC's human resource capacity

Budget programmes

Budget programmes– 2	**Budget programmes– 1**
067 "Ensuring a guaranteed volume of free medical care"	006 "Training specialists with higher, postgraduate education and social support for trainees"

Section 5. Strategic orientations, objectives and target indicators

No.	Target indicator	Responsible	Information source	Unit	2019	Scheduled period				
						2020	2021	2022	2023	2024
1	2	3	4	5	6	7	8	9	10	11
Strategic orientation 1. Cancer care according to international standards, coordination of the cancer service										
Objective 1.1. Improved accessibility and quality of cancer care										
1.	Proportion of hospital-replacing care provided	NROC	NRIOC data	%	5,2	9,35	20,0	25,0	25,0	25,0
2.	Proportion of post-operative complications	NROC	NRIOC data	%	1,0	1,0	0,9	0,9	0,8	0,8
3.	Proportion of patients in fee-based services, including foreign patients	NROC	NRIOC data	%	-	15	15	15	15	15
4.	Average length of stay in a bed	NROC	NRIOC data	bed-days	10	10	9,5	9,0	8,5	8,0
Objective 1.2. Coordination and monitoring of cancer service development										
5.	Patient satisfaction with the quality of care provided at the NROC	NROC	Personal details	%	48,0	50	55	60	65	70
Strategic orientation 2. Development and implementation of personalised cancer prevention, diagnostics and treatment methods										
Objective 2.1. Strengthening disease prevention and early MN detection										
6.	Number of media and social networking publications as part of awareness raising for disease prevention and early diagnosis of cancer	NROC	Materials	units	1	12	13	14	15	16
Objective 2.2. Implementation of innovative technologies and a personalised approach to diagnosis and treatment of MN										
7.	Proportion of HTMS for planned hospital admissions based on the approved HTMS list	NROC	NRIOC data	%	4,8	5,0	5,5	6,0	7,0	8,0

No.	Target indicator	Responsible	Information source	Unit	2019	Scheduled period				
						2020	2021	2022	2023	2024
Strategic orientation 3. Development of human resources and research activities										
Objective 3.1. Researches in the field of oncology										
8.	The ratio of the number of articles published during the last 5 years in international ranking journals indexed by Web of Scopus to the number of full-time research and teaching staff	NROC	NRIOC data	ratio	1:30	1:25	1:25	1:20	1:15	1:10
9.	Average Hirsch index of research and teaching staff according to Web of Science or Scopus.	NROC	NRIOC data	ratio	0,33	0,4	0,5	0,5	0,6	0,6
10	The ratio of commercialised R&D results to the number of research programmes.	NROC	NRIOC data	ratio	0	0:1	0:1	1:2	1:2	1:3
11	Ratio of NROC teaching staff to the number of trained professionals from the regions of Kazakhstan.	NROC	NRIOC data	ratio	27:20	27:25	27:30	27:32	27:35	27:40
12	Proportion of residency graduates who successfully pass the independent examination on their first attempt.	NROC	NRIOC data	proportion	-	-	-	95	96	98
13	Proportion of residency graduates who are employed in the first year after graduation	NROC	NRIOC data	proportion	-	-	-	95	96	98
Objective 3.2. Enhancing the NROC's human resource capacity										
14	Reduced turnover of medical staff	NROC	NRIOC data	%	26	23	20	18	15	13
15	Number of staff according to the staffing table	NROC	NRIOC data	%	70	70	72	74	76	78
16	Employee satisfaction with the work process	NROC	Personal details	%	60	65	70	75	80	85
17	Proportion of doctors' staff who speak	NROC	NRIOC data	%	1	2	4	6	8	10

No.	Target indicator	Responsible	Information source	Unit	2019	Scheduled period				
						2020	2021	2022	2023	2024
	English (NCT-Intermediate)									

Section 6. Resources

Resources	Unit	2019	Scheduled period				
			2020	2021	2022	2023	2024
Budget programmes aimed at achieving the objectives of the Strategic Plan							
006 "Training specialists with higher, postgraduate education and social support for trainees"	thous. KZT	14135,0	14135,0	14135,0	14135,0	14135,0	14135,0
067 "Ensuring a guaranteed volume of free medical care"	thous. KZT	6100 595,91	6100 595,91	6100 595,91	6100 595,91	6100 595,91	6100 595,91

Abbreviation expansion

NROC	National Research Oncology Center LLP
CAR	Central Asia region
Integral Plan	Cancer Control Integral Plan for 2018-2022
MoH of the RoK	Ministry of Healthcare of the Republic of Kazakhstan
Roadmap	Interdepartmental Roadmap for implementation of the National Research Oncology Center Construction Project
NOTRC	National Oncology and Transplantology Research Centre JSC
KazNIIOiR	Kazakh Research Institute of Oncology and Radoiology JSC
MN	Malignant neoplasms
GMS	General medical services
HTROC	High-tech radiation oncology centres
LA	High-energy linear accelerator
PET	Positron emission tomograph
RDC	Republican diagnostic center
SPECT	Single Photon Emission Computed Tomography
RPA	Radiopharmaceutical agent
HMC AD PK	Hospital of the Medical Center of the Administrative Directorate of the President of Kazakhstan
OECD	Organization for Economic Cooperation and Development
PPP	Public-private partnership
ECPR IS	Electronic Cancer Patient Register information system
BC	Breast cancer
CerC	Cervical cancer
ColC	Colorectal cancer
HTMS	High-tech medical services
WHO	World Health Organization
SHIF	Social Health Insurance Fund