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# Colorectal screening in Kazakhstan: analysis of accessibility, problems, and prospects for further improvement

**Abstract.** *This article offers an analysis of the screening program for colorectal cancer (CRC) conducted in the Republic of Kazakhstan. According to the authors' assessment, the staffing level is 100%, the availability of the relevant equipment is 65%. The accessibility of the first stage of screening for the population is high as confirmed by the coverage of both urban and rural population. However, the rural population of Aktobe, Almaty, Karaganda, Kostanay, and Mangystau Regions undergo colonoscopy less often than the urban population. The proportion of CRC detected by screening among the total number of cancer cases in a population of target age has increased from 29.8% in 2011 to 52.2% in 2014. It is a good indicator given only 23.6% of CRC cases detected at an early stage in 2018 and the decrease in the number of cases diagnosed at stage IV of the process from 15.1% in 2011 to 1.6% in 2018. However, the observed decline in mortality is only from 9.6‰ in 2013 to 8.4‰ in 2017. The article focuses on the problems faced at different stages of screening and the prospects for the further improvement of the screening program.*

**Keywords:** colorectal cancer, screening, hemocult test, colonoscopy.

**Relevance.** According to Globocan data (2018), the incidence of colorectal cancer (CRC) in Kazakhstan is lower than in all other OECD countries (15.4‰) except Mexico (11.2‰). The highest CRC incidence in the OECD countries is noted in Hungary (51.2‰); the incidence is also high in South Korea, Slovakia, Norway, Slovenia, Denmark, and Portugal where it reaches 40-44.5‰ [1].

In Kazakhstan, the CRC incidence is steadily increasing (from 15.2‰ in 2006 to 16.5‰ in 2012 and 17.5‰ in 2017). Since 2013, CRC ranking in the incidence of cancer has changed from 4th to 3rd in both sexes [2].

Taking into account the situation in the Republic and worldwide, in 2011 Kazakhstan has introduced a screening program for early detection of pre-tumor and tumor colon pathologies.

**Purpose of the study** is to analyze the CRC screening coverage in Kazakhstan, challenges in the implementation of the screening program, and to determine prospects of its further improvement.

**Materials and methods.** The research targeted the statistical data of patients covered by screening for early detection of pre-tumor and malignant colon neoplasms in 2011-2018. The data was obtained from the reporting forms provided by Medinform LLP based on the data from the Outpatient Automated Information System. Population information was obtained from the Covered Population Register (CPR) of the Republican Electronic Health Center.

In 2011-2017, the CRC screening covered men and women at the age of 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, and 70 years; since 2018, it covers men and women aged 50 to 70 years.

Occult blood in feces (FOB) test is the basis of screening. Since 2013, the screening includes an immunochemical (immunofluorescent) hemoculture analysis. Also, since

2013 the in-depth diagnostics stage includes total colonoscopy.

Since 2011, the cancer cases detected during screening are synchronized with the data from the Cancer Patients' Electronic Register (CPEP).

Stages of the screening:

1) Preparatory stage includes making a list of the target group, invitation, program assistance.

2) Administration of hemocult test.

The patients conduct hemocult tests independently following the instructions from the PHC nursing staff. Then, the patients receive the test results in the prevention room or from the district nurse. In some cases, the nurses ask a patient to bring a container with the material, and the test itself is conducted in the prevention department or the outpatient clinic lab.

3) Colonoscopy.

In case of a positive hemocult test, the patient is sent for the examination of the entire colon section (total colonoscopy). The district nurse invites/visits the patient, clarifies the importance and necessity of further endoscopic examination, refers the patient to the endoscopy department, recommends medicines to clean the intestines, and instructs on the preparation of intestines for examination. Colonoscopy is conducted in the endoscopy departments of the city, district outpatient clinics, consulting and diagnostic centers/diagnostic departments.

**Results.** *Availability of resources and personnel.* Hemocult test is procured centrally and by all primary health care organizations at all levels, including rural health posts.

The following equipment is available at this stage:

115 colonoscopes, of them, 75 are video colonoscopes (65%); only 79 (68.7%) are equipped with a set of surgical instruments for neoplasm biopsy, submucosal resections, pol-

ypectomy of small polyps. Not all endoscopic cabinets have automatic devices for processing endoscopes, more often 1 device accounts for a gastroscope and a colonoscope.

There are 123 endoscopists for 81.5 spaces. According to the current issue of the Order of the Minister of Healthcare of the Republic of Kazakhstan of April 7, 2010 No. 238 "On approval of typical staffing and staffing standards of healthcare organizations", 1 examination shall take 100

minutes what means 1,000 examinations per year. Based on the number of screening colonoscopies in the country (10-12,000), the staffing level of endoscopists is 100%.

Accessibility for the public is high including rural population. No specialists or special tools except test materials are required to perform the tests. The screening accessibility for rural population is also confirmed by the CRC screening results for 2016-2017 (see Tables 1 and 2).

**Table 1** – Coverage of urban and rural population by CRC screening, 2017-2018

Regions	Examined in 2017				Examined in 2018			
	Urban population		Rural population		Urban population		Rural population	
	Abs.	% of plan	Abs.	% of plan	Abs.	% of plan	Abs.	% of plan
Akmola Region	11 716	52.5*	9 738	40.5*	26 141	99.7	23 911	103.6
Aktobe Region	25 257	87.4	13 078	139.3	24 629	96.0	11 530	130.2
Almaty Region	23 674	87.1	67 000	104.7	21 252	87.1	61 435	104.9
Atyrau Region	12 550	102.9	12 320	100.9	9 474	90.7	12 672	114.4
West Kazakhstan Region	17 937	109.6	16 198	91.2	16 392	97.8	15 063	101.5
Zhambyl Region	22 256	97.8	25 097	102.0	21 165	85.4	23 054	118.7
Karaganda Region	62 084	99.6	14 320	101.9	58 605	99.5	13 722	102.0
Qostanay Region	29 650	97.2	21 429	101.9	27 330	96.9	21 378	105.8
Qyzylorda Region	12 327	92.8	17 512	106.0	11 127	98.7	17 090	105.1
Mangystau Region	12 167	91.8	11 924	121.6	13 753	98.6	8 592	105.9
South Kazakhstan Region	48 479	92.5	51 277	108.3	47 180	89.8	47 680	118.5
Pavlodar Region	31 885	92.9	13 215	124.1	25 137	89.0	16 530	123.7
North Kazakhstan Region	12 704	107.8	26 812	104.8	9 899	119.5	27 227	99.8
East Kazakhstan Region	43 223	95.1	40 343	110.9	41 552	103.8	40 002	102.3
The city of Astana	34 888	100.1	2	0.0	29 356	100.1	3	0.0
The city of Almaty	78 180	100.5	3	0.0	73 480	100.6	420	0.0
<b>The Republic of Kazakhstan</b>	<b>478977</b>	<b>94.7</b>	<b>340268</b>	<b>102.1</b>	<b>456472</b>	<b>96.7</b>	<b>340309</b>	<b>108.4</b>

\* Underperformed due to the late delivery of hemocult tests

**Table 2** – Coverage of urban and rural population by colonoscopy as part of CRC screening, 2017-2018, % of positive hemocult tests

Регионы	Examined in 2017				Examined in 2018			
	Urban population		Rural population		Urban population		Rural population	
	Abs. No. of positive hemocult-tests	% of conducted colonoscopies	Abs. No. of positive hemocult-tests	% of conducted colonoscopies	Abs. No. of positive hemocult-tests	% of conducted colonoscopies	Abs. No. of positive hemocult-tests	% of conducted colonoscopies
Akmola Re-gion	247	70.0	89	58.4	225	79.6	162	79.6
Aktobe Re-gion	311	92.3	212	86.8	340	84.7	124	75.0
Almaty Re-gion	292	75.0	610	61.8	305	82.0	865	70.8
Atyrau Re-gion	117	67.5	259	85.7	302	83.4	228	88.2
West Ka-zakhstan Region	207	94.7	186	76.9	192	87.5	304	82.2
Zhambyl Region	210	88.1	156	97.4	238	91.6	211	93.4
Karaganda Region	959	92.8	227	77.5	1193	78.3	161	68.3
Qostanay Region	538	75.7	112	60.7	287	78.4	76	60.5
Qyzylorda Region	166	57.8	181	81.2	203	62.6	258	63.6
Mangystau Region	133	90.2	115	68.7	214	85.0	130	76.2
South Ka-zakhstan Region	482	74.7	443	74.9	583	70.2	468	65.6
Pavlodar Region	511	71.6	127	81.1	511	83.6	141	90.1
North Ka-zakhstan Region	395	67.3	218	73.4	166	54.2	124	75.0
East Ka-zakhstan Region	533	66.0	275	69.1	712	76.3	305	73.4
The city of Astana	833	54.4	0	0	738	56.9	0	0
The city of Almaty	949	92.2	0	0	1 137	81.4	0	0
<b>The Republic of Kazakhstan</b>	<b>6 883</b>	<b>77.3</b>	<b>3 210</b>	<b>74.3</b>	<b>7 346</b>	<b>76.7</b>	<b>3 557</b>	<b>74.6</b>

It should be noted that not all rural population has access to endoscopic examination. Thus, the access to colonoscopy is limited for the rural population of Aktobe, Almaty, Karaganda, Qostanay, and Mangystau Regions

(Table 2). Low coverage of rural population with colonoscopy may be due to a low awareness of the population about the necessity to pass endoscopic examination in case of positive hemocult test results, or the nursing staff

may not be sufficiently conclusive regarding the need to pass further examinations. The opposite situation is noted in Atyrau, Zhambyl and North Kazakhstan Regions, where the number of colonoscopies performed is higher among the rural population than among the urban population.

*The results of screening.*

The screening has covered 790,000 people in 2015 vs. 1 174,000 people in 2012. In total, 7,291,950 men and wom-

en have been examined from 2011 till 2018.

The annual screening coverage was about 800,000 to 1,000,000 people. It corresponded to 50-65% coverage in 2 years of the target group aged 50 to 70 years (Table 1). Since 2015, the examination plan was reduced due to the reduction in financing. In 2018, 860,612 people were examined because the target group was increased to include the entire population aged 50 to 70 years.

**Table 3** – Coverage and efficiency of CRC screening

Years	No. of examined men and women	% of the total no. of men and women 50-70 y.o. acc. to CPR	No. of cancer cases detected by screening		Total no. of de-tected cancer cas-es acc. to CPER		Share of can-cer cases de-tected by screening in the total no. of cases detected at target age
			Abs.	% of coverage	Total	Of them, at target age	
2011	982 919**	32.8*	199	0.02	2 563	668	29.8
2012	1 174 155	39.2*	228	0.02	2 766	724	31.5
2013	896 278	29.9*	366	0.04	2 948	942	39.9
2014	970 056	32.4*	514	0.05	3 086	985	52.2
2015	791 904	24.6	467	0.06	3 148	995	46.9
2016	796 781	24.8	475	0.06	3 158	1 186	40.1
2017	819 245	24.0	349	0.04	3 131	1 051	33.2
2018	860 612	25.2	309	0.04	3 210	1 829	16.9
<b>Bcero</b>	<b>7 291 950</b>		<b>2 907</b>	<b>0.04</b>	<b>24 010</b>	<b>8 380</b>	<b>34.7</b>

\* Calculation based on the CPR data for 2014

An important screening indicator is the patients' participation in colonoscopy in case of positive hemocult test results. This indicator was increasing annually, from 59.3% in 2013 to 74% in 2016-2017 and 76% in 2018. According to European recommendations, an acceptable level of colonoscopy is 90%.

The level of precancer detected during colonoscopy has increased from 11.5% in 2013 (when the endoscopic evaluation system was optimized to identify polyps) to 14.4% in 2015 and 20.3% in 2017. The level of adenoma detection was 17.8% in 2018 (international recommendations are 25% and more). This indicator is included in the quality indicators of screening programs in the implementation of the Comprehensive Plan and shall be increased up to 23% by 2022.

CRC detection was increasing annually till 2017, from 199 cases in 2011 and 228 cases in 2012 to 514 cases in

2014. In 2017-2018, it amounted to 0.04% of the screened population.

The share of CRC cases detected by screening in the total number of cancer cases in the target age population has increased from 29.8% in 2011 to 52.2% in 2014, i.e. every third case of cancer at target age was detected by screening.

The highest share of CRC detection by screening in 2011-2018 was noted in West Kazakhstan, Qostanay, Pavlodar, and North Kazakhstan Regions (an average annual detection rate of 0.06% and higher); the detection in the South Kazakhstan Region and the city of Almaty was low.

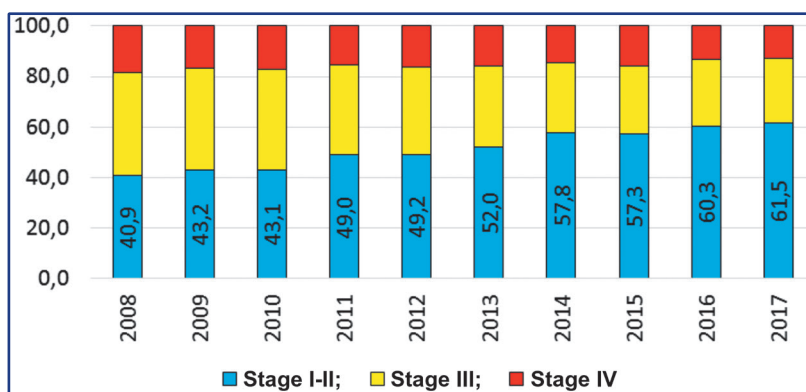
The share of Stage I CRC detected was 18.1% (Table 4). That indicator was growing in the first 4 years of screening; since 2014, it varies from 19 to 23%. In 2018, the early detection of CRC was 23.6%. There is a pronounced positive downward trend of the number of cases diagnosed at Stage IV of the process, from 15.1% in 2011 to 1.6% in 2018.

**Table 4** – The structure of CRC cases detected by screening

Years	Detected CRC cases, Abs.	Stage I		Stage II		Stage III		Stage IV	
		Abs.	%	Abs.	%	Abs.	%	Abs.	%
2011	199	14	7.0	128	64.3	27	13.6	30	15.1
2012	228	14	6.1	117	51.3	65	28.5	32	14.0
2013	366	45	12.3	227	62.0	69	18.9	25	6.8
2014	514	118	23.0	299	58.2	71	13.8	26	5.1
2015	467	95	20.3	292	62.5	63	13.5	17	3.6
2016	475	101	21.3	298	62.7	65	13.7	11	2.3
2017	349	67	19.2	215	61.6	56	16.0	11	3.2
2018	309	73	23.6	200	64.7	31	10.0	5	1.6
<b>Total</b>	<b>2 907</b>	<b>527</b>	<b>18.1</b>	<b>1776</b>	<b>61.1</b>	<b>447</b>	<b>15.4</b>	<b>157</b>	<b>5.4</b>

In the structure of CRC cases detected in all age groups, the share of Stage I-II cases was 40.9% in 2008. It increased up to 49.2% after the introduction of screen-

ing in 2011, and up to 61.5% in 2017. It indicates a marked increase in the share of localized forms of the disease (Figure 1).

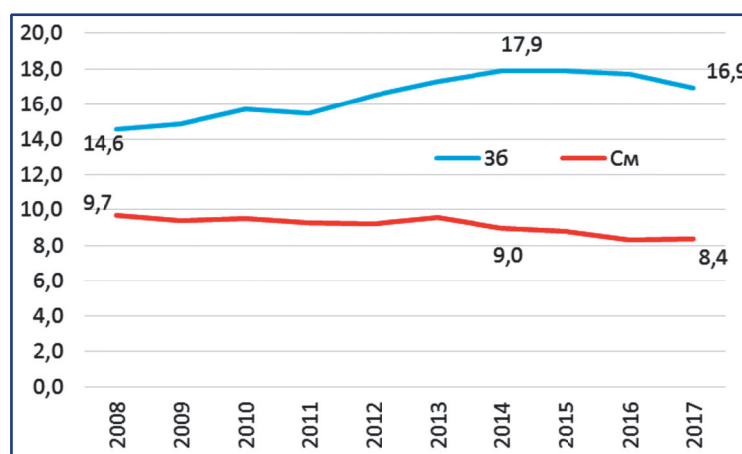


**Figure 1** – The share of Stage I-II CRC cases among all primary patients

A high level of early Stage I CRC detection in 2011-2018 was noted in West Kazakhstan, Karaganda, Mangystau, South Kazakhstan, and North Kazakhstan Regions. A low level of Stage I CRC detection was noted in Aktobe, Atyrau, Zhambyl, and Qyzylorda Regions.

Over the years of screening in Kazakhstan, there is a positive trend of increasing CRC incidence (as a compen-

sating result of the early detection program implementation) and decreasing CRC mortality. Figure 2 shows the dynamics of CRC incidence and mortality in Kazakhstan in 2008-2017. The CRC incidence has increased from 14.6‰ in 2008 to 17.9‰ in 2014, and decreased to 16.9‰ in 2017. The mortality curve has a pronounced downward trend, from 9.6‰ in 2013 to 8.4‰ in 2017.



**Figure 2** – CRC incidence and mortality, per 100,000 population

**Discussion and Conclusions.** The analysis of the screening program implementation stages and results has revealed a number of challenges.

The quality of sampling:

a) A low level of positive hemocult tests may be due to improper instructions on using the hemocult test given by the nurse.

b) A lack of objective assessment of hemocult testing process.

c) A delay in the hemocult tests' delivery: in case of centralized procurement – in April or later.

The stage of colonoscopy:

a) Refusal of the patients to pass the examination (25-30%).

b) Only 35% of patients receive sedation during colonoscopy (according to allocated funding).

c) The volume of total colonoscopy is not controlled.

d) Micro-invasive manipulations are not always performed since the endoscopy rooms are underequipped with surgical instruments (68.7%).

e) Low level of precancer detection (13% during colonoscopy in 2017, at the internationally recommended lev-

els of 23% or higher).

f) The current rates cover only a half of organizational expenses on purchasing medicines to clear the intestines (due to the devaluation of Tenge).

CRC screening can be modified by using automated quantitative hemocult test. Its introduction will allow to:

- increase the detectability of inflammatory diseases, precancerous conditions and early stages of CRC followed by confirmation by colonoscopy;

- reduce the number of false positive results in order to reduce the number of unreasonably prescribed colonoscopies (using only the hemoglobin test, without transferin) by 30%;

- form risk groups for CRC development and perform efficient monitoring;

- timely carry out adequate therapeutic actions;

- ensure the study objectiveness by eliminating the human factor;

- connect to information systems.

Despite the significant advantages of using automated quantitative hemocult test, its high cost remains its main disadvantage.

The following recommendations have been developed taking into account the urging nature of the problem, the experience gained by Kazakhstani specialists and the available resources:

1) to raise the awareness, improve the communication skills of the medical personnel needed to motivate the population to pass screening and colonoscopy;

2) to revise the methodological approaches to the screening strategy by introducing a validated automated hemocult test with the quantitative determination of hemoglobin in feces;

3) to increase the liability of the specialists of the relevant PHC organizations for the final results of screening, to strengthen the interaction between the stages of screening: PHC-screening → a general practitioner → an endoscopy room, i.e., to harmonize direct communications and feedback in the system of treating the patients with identified pre-tumor pathology;

4) to increase the level of training of endoscopists in conducting total diagnostic colonoscopy as well as minimally invasive endoscopic surgical interventions;

5) to develop and introduce the information system of screening that will allow monitoring the examinations and improving their quality component.

In the future, an analysis of medical and economic efficiency is needed for an economic assessment of conducted screening and identifying the most efficient and cost-effective approach to the further implementation of the screening program.

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