



## EPIDEMIOLOGY OF PROSTATE CANCER In KURSK REGION

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*The paper dwells on analysis performed on 2,238 male patients with primary incidence and 999 patients who died due to prostate cancer over 2007–2016 in Kursk region.*

*Data were processed with "Statistica for Windows" software package (ver. 12.5). The authors applied intensive overall and sex-age (per 100 thousand males) parameters. Overall incidence and mortality were compared with the data collected in the Central Federal District. Sex-age incidence and mortality due to prostate cancer were compared with the same parameters in the Russian Federation as a whole. To test validity of discrepancy between data sets, Student's parametric test (*t*) was applied with 95 % significance. Incidence and mortality due to prostate cancer were predicted for a period up to 2021 with an autoregressive integrated moving average (ARIMA).*

*Prostate cancer occupies the fifth place among malignant neoplasms in Kursk region and the sixth place in the overall mortality structure. In Kursk region a growth in incidence with prostate cancer amounted to 100.3 % in 2016 against 2007; a growth in mortality, 85.6 %. By 2021 incidence with prostate cancer can reach 71.24, and mortality, 30.79. Incidence among males in Kursk region has grown due to an increase in number of male patients aged 60–64 and 80 and older. Mortality caused by prostate cancer has grown due to an increase in number of deceased males aged 50 and older.*

*In the nearest future Kursk region can take a leading place among other regions in the Central federal District as per incidence and mortality due to prostate cancer. The research results are being applied for planning and developing a regional target program "Oncology".*

**Key words:** malignant neoplasms, epidemiologic analysis, incidence, mortality, prostate cancer, sex-age parameters, target program.

Prostate cancer (PC) is one of the most widely spread malignant neoplasms in men [1–3]. Incidence with PC has increased significantly over recent years [4–5]. Researchers revealed that incidence with PC was higher in highly developed countries, and the lowest incidence with the disease was detected in the least developed countries [6].

Incidence with PC varies worldwide and discrepancies between different population groups can be more than 50 times [7, 8]. The highest incidence with PC is observed in Australia / New Zealand (111.6), in North America (97.2), and in Western Europe (85.8); the lowest one is registered in South and Central Asia (4.5) [7]. Regions where incidence level is substantial in comparison with other regions located on the same continent include South Africa (61.7), Western Asia (28.0),

North America, Western Europe (85.8), and Australia / New Zealand (111.6) [8].

Ageing of population leads to a growth in life expectancy and causes risks of PC in future [7]. Risk of the disease is equal to approximately 1:10,000 among people younger than 40; still, each sixth man will have PC diagnosed in him over his life span. Men younger than 50 account for only 0.1% of patients with PC. Risk of the disease increases substantially only among those who are older than 60. Average age of male patients with PC amounts to 72–74 [9].

There are several risk factors causing the disease; primary ones are low physical activity, overweight, alcohol intake, consumption of red meat, inflammatory diseases in the kidneys and urinary bladder etc. [9, 10, 11]. 20.3 million new PC cases are predicted to be

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detected by 2030, and 13.2 million patients from them will not survive [5, 7].

An issue related to PC screening is rather controversial [9, 12, 13]. Primary PC treatment usually involves eradication of the prostate, radiotherapy and hormonal therapy, but sometimes it can be only medical supervision. Choice on a therapy depends on age, cancer stage, comorbidity, preference of a patient and an urologist etc. [14].

Mortality caused by PC remains the highest and occupies the second rank place after mortality caused by lung cancer [1, 2, 7]. Frequency and prevalence of PC differ in different world regions [7, 8]. In 2012 PC was diagnosed in 1.1 million men, and 70% out of them (795,000 cases) were registered in developed countries [6, 8, 9].

In the Russian Federation incidence with PC grew from 30.74 per 100,000 men in 2007 to 59.91 per 100,000 in 2017; the growth amounted to 100.5%. Average age at which a male patient was diagnosed PC became younger in 2017 as it fell to 69.6 while in 2007 it was equal to 70.5 [15, 16, 17]. In the Russian Federation PC occupied the second rank place among malignant neoplasm in men in 2017 after malignant neoplasms in the trachea, bronchial tubes, and lungs (17.4%) and accounted for 14.5% [15].

Mortality caused by PC grew from 13.54 per 100,000 men in 2007 to 18.46 per 100,000 men in 2017 in the Russian Federation; the growth amounted to 34.27%. PC occupied the second rank place in mortality caused by malignant neoplasms and accounted for 8.1%; the first rank place belonged to malignant neoplasms in the trachea, bronchial tubes, lungs, and stomach (10.7%) [15].

Mortality caused by malignant neoplasms is a basic indicator of public health-care efficiency. But still, statistical data are often distorted due to necessity to encode death causes of oncologic patients. It happens due to migration, errors related to filling in death certificates, incorrect determination of the primary death cause, incompetent personnel filling in medical death certificates etc. [18, 19].

**Our research goal** was to analyze PC epidemiology in a specific Russian region (by the example of Kursk region).

**Data and methods.** To accomplish the research, we took data from the cancer register collected over 2007–2016 by the Kursk regional cancer clinic on 2,238 patients who had PC diagnosed for the first time and on 999 patients who died from PC. According to official statistic data, male population in Kursk region decreased from 531,102 in 2007 to 509,615 in 2016. Data were statistically processed with «Statistica for Windows» software (ver. 12.5). We applied "crude" (total and age-sex) intensive (per 100,000 men) incidence and mortality values according to the Methodical guidelines developed by P.A. Herzen's Moscow Scientific Research Oncologic Institute [20]. Total "crude" incidence and mortality values were compared with data collected in the Central Federal District (CFD) over 2007–2016. «Crude» age-sex incidence and mortality values were compared with the same official statistic data in the overall country over the same period [15]. To test validity of discrepancy between data arrays, we applied parametric Student's t-test with significance level being equal to 95%. Incidence and mortality caused by PC were predicted with autoregressive integrated moving average (ARIMA) [21] for a period up to 2021.

**Results and discussion.** PC accounted for 5% in the structure of incidence with malignant neoplasms in Kursk region and occupied the 5th rank place after skin neoplasms (13.1%), lung and breast cancer (10.9% each), stomach cancer (7.1%), and colon cancer (5.1%).

Average incidence with PC amounted to 41.03 per 100,000 in Kursk region over 2007–2016 and was authentically lower than in the CFD (51.63 per 100,000 men) over the same period of time,  $t=2.12$ ,  $p=0.05$ .

But still, a growth in incidence with PC in 2016 against 2007 was more apparent in Kursk region (100.3%) than in the CFD (84.5%). Incidence with PC in Kursk region grew from 28.55 per 100,000 men in 2007 to

57.19 per 100,000 men in 2016; in the CFD it grew from 31.99 per 100,000 men in 2007 to 59.03 per 100,000 men in 2016. As predicted, by 2021 incidence with PC will have grown up to 71.24 per 100,000 men in Kursk region (Figure 1).

Kursk region occupied the 13th place among all the region in the CFD as per primary incidence with PC over 2007–2016 (Table 1). Therefore, in the nearest future Kursk region will take a leading place as per incidence with PC among CFD regions.

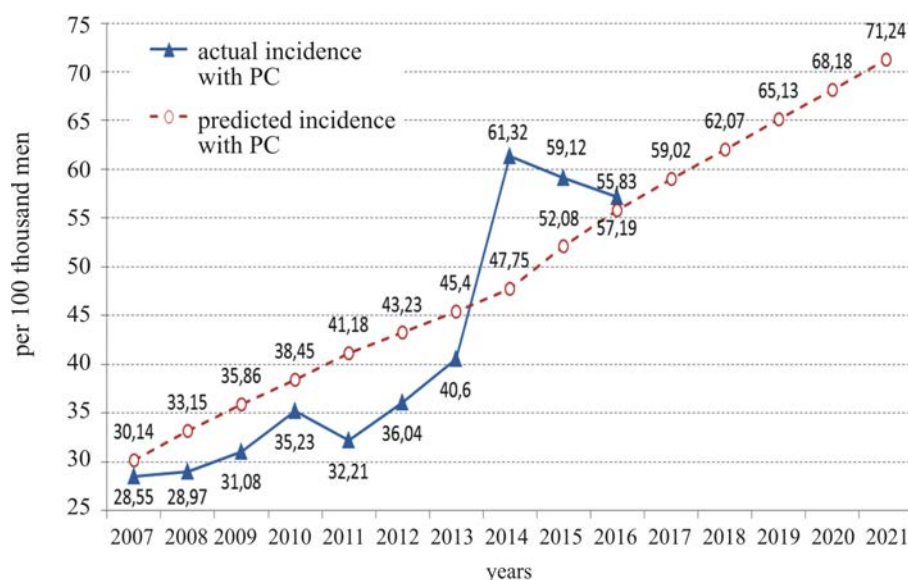


Figure 1. A prediction for incidence with PC in Kursk region

Table 1

Dynamics of incidence with prostate cancer in the Central Federal District regions

Regions	Incidence (per 100 thousand men)			
	2007	2016	average (2007–2016)	A growth in 2016 against 2007 (%)
CFD	31.99	59.03	51.63	84.5
Belgorod region	28.94	45.73	40.52	58.0
Bryansk region	31.94	40.44	43.96	26.6
Vladimir region	25.6	50.75	40.32	98.2
Voronezh region	36.55	59.56	51.38	63.0
Ivanovo region	28.02	77.49	46.57	176.6
Tver region	31.82	58.82	47.73	84.9
Kaluga region	44.19	83.28	62.99	88.5
Kostroma region	26.76	39.95	37.31	49.3
Kursk region	28.55	57.19	41.03	100.3
Lipetsk region	35.85	64.04	44.92	78.6
Moscow city	66.12	68.39	70.78	3.4
Moscow region	33.44	51.82	45.04	55.0
Orel region	29.21	61.43	46.86	110.3
Ryazan region	28.74	57.36	47.12	99.6
Smolensk region	18.68	35.63	28.17	90.7
Tambov region	19.22	41.73	35.34	117.1
Tula region	33.76	53.95	44.31	59.8
Yaroslavl region	29.67	62.62	47.83	111.1

In Kursk region men who had PC diagnosed in them for the first time were 35–39 years old (0.54 per 100 thousand men), a peak in incidence (367.49 per 100 thousand men) was detected among those aged 75–79 with subsequent fall among those aged 80 and older (316.42 per 100 thousand men). It was quite consistent with data collected in the country in general (Table 2). Authentically ( $p < 0.05$ ) lower sex-age incidence with PC in Kursk region than in the RF on average was detected among men aged 55–59 (46.02 per 100 thousand men against 60.40 per 100 thousand men in the RF on average,  $t = 3.23$ ,  $p = 0.05$ ); men aged 60–64 (112.50 per 100 thousand men against 154.95 per 100 thousand men in the country on average,  $t = 3.7$ ,  $p = 0.002$ ); and among men aged 70–74 (303.39 per 100 thousand men against 383.50 per 100 thousand men in the RF on average,  $t = 2.24$ ,  $p = 0.04$ ).

In Kursk region dynamics of sex-age incidence with PC was multidirectional among men aged 35–44 and there was no growth detected in it. Sex-age incidence decreased among men aged 45–59, with the most significant drop (–70,0%) being detected among men aged 50–54. Sex-age incidence with PC grew among men aged 60–80 and older, its growth being higher among those aged 80 and older (123.6%).

As for the RF in general, sex-age incidence with PC grew practically in all age

groups, excluding 35–39 and 55–59 years; the most significant growth was detected among men aged 65–69 (70.3%); the least significant (8.3%), among those aged 80 and older (Table 2).

In Kursk region prostate cancer took the 6th place (4.5%) in the structure of mortality caused by malignant neoplasms after lung cancer (17.9%), stomach cancer (11.5%), breast cancer (7.2%) colon and rectal cancer (5.8% each), and pancreas cancer (4.6%).

We didn't detect any authentic discrepancies in mortality caused by PC in Kursk region (its average value over 10 years being equal 18.89 per 100 thousand men) and in the CFD (18.51 per 100 thousand men),  $p > 0.05$ . However, mortality growth in 2016 against 2007 was equal to 85.8% in Kursk region and it was higher than in the CFD (35.24%). In Kursk region mortality caused by PC grew from 13.43 per 100 thousand men in 2007 to 24.96 per 100 thousand men in 2016; in the CFD it grew from 15.38 per 100 thousand men in 2007 to 20.80 per 100 thousand men in 2016.

Unless the situation changes, mortality caused by PC can reach 30.79 per 100 thousand men in Kursk region (Figure 2).

Kursk region occupied the 18th place as per PC-caused mortality over 2007–2016 among all the CFD regions (Table 3).

Table 2

Comparison of sex-age incidence with prostate cancer (per 100 thousand men of a relevant age) (average values for 2007–2016)

Age	Kursk region	Growth/decrease in 2016 against 2007 (%)	The RF	Growth/decrease in 2016 against 2007 (%)	t	p
	$\bar{x} \pm \sigma$		$\bar{x} \pm \sigma$			
35–39	0.54 ± 1.13	0	0.25 ± 0.1	0	0.76	0.46
40–44	0.28 ± 0.90	0	0.91 ± 0.13	26.9	2.06	0.06
45–49	2.54 ± 1.58	-30.0	4.16 ± 0.46	38.8	2.95	0.01*
50–54	14.79 ± 9.72	-70.0	19.21 ± 2.86	47.9	1.31	0.21
55–59	46.02 ± 10.83	-22.5	60.40 ± 8.16	-6.0	3.23	0.01*
60–64	112.50 ± 29.33	42.8	154.95 ± 18.97	39.7	3.7	0.002*
65–69	240.05 ± 65.68	61.5	279.07 ± 59.22	73.1	1.35	0.19
70–74	303.39 ± 91.39	50.5	383.50 ± 58.48	53.6	2.24	0.04*
75–79	367.49 ± 140.97	54.8	434.49 ± 70.29	55.0	1.29	0.22
80 and older	316.42 ± 108.90	123.6	346.89 ± 23.02	8.3	0.83	0.42

\*note:  $\bar{x}$  is average value,  $\sigma$  is standard deviation; t is Student's test, p is significance level.

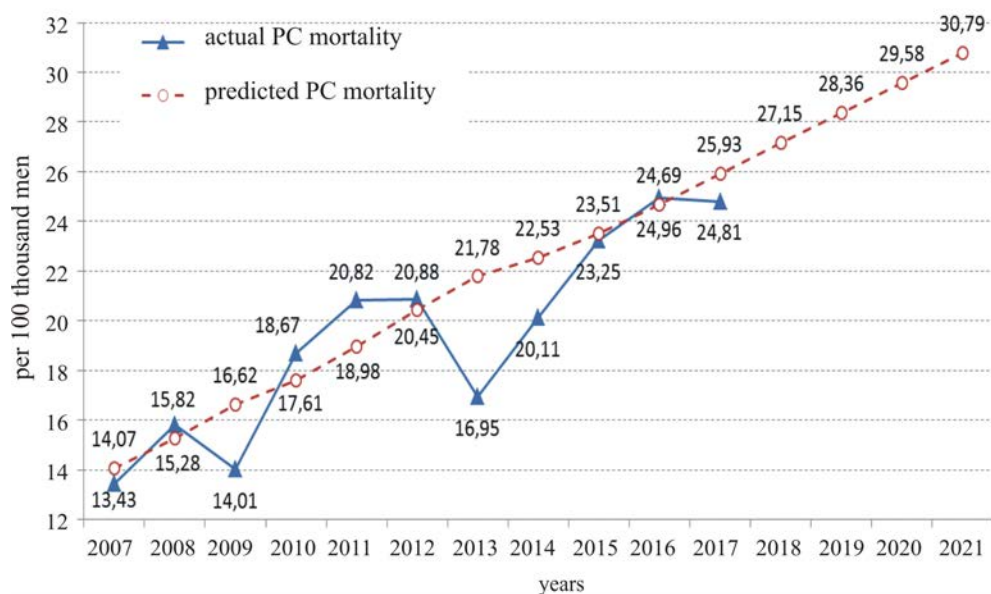


Figure 2. Predicted mortality caused by prostate cancer in Kursk region

Table 3

## Dynamics of mortality caused by prostate cancer in the Central Federal District regions

Regions	Mortality (per 100 thousand men)			
	2007	2016	average (2007–2016)	growth/decrease in 2016 against 2007 (%)
CFD	15.38	20.80	18.51	35.2
Belgorod region	11.23	18.60	16.14	65.6
Bryansk region	17.48	20.94	18.08	19.8
Vladimir region	16.55	20.30	19.20	22.7
Voronezh region	14.81	19.04	18.13	28.6
Ivanovo region	12.24	20.56	16.30	68.0
Tver region	15.02	24.85	18.18	65.5
Kaluga region	19.91	24.83	20.14	24.7
Kostroma region	16.37	21.15	17.51	29.2
Kursk region	13.43	24.96	18.89	85.9
Lipetsk region	12.95	17.24	15.29	33.1
Moscow city	17.79	23.31	19.76	31.0
Moscow region	17.62	16.59	18.57	-5.9
Orel region	16.35	20.18	19.19	23.4
Ryazan region	15.13	23.33	19.68	54.2
Smolensk region	11.03	18.38	14.45	66.6
Tambov region	14.86	13.50	14.25	-9.2
Tula region	17.38	23.59	21.49	35.7
Yaroslavl region	16.62	22.10	18.87	33.0

Comparison of sex-age mortality caused by prostate cancer  
(per 100 thousand men of a relevant age) (average values for 2007–2016)

	Kursk region	Growth/ decrease in 2016 against 2007 (%)	The RF	Growth/ decrease in 2016 against 2007 (%)	t	p
	$\bar{x} \pm \sigma$		$\bar{x} \pm \sigma$			
40–44	0.55 ± 1.17	-	0.3 ± 0.06	-21.4	0.65	0.52
45–49	1.42 ± 2.04	-	1.18 ± 0.17	-11.5	0.35	0.73
50–54	8.9 ± 6.08	618.9	4.72 ± 0.29	13.4	2.06	0.06
55–59	18.24 ± 7.78	-8.1	14.99 ± 0.79	-6.0	1.24	0.23
60–64	51.69 ± 14.08	42.8	38.61 ± 1.28	2.1	2.77	0.01*
65–69	90.32 ± 27.8	96.4	75.81 ± 2.67	11.2	1.55	0.14
70–74	166.63 ± 85.69	209.3	130.19 ± 7.22	14.7	1.27	0.22
75–79	197.48 ± 76.71	113.7	188.79 ± 11.15	20.6	0.34	0.74
80 and older	142.38 ± 51.98	26.5	243.05 ± 14.98	18.6	5.59	0.00003

\*note:  $\bar{x}$  is average value,  $\sigma$  is standard deviation; t is Student's test, p is significance level.

40–44 was the youngest age at which mortality caused by PC was detected in Kursk region (0.55 per 100 thousand men); it reached its peak among men aged 75–79 (197.48 per 100 thousand men) and then went down among those aged 80 and older. Authentically high discrepancies between mortality caused by PC in Kursk region against data collected in the RF were detected among men aged 60–64 (51.69 per 100 thousand men against 38.61 per 100 thousand men in the RF,  $t=2.77$ ,  $p=0.01$ ). Mortality caused by PC among men aged 80 and older was 2 times higher in the country on average (243.05 per 100 thousand men) than in Kursk region (142.38 per 100 thousand men),  $t=5.59$ ,  $p=0.00003$ .

Mortality caused by PC grew in 2016 against 2007 practically in all age groups of men in Kursk region; the highest growth was among those aged 50–54, by 618.9%, 70–74, by 209.3%, and 75–79, by 113.7% (Table 4); growth rates were not so high in all the age groups as regards the country in general.

**Conclusion.** So, incidence with prostate cancer in Kursk region, just as in most regions in the CFD grows due to an increase among men aged 60–64 and 80 and older. In Kursk region, risk for men younger than 60 to die from prostate cancer amounts to  $1.45 \cdot 10^{-4}$ , and it is almost 3 times higher than the same parameter in the RF in general ( $5.3 \cdot 10^{-5}$ ).

As per experts' forecasts, unless prevention activities are implemented, Kursk region can soon become one of those regions in the country where incidence with prostate cancer and mortality caused by it are the highest, an increase in mortality among men aged 50–65 being a reason for it as well.

All the data obtained in the research are being applied to plan and develop «Oncology» regional program in Kursk region.

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**Conflict of interest.** The authors state there is no any conflict of interests.

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