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Healthcare Efficiency as a Wellbeing Factor in the Siberian Federal District

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Abstract

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An assessment of the efficiency of healthcare systems in territorial entities of the Russian Federation's Siberian Federal District was carried out using Minmax method on the basis of data presented in Unified Interdepartmental Statistical Information System. Four groups of components were assessed (presence, usage, availability of resources and medical efficiency), while being decomposed into 14 indicators.
The study of selected components and indicators dynamics through 2005-2013 allowed revealing its multidirectional influence on the efficiency of healthcare systems in the Siberian Federal District territorial entities. Low or average level of efficiency was revealed in 9 out of 13 territorial entities, usually determined by the insufficient level of usage or availability of resources. Possible ways of improving the district's healthcare system efficiency were defined. It is proved that the efficiency of The Siberian Federal District healthcare systems is an essential factor in ensuring the wellbeing of the population who live in district which is distinct in uncongenial climatic-ecological conditions affecting health.

Keywords: Efficiency; healthcare; Minmax method; wellbeing.

1. Introduction

The European Office of the World Health Organization notes that the state should give priority to healthcare, which should be considered as an investment in the future prosperity and social wellbeing (WHO, 2009). However, the increase in spending on healthcare (The World Bank, 2015; OECD, 2015) does not lead to improvement of population`s health outcomes, some of them are even becoming worse.

Morbidity of the Russian Federation's population steadily grows following the worldwide trend. Overall morbidity of country's population increased by 17.7% through 2005-2013, by 13.7% in The Siberian Federal District (Kudelina et al., 2016). The Siberian Federal District was established on 13 May 2000 of 12 territorial entities of the Russian Federation, including 4 republics; 3 krais; 5 oblasts. Its territory comes to 30% of the territory of Russia, the population is 13.2% of Russia's population and the population density is about two times lower than the average value across Russia. In 2014, the Gross Regional Product (GRP) per capita was 316.4 thousand rubles, i.e. 77.4% of the average value across the Russian Federation (408.5 thousand rubles) (FSSS, 2016).

While comparing healthcare systems in federal districts of the Russian Federation it was revealed that in The Siberian Federal District the expenditures and costs are adequate to each other from the point of view of healthcare efficiency, but it is necessary to pay rapt attention to population health indicators ("medical efficiency" component), which appear to be one of the lowest. Certainly, it is the complex climate in Siberian region, numerous plants are located on its territory, what negatively affects ecology affecting health (Kudelina, & Eremina, 2016). In addition, ecology level as well as the levels of education, housing availability, transport development and agriculture are the determinants of nation's health (ODPHP, 2016).

2. Methodology

A measurement of healthcare systems efficiency in territorial entities of The Siberian Federal Districts through 2005-2013 (or latest available) was conducted using Minmax (Maxmin) method with 4 components decomposed into 14 indicators.

1. *Presence of medical resources:* provision per 10 thousand population: physicians (the indicator includes physicians of all medical specialties), nurses, hospital beds; institutions providing medical care to population (4 indexes).

2. *Usage of resources*: average duration of patient stay at a hospital bed, days; average occupation of a hospital bed, days; number of procedures per 1 surgeon; expenditures of Territorial Compulsory Health Insurance Funds for covered period per 1 resident (the indicator is calculated as a relation of spending's to number of resident population) (4 indexes).

3. *Availability or resources*: capacity of outpatient-polyclinic institutions, visits during shift per 10 thousand population; average number of hospital visits per 1 resident; level of hospitalization to 24-hour hospital per 100 residents (3 indexes).

4. *Medical efficiency*: morbidity of cancer diagnosed for the first time per 100 thousand population; expected lifetime at birth, years; number of days of temporary disability per 100 employees (3 indexes).

To implement the complex analysis of healthcare practice through selected criteria an adapted method of healthcare efficiency evaluation (Eremina, & Kudelina, 2014a), which was proposed by Canadian Institute for Health Information (Barua, 2013), was used. According to research methodology, Minmax method was applied in regard to each index characterizing the following components: presence, usage, availability and medical efficiency, after that a summing up of acquired coefficients as a whole component and Minmax method was applied again to get the overall result.

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3. Analysis of investigated components' indexes

Provision of medical personnel in The Siberian Federal District's territorial entities differs dramatically. The highest values were recorded in Tomsk Oblast, the lowest - in Republics of Khakassia and Buryatia (61.2-57.6; 31.9-33.1 and 32.4-35.5 physicians per 10 thousand population, accordingly) (table 1). Provision of nurses through selected period increased by 2-5% in 8 regions, changed insignificantly in 2 regions, and the decrease of index was recorded in two Oblasts: Tomsk Oblast - by 16.3%, Novosibirsk Oblast - by 12.65% (table 2). Indicators characterizing the usage of healthcare resources are presented in physical and monetary terms (table 5-8). Average duration of patient stay at a hospital bed gradually decreased by 10.62% through 2005-2013: from the highest value at Krasnoyarsk Krai - 15.0 days (with a range of 15.0-12.29 days) to the lowest - 9.4 days at the Republic of Altai in 2013 (the range of 10.3-9.4 days) (table 5). Variation of "average occupation of beds, days per year" index was different in territorial entities throughout study period, with increase in 7 out of 12 district's territorial entities. For instance, the most active usage of available bed capacity was recorded in Irkutsk Oblast, where occupation of a hospital bed is 339-334 days as well as in Kemerovo Oblast despite slight decline from 333 to 330 days (table 6). In Novosibirsk Oblast, bed capacity is used less intensively throughout the period, however, the growth is 25.29% (261-327 days), an evidence of the apparent efficiency of undertaken organizational actions, directed to situation's stabilization and improvement.

Table 1. Provision of physicians per 10 thousand population

Territorial entity	2005	2006	2007	2008	2009	2010	2011	2012	2013
Republic of Altai	35.4	36.9	37.9	38.8	39.6	38.8	39.9	39.5	40
Republic of Buryatia	32.4	33.4	33.2	33.2	34.2	34	34.9	34.9	35.5
Republic of Tuva	38.2	39.5	38.9	40.5	40.7	41	43.2	43.1	44.9
Republic of Khakassia	31.9	32.9	32.8	33.1	32.9	32.2	32.5	32.5	33.1
Altai Krai	40.2	41.1	41.6	41.8	42.8	43.5	45.1	45.3	52
Zabaykalsky Krai	46.4	48.3	48.6	50.2	50.7	49.5	49.8	50.1	53.6
Krasnoyarsk Krai	41	40.9	41.6	41.8	42	43.2	43.2	43	42.4
Irkutsk Oblast	38.6	38.6	40.4	40.8	42	42.3	42.7	42.8	48.1
Kemerovo Oblast	41	41.4	42.1	42.4	42.1	41.1	42	42.1	42.5
Novosibirsk Oblast	52.7	47.8	48	50.4	50	49.5	49.5	49.1	48.7
Omsk Oblast	48.5	49.2	49.3	50.5	46.3	45.9	50.9	51	51.5
Tomsk Oblast	61.2	62	54.9	57.6	56.3	57	65.1	64.6	57.6

Table 2. Provision of nurses per 10 thousand population

Territorial entity	2005	2006	2007	2008	2009	2010	2011	2012	2013
Republic of Altai	124.5	126.8	127.7	130.2	129.6	130.2	132.8	131.6	130.6
Republic of Buryatia	93.1	95.5	96.5	95.6	95.4	95.2	94.7	94.8	95.1
Republic of Tuva	128.5	128.5	129.1	130.9	129.7	131.2	134.4	133.9	135.7
Republic of Khakassia	93.1	94.4	92.1	95.8	95.5	96.7	97.5	97.5	95.8
Altai Krai	96	97.3	98.2	98.7	99.1	98.4	99.9	100.3	100.7
Zabaykalsky Krai	98.3	101.4	103.9	105.3	104.3	103.8	104.3	104.9	103.6
Krasnoyarsk Krai	94.2	94.6	95.3	95.6	97.6	99.1	101	100.7	99.8
Irkutsk Oblast	91.5	92.6	93.7	93.3	94.5	94.9	95.2	95.4	95.4

Kemerovo Oblast	92.8	94.3	93.4	92.4	91.6	89.1	90.1	90.4	88.7
Novosibirsk Oblast	100.4	91.8	92.8	91.7	93	92	89.9	89.2	87.7
Omsk Oblast	111.1	112.9	113.4	112.7	95.7	95.5	110.6	110.7	108.5
Tomsk Oblast	99.2	100.4	86.7	85.5	84.5	83.5	98.6	97.7	83.2

Table 3. Provision of hospital beds per 10 thousand population

Territorial entity	2005	2006	2007	2008	2009	2010	2011	2012	2013
Republic of Altai	99.3	99.7	97.3	94.8	88.6	88.2	85.8	81.5	77.4
Republic of Buryatia	91.2	93.2	92	87	84.6	82.8	79.6	79.5	78.9
Republic of Tuva	143.1	140.7	139.3	130.4	122.9	121.4	124.1	117.7	117.4
Republic of Khakassia	88.5	87.1	85.7	86.6	85.9	85.4	81.3	80.5	78
Altai Krai	107.9	108.5	108.3	108.9	105.7	103.2	99.2	94.9	92.8
Zabaykalsky Krai	117.2	117.9	119.1	111.3	103.6	103.6	98.7	98.7	96.3
Krasnoyarsk Krai	94.3	92.1	89.8	87.8	85.5	84.3	79.6	78.2	76.8
Irkutsk Oblast	98.7	98	98.2	98.4	96.3	96.2	96.2	94	92.2
Kemerovo Oblast	93.4	95.1	92.7	83.9	83.4	83.3	84.4	84.8	80.9
Novosibirsk Oblast	122.5	106.4	106.7	103.6	102.3	98.4	93.9	90.8	88.2
Omsk Oblast	106.1	105.5	106	104.2	99.8	89.8	89.2	86.8	84.4
Tomsk Oblast	117	117.9	105.9	99.9	99.3	98.5	110.8	95.2	94.4

Table 4. Provision of institutions providing medical care per 10 thousand population

Territorial entity	2005	2006	2007	2008	2009	2010	2011	2012	2013
Republic of Altai	3.26	1.24	1.24	1.23	1.22	1.22	1.16	1.01	1.00
Republic of Buryatia	1.93	0.49	0.49	0.49	0.44	0.45	0.58	0.57	0.54
Republic of Tuva	2.37	2.34	2.32	1.28	1.28	1.24	1.27	1.16	1.10
Republic of Khakassia	1.71	1.70	1.73	1.73	1.73	1.73	0.79	0.73	0.73
Altai Krai	1.72	0.68	0.69	0.70	0.71	0.70	0.76	0.69	0.69
Zabaykalsky Krai	1.75	1.73	0.83	0.85	0.81	0.76	0.81	0.75	0.78
Krasnoyarsk Krai	1.44	1.09	1.46	1.31	1.30	1.33	0.63	0.59	0.56
Irkutsk Oblast	1.27	1.21	0.57	0.57	0.60	0.59	0.63	0.60	0.53
Kemerovo Oblast	1.35	1.37	0.92	0.92	0.89	1.21	0.60	0.56	0.57
Novosibirsk Oblast	1.29	0.90	0.48	0.43	0.43	0.41	0.45	0.44	0.44
Omsk Oblast	1.63	0.54	0.52	0.52	0.52	0.52	0.55	0.55	0.54
Tomsk Oblast	1.09	0.97	0.91	0.89	0.83	0.79	0.72	0.65	0.61

Note: the index is calculated as the relation of the number of institutions providing medical care to the population to the number of resident population.

Number of procedures per 1 surgeon was significantly various among territorial entities, therefore, the index analysis was conducted using "average value" method. For instance, the highest surgical activity was recorded in the Republic of Altai and Kemerovo Oblast, where up to 988 and 1005 procedures were performed, respectively, the lowest activity was recorded in Tomsk Oblast and the Republic of Tuva (up to 400 and 374 procedures, table 7). Thus, the average number of procedures performed by a surgeon per year came to: 2008 – 323.5; 2009 – 310.9; 2010 – 319.5; 2011 – 306.6; 2012 – 658.9; 682.6 (table 7). The index growth in territorial entities reached 1.5-2.7 times, the deviation was recorded in both directions: the index decrease from average to 50% in the Republic of Tuva and Zabaykalsky Krai, growth to 30-40% in Kemerovo Oblast and the Republic of Altai, - indicating different intensity of workforce resources usage, particularly, surgeons.

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Table 5. Average duration of stay, days

Territorial entity	2005	2006	2007	2008	2009	2010	2011	2012	2013
Republic of Altai	10.3	10.5	10.3	10	9.8	9.6	9.7	9.6	9.4
Republic of Buryatia	12.9	12.7	12.3	11.9	11.6	11.6	11.5	11.5	11.6
Republic of Tuva	12.9	12.4	12.3	11.9	11.2	11.6	11.5	11.6	11.7
Republic of Khakassia	12.4	12.2	12.1	12	11.7	11.6	11.8	11.7	11.4
Altai Krai	12.1	12.2	11.8	11.9	11.9	11.7	11.7	11.6	11.4
Zabaykalsky Krai	14.7	14.6	14.2	14	13.7	13.5	13.3	12.9	12.2
Krasnoyarsk Krai	15	14.9	14.6	14.5	13.9	13.3	12.7	12.4	12.2
Irkutsk Oblast	13.6	13.7	13.1	13	12.7	12	11.9	11.7	11.7
Kemerovo Oblast	12.9	13.1	13.3	12.9	12.8	12.9	13.1	12.9	12.3
Novosibirsk Oblast	13	12.9	12.6	12.3	12	11.6	11.5	11.2	11.7
Omsk Oblast	13.4	13.3	12.9	12.8	12.5	12.4	12.2	11.9	11.3
Tomsk Oblast	14.5	14.4	14.2	14.4	14.1	13.8	14.1	13.9	13.7

Table 6. Average occupation of hospital bed, days

Territorial entity	2005	2006	2007	2008	2009	2010	2011	2012	2013
Republic of Altai	327	332	338	322	328	329	323	312	323
Republic of Buryatia	314	312	319	320	321	323	328	329	327
Republic of Tuva	310	310	316	328	326	326	313	318	328
Republic of Khakassia	319	313	313	317	318	314	330	325	332
Altai Krai	327	328	329	327	334	328	328	325	328
Zabaykalsky Krai	310	313	313	318	334	323	312	326	311
Krasnoyarsk Krai	328	320	318	319	320	314	321	315	312
Irkutsk Oblast	339	348	340	336	334	333	331	330	334
Kemerovo Oblast	333	333	335	336	340	339	335	331	330
Novosibirsk Oblast	261	265	269	312	322	326	328	330	327
Omsk Oblast	324	322	322	323	334	334	333	321	322
Tomsk Oblast	300	297	294	297	299	304	319	320	320

Analysis of expenditures on medical care per 1 resident was implemented on the basis of the relation of territorial compulsory health insurance funds expenditures throughout the covered period to a number of permanent residents in a territorial entity. In all territorial entities of The Siberian Federal District through 2010-2013 the number of funds spent increased at least in 2 times: from 3.03 thousand rubles in Omsk Oblast in 2010 to 12.22 thousand rubles in Krasnoyarsk Krai in 2013 (table 8). In 2013, the index value in Krasnoyarsk Krai and the Republic of Tuva exceeded the average value in The Siberian Federal District more than by 20% - 9.5 thousand rubles per 1 resident (28,6% and 2.48%, accordingly), it las lower in Kemerovo and Novosibirsk Oblasts by 19.04% and 21.86%, accordingly. The range of differences is determined by panel of medical services included in the program of compulsory health insurance and subsidies given to provide medical care by district territorial entities' state management agencies.

Table 7. Number of procedures per 1 surgeon

Territorial entity	2008	2009	2010	2011	2012	2013
Republic of Altai	583	396	552	511	797	918
Republic of Buryatia	314	313	300	290	575	512
Republic of Tuva	283	336	242	236	390	374
Republic of Khakassia	350	367	351	360	834	807
Altai Krai	353	348	400	413	897	879
Zabaykalsky Krai	271	266	272	254	320	395
Krasnoyarsk Krai	279	272	271	266	628	605
Irkutsk Oblast	348	324	325	327	776	828
Kemerovo Oblast	367	371	355	321	905	1005
Novosibirsk Oblast	247	249	248	236	632	661
Omsk Oblast	309	311	342	300	750	807
Tomsk Oblast	178	178	176	165	403	400

Note: the index is calculated as a relation of number of surgeons to number of procedures through 1 year (in-patient clinics and 24-hour hospitals).

Table 8. Expenditures of Territorial Compulsory Health Insurance funds for covered period per 1 resident

Territorial entity	2010	2011	2012	2013
Republic of Altai	4.65	7.8	8.92	11.18
Republic of Buryatia	3.81	5.82	7.02	9.44
Republic of Tuva	5.89	8.91	10.5	11.45
Republic of Khakassia	4.33	6.7	7.29	9.75
Altai Krai	3.54	5.13	6.58	7.18
Zabaykalsky Krai	4.07	6.15	8.26	9.77
Krasnoyarsk Krai	4.92	8.75	11.1	12.22
Irkutsk Oblast	4.01	6.02	7.74	9.68
Kemerovo Oblast	3.4	5.49	6.45	7.70
Novosibirsk Oblast	3.58	5.18	6.94	7.43
Omsk Oblast	3.03	4.46	7.09	8.23
Tomsk Oblast	4.47	6.57	7.79	9.64

Note: the index is calculated as a relation of funds spent to the number of resident population.

The capacity of hospitals, calculated as the derivative of division of number of visits per shift multiplied by 10000 into population at the end of the year, is variable while comparing territorial entities indexes, but constant enough throughout the study period. The highest institution capacity was recorded in the Republic of Tuva - 288.2-322.4 visits per shift per 10000 population (maximum and minimum values through 2005-2013, table 9). Less than 200 visits per shift is typical for hospitals of the Republic of Buryatia. The average value of the capacity index in district territorial entities is 245.8 visits per shift per 10 thousand population: from 263.3 to 248.8 visits per shift in 2005 and 2013, accordingly.

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Table 9. Capacity of hospitals, visits per shift per 10 thousand population

Territorial entity	2005	2006	2007	2008	2009	2010	2011	2012	2013
Republic of Altai	297.2	290.5	283.6	277.6	284.4	285.1	286.5	284.9	291.8
Republic of Buryatia	192.3	196.3	195.2	199.1	197.5	199.5	198.6	201.8	206.9
Republic of Tuva	288.2	291.5	318.2	317.2	314	313.3	322.4	321.1	319.9
Republic of Khakassia	276.9	277.2	278.3	282.5	284	283.8	287.1	294.5	291.1
Altai Krai	254.9	264	268.6	266.3	268.3	258.9	264.4	272.8	272.7
Zabaykalsky Krai	190.4	205.8	203.5	207.8	210.5	217.8	227.6	227.2	229.1
Krasnoyarsk Krai	260.8	263.2	256.7	261.1	258.2	249.2	268.9	274.6	274
Irkutsk Oblast	211.8	197.3	224.9	225.6	227.8	230.9	231.8	239.9	239.6
Kemerovo Oblast	212.2	214.9	209.7	214.4	212.4	215.5	222.6	224.7	227
Novosibirsk Oblast	514.9	209.1	186.9	217.5	216.8	216.8	222.7	220.4	220.4
Omsk Oblast	210.1	247.6	211.2	213.7	212.7	207.1	213.4	211	211.9
Tomsk Oblast	247	243.7	213	218.1	212.3	210.3	234.4	206.4	201

Table 10. Average number of hospital visits per 1 resident

Territorial entity	2005	2006	2007	2008	2009	2010	2011	2012	2013
Republic of Altai	9.8	9.8	10.1	9.1	9	9.1	9.9	9.7	9.7
Republic of Buryatia	7.1	7.7	8.2	8.4	8.4	8.6	8.5	8.6	8.8
Republic of Tuva	8.1	8.3	8.7	9	9.3	9	10.1	9.4	9.6
Republic of Khakassia	7.7	8	8.3	8.4	8.6	8.3	8.4	8.5	8.8
Altai Krai	9.6	9.7	9.7	9.7	10	9.6	9.3	9.3	9.7
Zabaykalsky Krai	8	8	8.3	8.8	9	9.2	8.9	9.2	8.8
Krasnoyarsk Krai	8.3	8.5	8.6	8.8	9.1	9.1	9.3	9.3	9.1
Irkutsk Oblast	7.8	8	8.1	8.1	8	7.8	8.3	8.5	8.2
Kemerovo Oblast	9.8	9.6	9.6	10.1	10.4	10	10	9.9	9.5
Novosibirsk Oblast	9.9	9.1	8.9	9.7	9.9	9.6	9.6	9.5	9.1
Omsk Oblast	8.7	9	9	9	9.6	9.1	9.3	9.4	9.7
Tomsk Oblast	8.9	8.9	7.6	7.4	7.3	7.4	9.3	8.2	8.2

Table 11. Level of hospitalization to 24-hour hospitals per 100 residents

Territorial entity	2005	2006	2007	2008	2009	2010	2011	2012	2013
Republic of Altai	31.2	31	31.4	30	29.6	30.2	28.8	26.9	26.6
Republic of Buryatia	21.4	21.9	23.3	22.9	22.9	22.5	22	22.2	21.7
Republic of Tuva	36.6	35	36.3	36.9	36.1	34.4	33.9	33.8	32.8
Republic of Khakassia	22.4	22.4	22	22.6	23.1	23	22.7	22.5	22.6
Altai Krai	27.5	27.6	28.5	28.2	28.7	28.1	27.2	26.4	26.8
Zabaykalsky Krai	24.6	25	25.8	26.3	25.5	24.7	23.1	23.5	24.8
Krasnoyarsk Krai	20.4	19.6	19.4	19	19.3	19.3	19.5	19.2	19
Irkutsk Oblast	24.1	24.3	24.6	24.7	25	26.1	26.2	25.9	25.9
Kemerovo Oblast	23.4	23.5	22.8	22.4	21.9	21.5	21.4	21.4	20.8
Novosibirsk Oblast	24.6	21.5	22.3	22.6	23.2	23.2	23	22.9	21.6
Omsk Oblast	25.2	25.2	26.3	26.2	26.3	24.2	24.2	23.4	24
Tomsk Oblast	23.9	24.1	21.8	20.6	20.9	21.5	24.1	21.1	21.4

The average number of hospital visits increased in all territorial entities of The Siberian Federal District from 7.1-8.2 of minimal values of visits per 1 resident though 2005-2013 to 9.9-10.4 of maximum values through 2005-2009. In the following years, it is possible to state a convergence of

maximum and minimum values of the indicator: maximum values gradually decreased to initial ones as minimum ones increased by 15.5% in comparison with 2005 level (table 10). The lowest number of visits per shift was recorded in Irkutsk Oblast and the Republic of Buryatia, the highest one - in the Republic of Altai and Kemerovo Oblast - 7.1-8.8 and 9.6-10.4, accordingly (table 10).

The level of hospitalization to 24-hour hospitals shows an extent of hospital care availability to population, however, from the other hand, the high level of hospitalization is evidence of insufficient efficiency of primary care in outpatient-polyclinic condition. The highest values throughout the whole period were recorded in the Republic of Tuva - 38.6-32.8 per 100 residents. In other territorial entities the level of hospitalization varied from 20.4 to 31.2 per 100 residents in 2005 and from 19.0 to 26.8 per 100 residents in 2013 (table 11).

Assessment of achievement of the expected results on prevention, diagnosis, treatment, clinical examination and rehabilitation of patients was carried out using the indicators of "medical efficiency" components. Morbidity of cancer diagnosed for the first time per 100 thousand population throughout the study period increased in a varying degree, growing from 1.2% in the Republic of Altai to 59.2% in the Republic of Khakassia (table 12). In 5 territorial entities the index grew by 6-20%, by 20-30% in other 5. According to WHO forecasts, the level of cancer morbidity, as well as mortality due to this matter, are increasing worldwide (WHO, 2013b), however, such prominent growth of the indicator in the Republic of Khakassia triggers concerns and require in-depth study.

Table 12. Morbidity of cancer diagnosed for the first time per 100 thousand population

Territorial entity	2005	2006	2007	2008	2009	2010	2011	2012	2013
Republic of Altai	241.5	243.5	234.2	220.5	240.5	222.1	243.1	249	244.4
Republic of Buryatia	228.7	242.1	247.3	231.4	264.1	263.4	254.9	252.1	276.9
Republic of Tuva	157.4	168.6	164.6	155.7	155	162.4	171	177.5	179.4
Republic of Khakassia	231.1	254.2	285.1	292.8	297.1	313.6	337.4	357.4	367.9
Altai Krai	379.6	390.7	404.8	397.9	410.3	409.8	442.5	457.7	458.7
Zabaykalsky Krai	246	255.1	258.8	269.5	278.2	290.7	285.7	279.9	287.4
Krasnoyarsk Krai	286	303	304.7	309.6	314	317	341.9	350.9	361.5
Irkutsk Oblast	341.5	350.1	351.4	359.3	372.7	383.4	410	413.3	424.2
Kemerovo Oblast	297.5	297.3	320.4	320.5	342.6	339.7	360.5	349.8	337.2
Novosibirsk Oblast	386.7	386.8	401.3	412.5	424.2	429.5	428.8	422.9	428
Omsk Oblast	354.2	352.1	354.9	342.6	375.5	388.5	406.9	415.6	428.7
Tomsk Oblast	363.6	375.3	385.2	360.9	371.2	394.9	386.1	437.1	387.9

Table 13. Expected lifetime at birth, years

Territorial entity	2005	2006	2007	2008	2009	2010	2011	2012	2013
Republic of Altai	60.4	62.4	64.3	65	65.7	65.7	65.4	66.8	67.34
Republic of Buryatia	61	62.5	64.3	64.5	65.4	66.1	66.09	66.79	67.67
Republic of Tuva	55.8	58.2	58.8	60.1	59.6	60.5	61.39	61.09	61.79
Republic of Khakassia	61.1	64.4	66.1	66.4	67.1	67.1	67.75	67.64	68.57
Altai Krai	64.6	66.5	67.1	67.4	68.4	68.4	68.97	69.11	69.77
Zabaykalsky Krai	59.3	61.5	63.1	63.9	64.8	64.8	65.75	66.24	67.11
Krasnoyarsk Krai	63	65.5	66.4	66.8	67.5	67.6	68.27	68.42	69.06
Irkutsk Oblast	60.3	62.9	64.7	64.8	65.2	65.3	65.93	66.32	66.72
Kemerovo Oblast	61.4	62.9	63.8	64.4	65.1	65.4	66.18	66.76	67.72

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Novosibirsk Oblast	65.1	66.4	67.5	68.1	69	69.3	69.68	69.72	70.19
Omsk Oblast	65.2	66.1	66.5	67.5	68.7	68.8	69.5	69.25	69.74
Tomsk Oblast	65.1	66.7	67.9	67.9	68.2	68.8	69.53	70.07	70.33

Table 14. Number of days of temporary disability per 100 employees

Territorial entity	2005	2006	2007	2008	2009	2010	2011	2012	2013
Republic of Altai	677.5	731.8	692.5	658.1	721.5	753.4	751.9	816.7	816.1
Republic of Buryatia	724.9	727.9	777.4	795.3	788.6	799	809.6	785.6	785.1
Republic of Tuva	747.6	751.6	751.5	735.8	688	659.3	615.3	638.1	592.5
Republic of Khakassia	842.9	761.9	793.8	817.9	854.5	867.9	937.1	829.1	796.8
Altai Krai	806.4	791.9	821.4	881	858.2	865	882.6	828.9	837.8
Zabaykalsky Krai	653.7	659.3	669.7	696.6	751.5	744	669.3	643.6	621.9
Krasnoyarsk Krai	833.5	790.8	784.4	799.7	768	777.8	721.5	650.3	645
Irkutsk Oblast	797.8	802	840.2	846.4	881.2	849.1	786	708.4	691.1
Kemerovo Oblast	947.4	968.1	1000.4	954.9	910.2	878.8	924.8	823.6	809.7
Novosibirsk Oblast	857.7	825.8	874.4	928.9	922.3	868.8	857.4	944.3	803.1
Omsk Oblast	812.6	801.9	826.3	832	811.5	790.5	806.5	747.8	735.1
Tomsk Oblast	966.5	849.6	820.7	782.9	779.6	804.9	923.1	748.7	729.3

The indicator of expected lifetime at birth characterizes a duration of life of 1 person from a generation that was born in a given year assuming that the mortality rate in each year of age would stay the same as in the year the indicator was calculated throughout the lifetime of this generation. Average expected lifetime at birth of The Siberian Federal District residents in 2013 reached 61.79-70.33 years (table 13), while demonstrating growth around 7-13%. The highest expected lifetime was recorded in Tomsk and Novosibirsk Oblasts, the lowest - in the Republic of Tuva.

Number of days of temporary disability per 100 employees differs significantly: from a stable decline in 9 out if 12 district territorial entities (by 13.56% on average by the end of the period) to growth in three ones: in the Republics of Altai and Buryatia and in Altai Krai (by 20.46%, 8.30%, 3.89%, accordingly). The highest number of days of temporary disability in 2005, 966.5 days per 100 employees, happens to be in Tomsk Oblast, however, this index decreased by 24.54% to 729.3 days per 100 employees at the end of watch period. The lowest number of days of temporary disability is 592.5 days per 100 employees and it was recorded in 2013 in the Republic of Tuva (table 14).

A complex assessment of components of presence, usage and availability of healthcare resources and also of medical efficiency was implemented using Minmax method (fig. 1). The highest level of resource provision was recorded in Altai Krai, throughout almost the entire study period (fig. 1a), in about 2 times less - in the Republic of Tuva and Irkutsk Oblast, but in last three years the outcome, describing the presence of resources decreased in the first case and increased in the second case. The lowest provision of healthcare system resources was recorded in the Republics of Khakassia and Altai.

Fig. 1. Components of healthcare systems efficiency assessment in the Siberian Federal in The Siberian Federal District territorial entities in 2005-2013, calculated using Minmax method: a) presence of resources; b) usage of resources; c) availability of resources; d) medical efficiency.

Healthcare institutions of the Republic of Altai and Altai Krai use the available resources in the best way, their overall result is generally higher than 7 points, according to Minmax method (fig. 1b). However, if a shortage of resource provision is marked in the Republic of Altai, then for Altai Krai the indicator is the highest in comparison with other district territorial entities (table 1-4). Outcome dynamics in other territorial entities was multidirectional. For instance, the coefficient of resource usage tended to grow in Kemerovo, Irkutsk, Novosibirsk Oblasts and the Republic of Khakassia. Unsatisfactory outcomes were recorded in several territorial entities: in the Republic of Tuva, despite the situation's improvement in 2008-2009, a coefficient decline by 3 times was marked in the following years; a similar trend is seen in Krasnoyarsk Krai, the worst result is in Tomsk Oblast (the lowest score over 5 years, fig. 1b). Consistently the best throughout the study period, the availability of resources was demonstrated in the Republic of Altai and Tuva (fig. 1c), whereas it stays on initial level or varies around several points in other territorial entities. At the meantime, no territorial entity managed to improve the availability of healthcare resources throughout the study period. The coefficient decreased from 10 to 2.82 points in Novosibirsk Oblast, from 4.41 to zero value by 2007 in Tomsk Oblast. The same low availability of resources was recorded in the Republic of Buryatia, where the indicator varied around 0-1.82 points.

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Medical efficiency in all territorial entities throughout the study period stayed at a quite low level in Kemerovo and Novosibirsk Oblasts, where the estimated result reached 0-2.94 points and 0-4.50 points, accordingly (fig. 1d). The best result by the given component was recorded in Zabaykalsky Krai, where the coefficient variation reached 6.71-10.00 points and in the Republic of Altai through 2005-2011, however, it decreased significantly to 4.83 points in the last two years. A consistently average result was recorded in Omsk Oblast - around 5 points on average (fig. 1d).

4. Discussion of results

Analysis of the dynamics of coefficients change by components and by the entire outcome allowed to reveal the features of each territorial entity of The Siberian Federal District, which determine the best or the worst indicators in comparison with other regions. Those coefficients from 7.5 to 10 points were assigned to high performance results, average performance - from 4.0 to 7.49 points and low performance - from 0 to 3.99 points. 3 territorial entities made it to the group of the best: the Republics of Tuva and Altai and also Altai Krai (fig. 2).

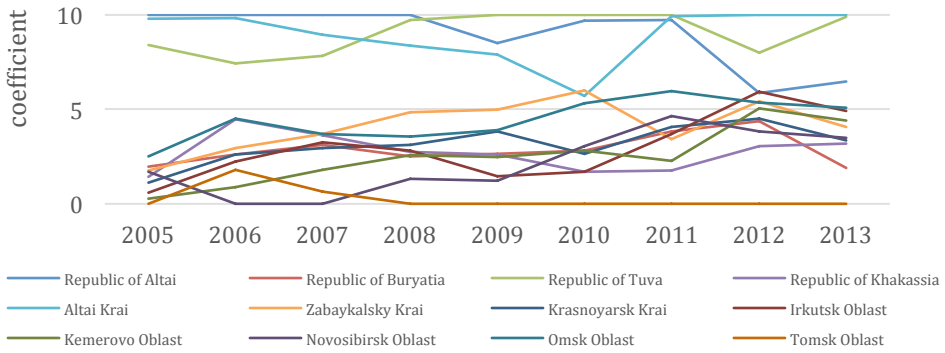

Fig. 2. Dynamics of healthcare systems outcomes in territorial entities of The Siberian Federal District of the Russian Federation through 2005-2013 using Minmax method.

A high result in the Republic of Tuva was achieved due to high availability of healthcare resources (7.26-10.00 points, fig. 1c) and sufficiently high medical efficiency (8.49-10 points in the last 4 years of the research, fig. 1d). Despite one of the lowest coefficient of resource presence, the Republic of Altai was practically unconditional leader throughout 2005-2011, what was determined by high level of availability and resource usage (fig. 1 b,c): for the first four years, the healthcare efficiency made 10 points, 8.49-9.72 points in the following three years, however, the coefficients decreased to 5.85-6.47 in 2012-2013 (fig. 2). In last two years, the availability of resources got even lower in the Republic - there was a decline of outcomes in "usage of resources" and "medical efficiency" to 0.67 points and 4-5 points, accordingly (fig. 1 b,d). At first sight, it may look that there is sufficiently effective and stable healthcare system in Altai Krai because the average result was revealed only by 2010 (fig. 2), but a high level of presence and usage of resources is not accompanied by the same level of availability and medical efficiency, in addition, the last mentioned component decreased in 2 times by 2008 and reached 0 points in 2013 (fig. 1d).

Unfortunately, the remaining 9 territorial entities of The Siberian Federal District demonstrated average and low indicators of healthcare systems efficiency, in addition, all of them shown low results

in the first years of study period. Hence, the efficiency of healthcare was improved first in Omsk Oblast (due to resource usage, fig. 1b) and Zabaykalsky Krai (due to medical efficiency, fig. 1d); it happened in Krasnoyarsk Krai in 2011 (due to some increase of availability and medical efficiency, fig. 1c,d) and in Novosibirsk Oblast, in some degree. By 2012, Irkutsk and Kemerovo Oblasts reached the average results by Minmax method while improving their indexes stage-by-stage since 2005 (fig. 2). Low efficiency of Tomsk Oblast healthcare system is primarily determined by insufficient usage or system's resources and decline in availability of resources to population (fig. 1b,c). It is possible to assume that making appropriate management decisions to increase availability of medical care as well as efficiency of resources usage would improve the outcomes because the medical efficiency of the Oblast is on consistently average level in comparison with other district territorial entities (fig. 1d).

5. Conclusion

Assessment of healthcare systems efficiency of The Siberian Federal District territorial entities using Minmax method, based on the research of dynamics of 14 indexes that characterize components of presence, usage, availability of resources and also medical efficiency during active reforming and optimization of resources through 2005-2013, shows multidirectionality and uncertainty of its impact on regional healthcare. However, it is possible to reveal the components which influence the decrease of efficiency as well as its increasing.

While developing typological groups of the Russian Federation's territorial entities according to economic efficiency in actual indicators of realization of territorial programs of state guarantees on capacity and financial provision of provided medical care, no territorial entities of The Siberian Federal District were allocated to low performance group. Seven territorial entities appeared in high efficiency group (the Republics of Altai and Buryatia; Zabaykalsky and Krasnoyarsk Krais; Kemerovo, Omsk and Tomsk Oblasts), two regions were of medium efficiency (the Republic of Khakassia, Novosibirsk Oblast) and three territorial entities were allocated to below the average level - the Republic of Tuva, Altai Krai, Irkutsk Oblast (Russkikn, Sirotkina, & Tinyakova, 2016). It was ascertained that the ratio of expenditures on realization of state guarantees program to acquired outcome, calculated using Minmax method, shows that high spending does not always lead to high efficiency of regional healthcare. Low expenditures may be accompanied by high and low outcome (Kudelina, & Eremina, 2016). It is appropriate to suppose that if the financial efficiency and the provision of district territorial entities financial resources are practically assured then structural and managerial transformations are necessary for the regions with low healthcare efficiency according to Minmax method in order to eliminate disadvantages, revealed in the complex assessment of components of presence, usage, availability and provision of resources and medical efficiency.

While assessing the efficiency, it is important to take into account different aspects of such multifaceted term as "healthcare system efficiency" in relation to stakeholders: governments, institutions, healthcare organizations, medical personnel, patients and households (Eremina, & Kudelina, 2014b), what is defined by their different goals. However, only the efficiency of use of state funds for achieving certain social-economic indicators cannot be a sufficient reason to provide efficiency of a healthcare system, whose first task is to maintain population health. The equilibrium

that would provide sustainable development of healthcare is possible only upon condition of balance of all regional systems components and influence of external and internal factors that define development and wellbeing of region's population. Healthcare policy, it legislation must influence on social determinants that define health (Levitsky, 2013).

The World Health Organization notes that health in the context of wellbeing should include at least the aspects of social, mental and physical health. At that, meaning (data) for each index of health should be determined, as well as various potential approaches should be tested and evaluated to the system of indicators with the introduction and interpretation of a single index (WHO, 2013a). Taking into account that the contribution of medical services provided by the health care systems is around 10-25% of health status level (Figueras et al., 2004; Wendt, 2009), the efficiency of systems of population medical care may be considered as one of the most important aspects of wellbeing of residents who live in The Siberian Federal District which is distinct in uncongenial climatic-ecological conditions affecting health.

The orientation of state policy to overcome misbalance of regional healthcare and maintenance of social solidarity and fairness would allow achieving objectives of "Health - 2020" policy. In particular: to reduce premature mortality; to increase average lifetime of the population; to decrease injustice in health (social determinants objective); to increase population wellbeing level; to provide universal coverage of healthcare services and the right to health (WHO, 2013a).

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