WAYS TO OPTIMIZE PROVIDING OF SPINE HEALTHCARE IN A LARGE REGION OF THE RUSSIAN FEDERATION

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The experience of the neurosurgical department specializing in the treatment of patients with injuries and diseases of the spine is presented. The paper describes the links of regional and in-hospital reorganization of the current system of spine pathology care that provided the increase in the efficiency of medical care and improvement of treatment outcomes.

Key Words: organization of spine health care, spine surgery, statistics, spine injury, degenerative diseases of the spine.

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Spinal diseases are a serious medical, social, and economic problem due to their high prevalence and a constantly increasing number of spinal patients in the general population [1, 2]. Specialized care for patients with spinal diseases and injuries should be provided timely and operatively to minimize complications that can lead to irreversible consequences.

Spine care can be effectively delivered only within a system that comprises the necessary units and services involved in this process in the region [3].

Krasnodar Krai is the third most populous region in the Russian Federation after Moscow and Moscow region: according to the Federal State Statistics Service, the number of permanent residents was 5,647,652 people in 2019. There is a pronounced seasonality in population fluctuations due to significant tourist flow in the region, which amounted to 17 million people in 2019. Krasnodar is located in the region's geographic center and comprises 23% of the region's population (over 1.3 million people).

Over the past 13 years, the Krasnodar Krai system of medical care delivery to spinal patients has undergone significant changes, analysis of which, in our opinion, may be useful in planning and implementing administrative and organizational measures in other regions of the Russian Federation.

The purpose of the study is to analyze the most effective measures for optimization of specialized medical care delivery to spinal patients within a region of the Russian Federation.

Material and Methods

The study analyzed the changes in the performance indicators of structural units of Krasnodar Krai medical institutions delivering specialized medical care to spinal patients in 2007–2019. We identified main organizational, administrative, personnel, educational, and material and technical measures that were undertaken in this period. The effect of implementation of these measures on the performance indicators of the specialized care delivery system was studied.

Until 2007, surgical care for patients with spinal diseases and injuries was provided in 12 trauma and neurosurgical departments of five Krasnodar Krai cities on the principle of decentralization. In 2000–2007, the total number of surgical interventions amounted to 300 operations per year, on average; material and technical facilities and qualifications of doctors were inadequate, and treatment approaches differed significantly in different clinics.

Dissatisfaction with the treatment outcomes and low availability of qualified care for many residents of the region were the basis for structural changes in the system of care delivery to patients with spinal diseases and injuries. For this purpose, a dedicated neurosurgical department No. 3 (NSD No. 3) was established in the Research Institute – Krasnodar Regional Clinical Hospital No. 1 n.a. Prof. S.V. Ochapovsky (RI-KRCH No. 1) in 2007, and the provision of surgical care for spinal patients was discontinued in six of the 12 departments in the region. In addition, a department of elective neurosurgery (NSD No. 1), specialized in surgical treatment of isolated degenerative disc diseases and intradural space-occupying lesions, continued functioning in the hospital.

At the same time, a decision was made to centralize the spinal surgery service at the RI-KRCH No. 1 due to the hospital's multispecialty and the facilities for continuous treatment of patients. On the basis of the agreed decision, care for patients with spinal diseases continued to be provided in the region's large cities most distant from Krasnodar: Sochi (300 km), Armavir (210 km), and Novorossiysk (160 km).

The tasks of the newly established department included provision of emergency and elective medical care to patients with spinal diseases and injuries as well as organizational and methodological work with medical institutions

in Krasnodar Krai. In the subsequent years, the increasing need for specialized treatment of patients with spinal pathology necessitated a reorganization of the service. To improve the efficiency of its functioning, the following measures were implemented:

1) reorganization of the functioning of in-hospital services of RI-KRCH No. 1 in terms of interaction with NSD No. 3;

2) organization of round-the-clock telecommunication interaction between regional clinics and RI-KRCH No. 1 to enable real-time discussion of patients with spinal pathology;

3) organization of a system for re-evacuation of patients to district hospitals for further treatment and/or follow-up care;

4) organization of an outpatient/polyclinic unit at RI-KRCH No. 1 for spinal patients;

5) increasing the bed capacity of the department and the number of specialized operating rooms for spinal surgery care;

6) relocation of patients with infectious spinal diseases outside the neurosurgical department, to the department of septic surgery;

7) regular thematic scientific and practical conferences at RI-KRCH No. 1 with participation of leading specialists from Russia and foreign countries as well as organization of annual master classes and cadaver courses.

The approaches to diagnosis, preoperative preparation, and treatment of patients in the department were changed. Particular attention was focused on the following areas:

1) complete examination and preparation of the patient at the pre-hospital stage provided by regional services and departments;

2) accurate planning of the hospitalization time and amount of surgery;

3) implementation of minimally invasive techniques.

Reorganization of the interaction between in-hospital services of RI-KRCH No. 1 and NSD No. 3 included the following:

1) providing twenty-four-hour availability of not only the spinal surgeon but also the operating nurse at a specialized operating room;

2) ensuring hospitalization of spinal patients to therapeutic departments (endocrinology, pulmonology, neurology) for preparation to surgery;

3) allocation of three specialized operating rooms only for patients with spinal pathology and optimization of surgical team work in terms of the time and pathology type, with separation of flows and allocation of equipped operating rooms for emergency care as well as elective and minimally invasive interventions;

4) optimization of anesthesiologist work for reducing the interval between operations by using the preoperative room at the stage of preparing the patient for surgery as well as by using optimal methods of intraoperative and postoperative analgesia;

5) involvement of physiotherapists and rehabilitologists in early rehabilitation since the first postoperative day.

The next stage of reorganization was creating the system for timely discharge from the department. The main indications for discharge were as follows: resolution of the surgical problem in the spine, relief of the initial symptoms, and lack of signs of early postoperative complications. In this case, about 65 % of patients were discharged home to be followed-up by outpatient specialists, and the remaining 35 % of patients were transferred to hospitals at their place of residence, in particular to resort institutions, to continue rehabilitation treatment. In most cases, re-evacuation was carried out by district's medical transport after receiving a telegram or telephone message. This logistic regulation mechanism has been actively used after 2010, when Order No. 428 of the Krasnodar Krai Health Department "On the compliance with the staging and organization of specialized medical care for the population of the region" came into effect.

In 2013, the department was expanded. Today, it has 32 inpatient beds for the adult population, a mixed staff of doctors, including neurosurgeons and orthopedic traumatologists, and 3 attached operating rooms, with one of which being set to work around the clock. If necessary, the department uses the hospital's operating room for septic surgery to treat patients with nonspecific infectious lesions of the spine.

The outpatient-polyclinic spinal unit of RI-KRCH No. 1 was established in 2012 and reorganized by increasing the staff of spine specialists from one to two doctors in 2016. In addition, the diagnostic capabilities were expanded by improving the clinic facilities, which enabled full and prompt examination of care seeking patients with spinal pathology in order to determine the approach for further treatment.

Therefore, the reorganization has affected almost all levels of the service engaged in specialized care delivery to patients with spinal pathology.

Results

The introduction of the principle of centralized delivery of specialized care to patients with spinal diseases and injuries enabled managing the main flow of patients to one large multidisciplinary hospital. Unconditional advantages of this organization are as follows:

– twenty-four-hour preparedness to provide specialized high-tech medical care;

– availability of doctors of related specialties;

– constant availability of the necessary implants, highly-specialized instrumentation, and equipment;

– constantly improved qualifications and experience of practicing spine specialists (neurosurgeons and orthopedic traumatologists).

Today, the spine service in Krasnodar Krai is represented by several neurosurgical departments: RI-KRCH No. 1 in Krasnodar, which comprises NSD No. 1 and NSD No. 3, a railway hospital, several private clinics, as well as departments in Sochi, Novorossiysk, and Armavir (Table 1).

It is worth noting that the railway hospital, private clinics, NSD No. 1, and the department in Armavir use only microsurgical or percutaneous techniques, without implantation of stabilization systems.

Emergency care for patients with traumatic spinal injuries is provided in three specialized centers in Krasnodar (93.0 %), Sochi (5.3 %), and Novorossiysk (1.7 %). This decentralization is related to compliance with the golden hour principle in spinal injury. Due to improved telecommunication interactions between regional centers, the patient with complicated spinal cord injury is immediately transferred to a neurosurgical department for emergency surgery. Treatment of degenerative pathology in Sochi and Novorossiysk is also focused on acute conditions, both using implantation techniques and without implantation.

As seen from Table 1, 70 to 100 % of all surgical care provided to patients with spinal diseases and injuries in the region is performed in NSD No. 3 of RI-KRCH No. 1. That is why we further focused on the changes in indicators playing a dominant role in the treatment of patients with spinal diseases and injuries. The main points of service modernization, which are outlined in the Material and Methods section, were directly implemented in NSD No. 3.

The main stages of spine service reorganization in Krasnodar Krai occurred in 2007–2012, starting from establishment of a highly-specialized spine department for 20 beds with a mixed staff of doctors, including orthopedic traumatologists and neurosurgeons, and one twenty-four-hour operating room.

Arrangement of the system of interhospital consultations and coordination of the timing of spinal patient transfer resulted in early admission of patients to a dedicated department and their earlier surgical treatment. An analysis of the timing of spinal cord injury patient admission shows that 52 % of patients are admitted to a department within the first six hours after injury, and another 42 % of patients are delivered within 6–24 h. The remaining 6 % are severe patients who are delivered to a clinic on a delayed basis. Early delivery of patients provides better neurological outcomes after surgery.

Establishment of specialized polyclinic reception for spinal patients ensured 100 % bed-space occupancy, and the waiting period for elective surgical care at NSD No. 3 decreased to 23 ± 4 days, on average. Necessary comprehensive prehospital examination of elective patients reduced the clinic' costs by 47 % and decreased the time from admission to surgery by more than 60 %. In the presence of uncompensated somatic diseases (diabetes mellitus, chronic obstructive pulmonary disease, peptic ulcer disease, cardiac pathology, etc.) as well as in the need for an in-depth examination and discussion, these patients were hospitalized to therapeutic (endocrinology, pulmonology, neurology, etc.) departments. At the same time, implementation of the regulations for early re-evacuation of operated patients to home or hospitals at the place of residence provided an earlier release of beds. Thus, it was possible to increase the department's throughput, with the preoperative and average bed day being reduced.

Patients with spinal infections constitute a separate category of spinal patients. To comply with the sanitary and epidemiological requirements, these patients are relocated outside NSD, to the department of septic surgery where they are supervised by the spine specialist who does not contact "clean" patients. This enabled separation of flows and a decrease in the number of infectious complications by more than 2.5-fold (from 3.28 to 1.25 %).

Expansion of the bed capacity to 32 beds and an increase in the number of operating rooms (from one to three) with the necessary equipment, which were undertaken in 2013, provided even a greater progress in the treatment of patients with spinal diseases, increasing the number of treated patients and operations by 25–30 %, on average.

Gradual implementation of the planned program provided the following results: the number of treated patients increased 3.7-fold, from 600 to 2,230 people, in the period between 2007 and 2019 (Fig. 1).

The mean length of a patient stay in the department (bed day) decreased 2.1-fold, from 12.8 to 6 days (Fig. 2).

The preoperative bed day decreased 4-fold, from 3.6 to 0.9 (Fig. 3). The bed turnover rate increased 4.8-fold, from 14.4 to 69.7, and the number of operations per year increased 3.9-fold, from 603 to 2,362 (Fig. 4).

Table 1

Distribution of spinal patients by medical and prophylactic institutions (MPIs) providing specialized medical care in Krasnodar Krai (according to the 2019 data), n

MPI		Trauma	Degenerative diseases	Cancers	Deformities	Infection	Total
Krasnodar							
KRCH No. 1	NSD No. 1	–	521	78	–	–	599
	NSD No. 3	542	1488	215	54	63	2362
Railway hospital		–	34	–	–	–	34
Private clinics		–	134	–	–	–	134
Sochi		32	94	–	–	1	127
Novorossiysk		10	38	–	–	2	50
Armavir		–	36	–	–	–	36
Total:		584	2345	293	54	66	3342

Continuous professional development of the department staff expanded the range of treated conditions. According to the analysis of ICD codes, the number of nosologies increased from 28 (2007–2008) to 97 (2018–2019). The number of surgical techniques introduced into practice and used to treat spinal patients increased several-fold.

Therefore, the implemented reorganization of the system for care delivery to patients with spinal diseases and injuries provided the optimal results (Tables 2, 3).

Table 2 displays the administrative and organizational measures that improved the performance of the dedicated department. Despite a significant increase in the number of treated patients and performed operations in combination with an expanded range of provided care, the number of complications decreased 3.4-fold, and hospital mortality decreased 4.8-fold.

Discussion

The presented data reflect the capabilities of managing a specialized spine department in a populous region with marked seasonal fluctuations in population size.

Centralization of specialized care delivery provides a unified approach to the principles of diagnosis and treatment, a unified material and technical base, and professional development of specialists. It should be noted that when developing a model for servicing the population, we adhered to the principle: decentralization – where possible, centralization – as needed [4]. The creation of the spinal surgical service adhered mainly to the centralization path, based on the results of a fundamental study by N.G. Fomichev [5] that if the population is over 500 thousand people, it is reasonable to centralize all beds in a dedicated spine department.

High-quality and efficient work of dedicated departments with achievement of optimal statistical indicators can be ensured by administrative and organizational measures with the management of patient flows, reorganization of in-hospital services, introduction of modern minimally invasive techniques, and improvement of the surgeon's skills [6, 7].

NSD No. 3 (32 beds) plays a dominant role in the organization of specialized care for patients with spinal diseases and injuries in Krasnodar Krai and provides more than 70 % of all surgical interventions. Despite the impressive number of treated patients, the entire neurosurgical service of Krasnodar Krai does not fully cover the needs for surgical care in patients with spinal diseases. In 2017, the prevalence of neurosurgical diseases was analyzed, and the needs for surgical treatment of the Russian Federation population were empirically calculated [8]. According to these data, spinal cord trauma (7 operations per 100 thousand population) and degenerative spine diseases (50 operations per 100 thousand population) are some of the main neurosurgical spinal diseases.

In relation of these indicators to the permanent population of Krasnodar Krai, about 400 operations should be performed for trauma and more than 2,800 for degenerative diseases in the spine. In fact, 584 interventions for spinal injuries were performed in the region in 2019, of which 542 (93 %) operations were performed at NSD No. 3; 2,345 surgeries were performed for degenerative spine diseases, of which 1,488 (63.4%) operations were performed at NSD No. 3. Thus, the number of operations for spinal injuries in Krasnodar Krai amounted to 9.5 per 100,000 population, which exceeds the calculated data by 35.7%. The most probable causes for this are the geographic location of the region, large seasonal tourist flow, and a high injury rate. It should be noted that patients with spinal injuries have absolute priority over all other cohorts and are operated on in the acute period, regardless of the injury type, which affects delivery of care to elective patients, most of whom suffer from degenerative diseases.

At the same time, the number of operations for degenerative spine diseases in Krasnodar Krai is 39.4 per 100,000 population, which is 21 % less than the calculated indicators. The cause for this is insufficient amounts of specialized units, equipment, trained specialists, and bed capacity in the region. In Krasnodar Krai, there are a total of 241 neurosurgical beds for treatment of patients with brain and spine diseases. Therefore, there are 4.3 neurosurgical beds per 100,000 population in Krasnodar Krai, 6.1 beds in the Southern Federal District, and 8.9 beds in the Russian Federation. Given the number of patients treated on the beds (7,873 individuals in 2019), we may talk about highly efficient use of the bed capacity.

An analysis of the all-Russian data shows that the weighted mean rate of surgical interventions for spinal trauma accounts for 5.8 % of all neurosurgical cases, and that of degenerative spine

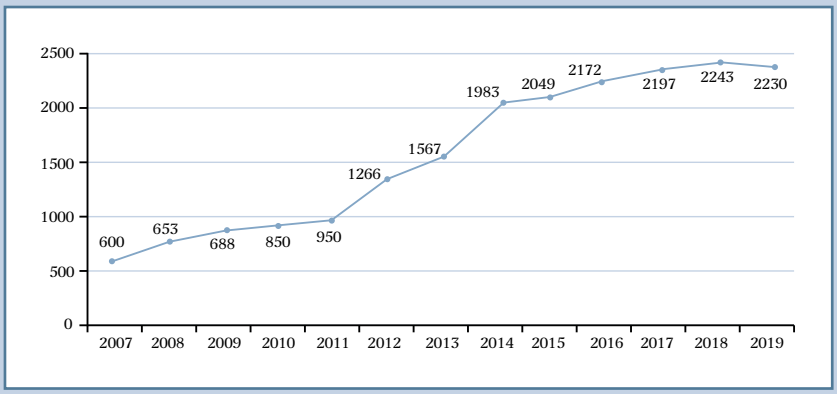

Fig. 1
Number of patients treated in the neurosurgical department No. 3 in 2007–2019

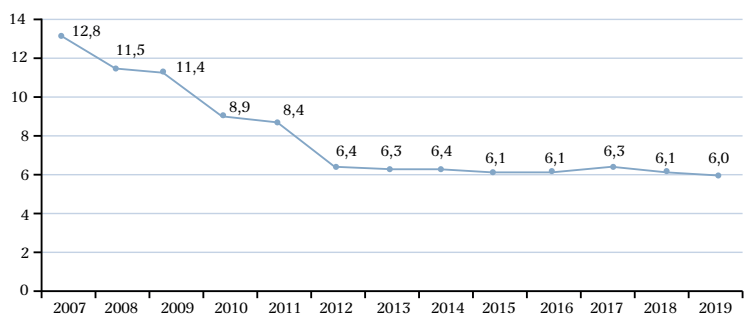

Fig. 2
Reduction in bed-days in 2007–2019

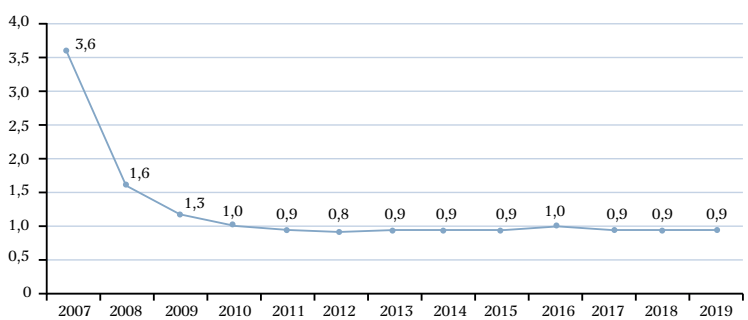

Fig. 3
Reduction in preoperative bed days in 2007–2019

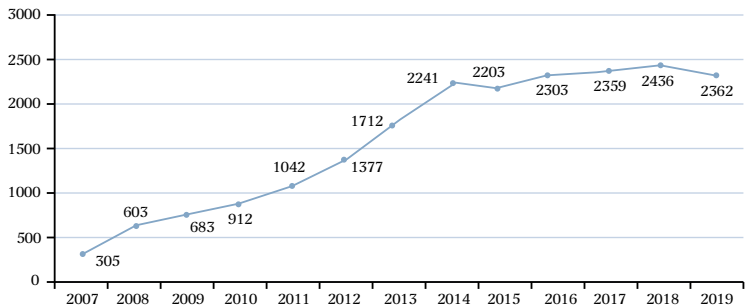

Fig. 4
Number of operations performed in 2007–2019

diseases is 35.9 % [8]. In Krasnodar Krai, these indicators are 11.1 and 44.7 %, respectively, which indicates a significant proportion of patients with spinal pathology among neurosurgical patients.

Another important indicator of the neurosurgical service performance is the level of surgical activity. This indicator is 44.0 % in the Russian Federation (2017), 48.3 % in the Southern Federal District, 71.1 % in Krasnodar Krai, and 96.0 % in NSD No. 3 of KRCH No. 1. Careful selection of patients for hospitalization to a neurosurgical department should become a priority task, which determines the high level of surgical activity and the targeted use of the neurosurgical bed.

Therefore, adaptive reorganization of the functioning of structural units increases the efficiency of medical care delivery and improves treatment results.

Conclusion

In this study, we identified the effect of main organizational, administrative, personnel, educational, and material and technical measures on the changes in indicators characterizing the quality of specialized medical care delivery to spinal patients. The presented model is based on the principle of centralization of highly specialized care, with a dominant department being housed in a multidisciplinary medical institution.

The considered stages of reorganization over a 13-year period led to an improvement in all the main indicators of the department performance, indicating possible ways to optimize delivery of specialized medical care to spinal patients.

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Table 2

Administrative and organizational measures affecting the performance of NSD No. 3 of KRCH No. 1

Measures	General data until 2007	2007–2009	2010–2012	2013–2015	2016–2019
Increase in the department's bed capacity	–	–	–	+	+
Expansion of the outpatient-polyclinic unit	–	–	–	+	+
Relocation of patients with infectious spinal diseases outside the neurosurgical department	–	–	–	+	+
Continuous professional development of specialists	–	–	+	+	+
Organization of the system for re-evacuation of patients to district hospitals for further treatment and/or follow-up care	–	–	+	+	+
Organization of telecommunication interactions between regional clinics	–	+	+	+	+
Reorganization of the work of hospital services of KRCH No. 1	–	+	+	+	+

Table 3

Changes in treatment outcomes of patients in NSD No. 3 of KRCH No. 1

Parameter	General data until 2007	2007–2009	2010–2012	2013–2015	2016–2019
Mean number of treated patients, n	510	647	1022	1866	2210
Mean number of operations, n	284	530	1110	2052	2364
Duration of hospital stay, days	19.6	11.9	7.9	6.3	6.1
Complications, %	2.7	2.4	1.8	1.3	1.2
Mortality, %	5.63	2.12	1.26	0.66	0.52

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