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Organizational and Informational Support for the Treatment of Patients with COVID-19 in a Multidisciplinary Emergency Hospital

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SUMMARY In modern conditions of global epidemiological challenges, a systematic approach to engineering (design) and reengineering (redesign) of treatment and diagnostic processes in hospitals acquires a special role for the state healthcare system.

In this case, the focus of special attention to the management of hospitals is solving a task of organizing the treatment of patients with COVID-19 in the absence of proven clinical practice and dynamically modify the corresponding information flow, as well as the need for optimization of resource support and enhance its efficiency in the face of strong growth in the number of new cases and lack of standard solutions for the reorganization of hospitals, especially of non-infectious profile.

In the paradigm of the systemic approach, effective management of the treatment and diagnostic process is not possible without a deep analysis of all its elements: from the moment the patient is admitted to the hospital until the completion of the treatment process. The recency of COVID-19 and the lack of clinical practice for the treatment of these patients have predetermined the need to develop comprehensive standards of clinical processes and their automation. It is the way of organizing the process to achieve the target state of the patient that forms the requirements for infrastructure and resource provision.

The article presents the experience of the N.V. Sklifosovsky Research Institute for Emergency Medicine in organizational and informational support of the process of diagnosis and treatment of patients with COVID-19.

KEYWORDS: therapeutic and diagnostic process, process modeling, infrastructure, information technology, organizational support, COVID-19, coronavirus infection

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UMIAS – Unified Medical Information and Analytical System
ALV – artificial lung ventilation
LIS – laboratory information system

RELEVANCE

After the announcement in March 2020 by the World Health Organization of the global pandemic COVID-19 and the subsequent introduction of a high alert regime in Russia, the main task of many medical institutions was the need to promptly reorganize the work of their hospital in accordance with new, largely unpredictable conditions.

Such a reorganization had to be carried out taking into account a number of influencing specific factors:

— novelty of the virus, lack of antiviral drugs with proven efficacy and verified standards of its treatment. This fact significantly complicated the possibilities of adequate forecasting and planning of resource provision of medical and diagnostic processes, it formed the need to work "on wheels" when new information and / or approaches to treatment appeared;

— in many cases, the process of treating patients with COVID-19 had to be organized on the basis of non-infectious hospitals. The re-profiling required the rapid formation of new competencies, patient routing schemes, changes in the structure of resource provision, as well as a significant change in the supporting infrastructure.

— increased requirements for the speed and efficiency of the ongoing reorganization in conditions of an active growth in the number of new cases of the disease.

All of the above factors determined the need for systematic and well-coordinated work of both medical and non-medical personnel of multidisciplinary hospitals in terms of the formation of new standards of treatment and diagnostic processes, as well as providing effective organizational and information support for the treatment of patients with COVID-19.

In the context of the process approach to organizing the activities of a medical institution, the primary is the treatment and diagnostic process itself, which is the entire set of actions for the diagnosis and treatment of a patient, carried out from the moment of admission to the hospital until the moment of discharge [1]. It is the chosen method of organizing such a process to achieve the patient's target state that forms the requirements for infrastructure and resource provision.

Fig. 1 schematically shows a conceptual model of the treatment and diagnostic process, which clearly reflects its environment: arrows entering from the left – resource provision; arrows entering from below are mechanisms for the implementation of the process that have an active transformative role; arrows entering from above – process control; outgoing arrows on the right – process results. In this case, the functional block (process) itself can be represented as a set of interrelationships of its subprocesses, reflecting the adopted approach to the organization of diagnostics and treatment of patients for a specific nosology.

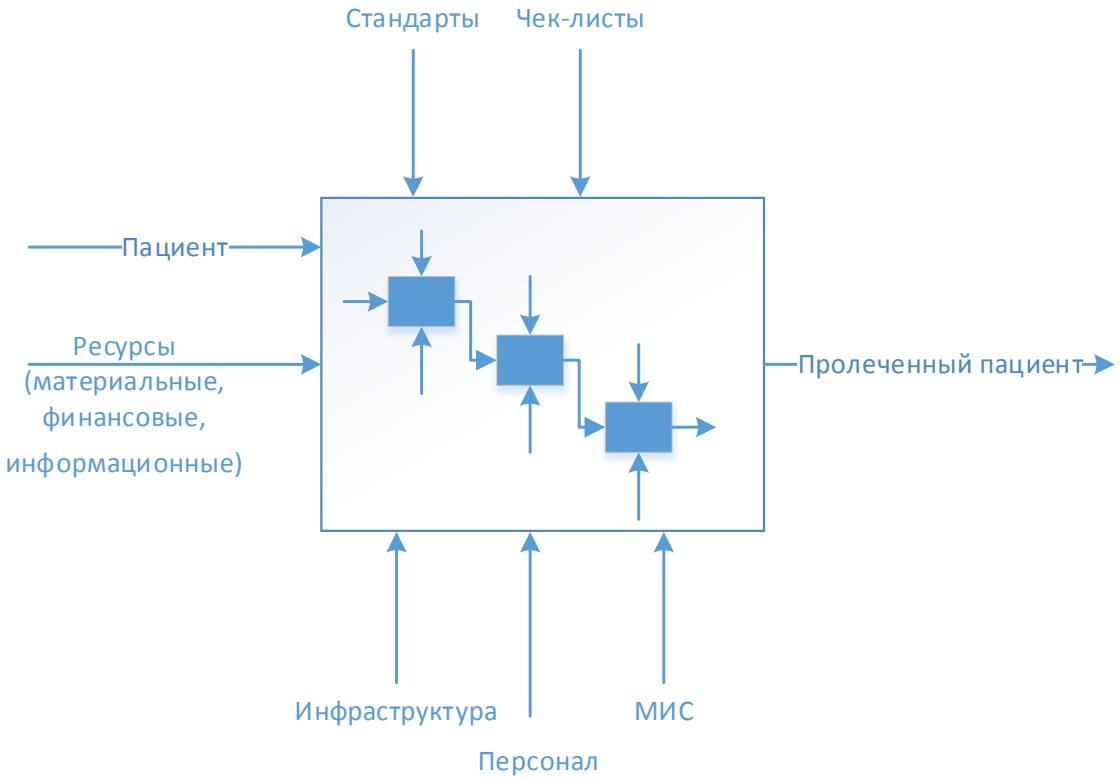

Fig. 1. Conceptual model of the treatment and diagnostic process

The purpose of creating a system of organizational and informational support for the process of diagnostics and treatment of patients with COVID-19 in the State Budgetary Healthcare Institution "N.V. Sklifosovsky Research Institute for Emergency Medicine"was the formation of a sufficient environment for the treatment and diagnostic process.

The main tasks include the organization of infrastructure, the systematic development of standards for the organization of treatment and diagnostic processes, the improvement of personnel, resource and information support for the diagnosis and treatment of patients with COVID-19, as well as the improvement of the process automation system.

This article presents the experience of solving the above-mentioned problems in the State Budgetary Health Institution "Research Institute for Emergency Medicine named after N.V. Sklifosovsky".

ORGANIZATION OF INFRASTRUCTURE

GBUZ "Research Institute for Emergency Medicine named after N.V. Sklifosovsky" (hereinafter referred to as “the Institute”) was chosen as one of the first hospitals to organize the treatment of patients with COVID-19, including due to the presence of a large resuscitation bed fund and developed competencies in the field of emergency medical care.

However, due to the absence of infectious units at the Institute, it was necessary to carry out serious changes in the existing infrastructure. It was decided to convert two separate buildings – cardiological and cardiac surgery units, into infectious buildings. Scheme of the first floor of one of the re-profiled buildings is shown in the Fig. 2.

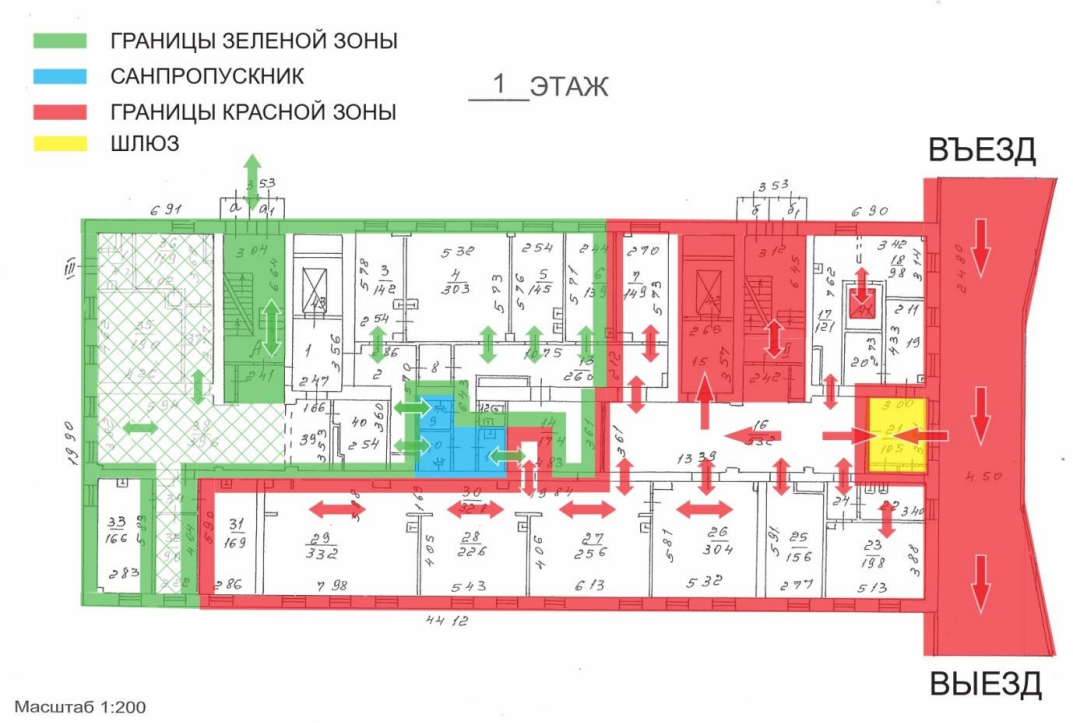

Fig. 2. Scheme of the first floor of the infectious disease building

The basic requirements for improving the infrastructure were set from two positions: the requirements of the treatment and diagnostic process and the safety of medical personnel and the requirements for ensuring the safety and comfort of the patient.

From the standpoint of ensuring the requirements of the treatment and diagnostic process and the safety of medical personnel, it was necessary to have:

— intensive care units in buildings with equipment corresponding to the specifics of the treatment process associated with a high risk of various kinds of complications, the most important of which is the development of viral pneumonia and acute respiratory distress syndrome. In this regard, each resuscitation bed was equipped with a mechanical ventilation apparatus (MVA) and oxygen supply systems;

— own computed tomography (CT) machine in the infectious diseases ward in order to minimize the transportation of patients with COVID-19 to other buildings. The project to prepare the premises and install the CT machine took a month, during which the transportation of patients to CT was organized by special teams from the medical staff of the Institute;

— sanitary checkpoints for entry / exit of medical personnel to / from the "red" zone;

— workplaces in the "red" zone, equipped with computers with the installed Unified Medical Information and Analytical System – UMIAS for the possibility of entering data into the patient's medical history. At the same time, all documents are printed exclusively in the "green" zone to minimize the spread of the virus through paper media;

— walkie-talkies and local telephones to ensure operational communication between the "red" and "green" zones;

— glass partition for the command area, from which coordination and prompt response of the duty administrator and the head of the corps to requests from medical personnel from the “red” zone is carried out (Fig. 3);

— systems of navigation signs, which significantly simplified and accelerated the movement of medical personnel in converted buildings, especially at first, in the conditions of the appearance of "red" zones;

— photo and name badges for medical personnel working in the "red" zone to recognize employees in closed protective suits;

— the operational headquarters of the corps, in which all key participants in the process gathered to coordinate and resolve emerging situations.

From the standpoint of the requirements for ensuring the safety and comfort of patients:

— wards with a separate bathroom and shower due to the need to provide an isolation regime for patients;

— video surveillance system in the corridors, allowing you to quickly respond to emergency situations;

— free wireless internet for patients;

— each ward was equipped with a computer to enable patients to communicate with their relatives;

— resuscitation wards were equipped with video panels with broadcasting of federal channels.

An important aspect was also the need to improve the infrastructure of the rest of the buildings of the Institute in crowded places (central admission department, department of transfusiology, etc.). In particular, a social distancing regime was introduced, the corresponding marking of seats and seats in elevators was carried out (Fig. 4), appropriate signs were placed, a ban was introduced on relatives visiting patients, etc.

Fig. 3. Command area with glass partition

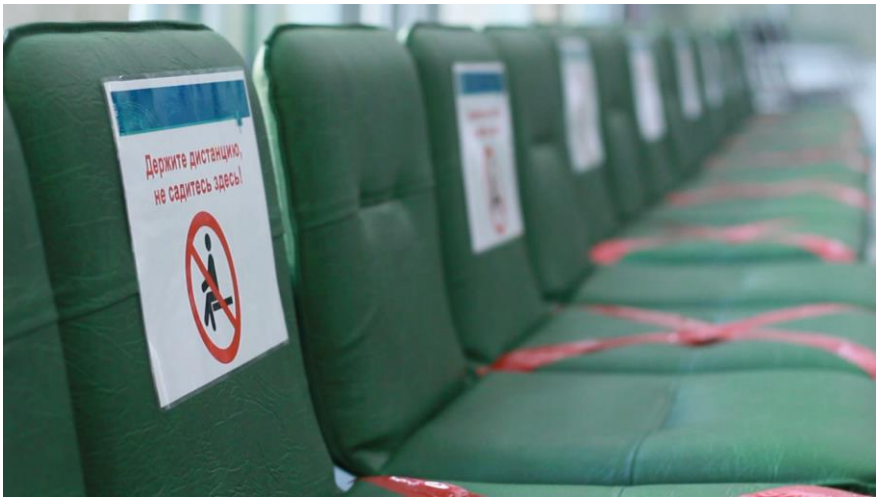

Fig. 4. Layout of seats to ensure social distance

MANAGEMENT OF THE DIAGNOSTIC PROCESS (STANDARDS)

There is no doubt that the most important factor in the success of preserving the life and restoring the health of patients with COVID-19 is the availability and implementation of standards for treatment and diagnostic processes.

In connection with the novelty of this virus and the lack of clinical practice for the treatment of patients with COVID-19, the Institute organized the development of appropriate standards for treatment and diagnostic processes.

In world practice, there are many approaches to describing processes [2, 4, 5]. The notation for the description of processes, tested and used at the Institute, was chosen as the main tool - a modified operogram, which clearly reflects such key characteristics of the process as follows:

— process participants (roles);
— process actions;
— labor costs of each participant in the process;
— frequency and frequency of all steps (actions) of the process;
— medicines and consumables required for the implementation of the process, and their standard amount;

— moments of decision-making by the doctor, taking into account the patient's condition and indications, as well as further branching of the process and other significant characteristics.

It should be noted that such models reflect the so-called "ideal" process from the standpoint of logic and equipment, but taking into account possible variants of events with a certain frequency of their occurrence. A detailed description of the principles and rules for describing medical and diagnostic processes in the format of modified operograms is presented by us in the corresponding article [1].

The model of the treatment and diagnostic process formed in this way is the basis for solving a number of managerial and economic problems:

— formation of regulations for the interaction of participants in the implementation of medical and diagnostic processes;

— effective planning of resources required for the implementation of medical and diagnostic processes;

— calculation of the standard cost of the treatment and diagnostic process, incl. to justify the need to adjust tariffs;

— analysis of "bottlenecks" of medical and diagnostic processes in terms of work organization, technical and technological equipment, inconsistency of the results of supporting processes (staffing, material and technical support, etc.) with the requirements of medical and diagnostic processes and, as a result, the initiation of development projects;

— automation of processes or their elements with maximum consideration of the specifics and details of the process, etc.

To develop such models for the treatment of patients with COVID-19, a small group of doctors from the department was formed, directly involved in the process. A more detailed approach to organizing such work was presented by us earlier [3].

Based on the results of the work, 5 models of treatment and diagnostic processes were developed: treatment and diagnostic process in the admission department, treatment of patients with COVID-19 in the infectious diseases ward, treatment of patients on the 1st day in the intensive care unit, treatment of patients in serious condition in the 2nd and subsequent days in the intensive care unit and treatment of patients in extremely serious condition on the 2nd and subsequent days in the intensive care unit.

On the basis of each model, a technological map was formed, which consolidates all resource characteristics of processes in kind.

In fact, the developed models and flow charts are the internal standard for the treatment of patients with COVID-19, taking into account the requirements of the Temporary guidelines for the prevention, diagnosis and treatment of a new coronavirus infection of the Ministry of Health of the Russian Federation and the existing clinical protocols of the Institute.

In order to support the implementation of the above standards, on the basis of the approved process model, checklists were developed, which are a list of mandatory diagnostic and other studies, consultations, etc., carried out to each patient in the course of treatment.

The checklist provides the doctor with the opportunity to check the standard, control his work, reduce the number of errors in case of fatigue and, as a result, improve the quality of medical care by shifting the quality control point towards preventing errors, which in some cases can save health and save patients live.

In addition to comprehensive standards of medical and diagnostic processes, simple and visual instructions were developed to ensure the safety of the work of medical personnel in the conditions of the infectious diseases department, in particular, a memo on the procedure for putting on and taking off personal protective equipment, a routing scheme for the transfer of biomaterial to the laboratory, a memo on hygienic treatment of hands and others (Fig. 5).

Fig. 5. Placement of a memo on the procedure for putting on personal protective equipment in the sanitary inspection

STAFF SUPPORT

In infectious diseases buildings, due to the special specifics and intensity, the staff of doctors and nurses at the reception was increased, second-year residents were involved in the work in the departments in the positions of intern doctors and the role of corps administrators was introduced. Basically, the heads of the departments of anesthesiology and resuscitation and the heads of the emergency services of the Institute were selected for this role. For round-the-clock duty in the command area, 5 paired brigades of administrators were formed. Also, in order to improve the quality and effectiveness of treatment, at least 2 times a day, rounds of the buildings were carried out with the participation of the management of the Institute.

PROCESS AUTOMATION

A significant success factor in the identification and further treatment of COVID-19 is timely and high-quality diagnosis of the disease.

Clinical laboratory of the Research Institute named after N.V. Sklifosovsky is one of the largest laboratories of state hospitals in Moscow. Most of the polyclinics do not have their own laboratories, in addition, only three laboratories in Moscow, including the laboratory of the Institute, were sufficiently equipped to carry out research in the required volume.

In UMIAS, additional functionality was implemented, to which polyclinic doctors and doctors in hospitals got access. The task of UMIAS is to keep track of analyzes for COVID-19, which contains all personal information about the patient: place of work, actual address, mobile phone, etc.

At the initial stage, UMIAS was not integrated with any automated laboratory system, and therefore all patient data had to be transferred manually, for which additional personnel were involved in the laboratory of the Institute, who were on duty around the clock..

Thanks to the integration of the Laboratory Information System of the Institute (hereinafter - LIS) with the EMIAS.COV portal, today data from the LIS is transferred automatically, which made it possible to minimize repeated manual data entry. At the same time, thanks to the use of barcode scanners, the procedure for transferring biomaterial has been simplified. Upon receipt of the material in the laboratory, it became necessary only to scan the barcode in order for the information on the registration of the biomaterial to begin to be generated in EMIAS.COV and LIS automatically.

RESOURCE SUPPORT

In terms of resource provision of processes, an important role was played by effective interaction with various organizations within the framework of charitable assistance:

— organization of free meals for staff involved in organizing the treatment of patients with COVID-19.

— organizing free travel to home and work for employees using one of the taxi aggregators.

— organization of free accommodation for employees in nearby hotels in order to ensure the safety and health of family members of medical personnel, etc.

All this made it possible to provide additional emotional and material support to medical personnel involved in the fight against the COVID-19 pandemic, and to provide them with conditions for rest and recuperation.

At the same time, the coordination of the work of the contract service, the pharmacy warehouse and the main nurse of the infectious diseases corps played an important role in supplying the medical staff with the necessary consumables and medicines. On a daily basis, balances at each warehouse and delivery plans were collected and sent to all participants to ensure the continuity of the treatment process.

INFORMATION SUPPORT

The most important aspect of the fight against the global pandemic is information support, both for doctors working with patients with COVID-19 and for society as a whole.

The exchange of experience and "best practices" among medical professionals is one of the key factors in the successful fight against such diseases.

A number of videoconferences were launched at the Institute on the official channel of the N.I. N.V. Sklifosovsky on the Youtube.com platform. The first issue, entitled "How they help patients with COVID-19 at the Sklifosovsky Research Institute" was in great demand, more than 1,500 people watched the broadcast live, and in two months the video received 6,234 views.

A series of live broadcasts that followed highlighted a number of critical issues related to the specificity of diagnosis and treatment of the disease, as well as to the Institute's experience in the application of new treatment methods.

The topics of the videoconferences were: laboratory diagnostics of COVID-19, features of instrumental diagnostics (CT and X-ray), ultrasound diagnostics, treatment of patients in serious condition in intensive care units, etc. All information materials in total have gained over 24,000 views in 2 months.

The presented statistics of views was recognized as extremely successful, since the main audience was medical specialists, including those from regions for which the Institute's experience in these matters is especially relevant.

CONCLUSION

This article summarizes and systematizes the experience of the N.V. Sklifosovsky Institute in terms of organizational and informational support for the treatment of patients with COVID-19, which indicates that only well-coordinated and systematic work of a multifunctional team consisting of medical specialists and specialists with competencies in the field of organizing and automating processes can quickly achieve decent results in the most difficult and unforeseen situations, one of which is the COVID-19 pandemic.

REFERENCES

1. Perminov AYu, Tyrov IA, Fomenko NS. Metodicheskie aspekty opisaniya protsessov meditsinskogo ucherzhdeniya: notatsii, osobennosti, effekty. *Eurasian Union of Scientists*. 2019;(2):38–42. (In Russ.)
2. Weske M. *Business Process Management: Concepts, Languages, Architectures*. Germany: Springer-Verlag; 2019.
3. Petrikov SS, Perminov AYu, Tyrov IA, Fomenko NS. Razrabotka organizatsionno-metodicheskogo podkhoda k povysheniyu effektivnosti upravleniya gosudarstvennym mnogoprofil'nym statsionarom skoroy pomoshchi. *Moskovskaya meditsina*. 2019; (5):78–85. (In Russ.)
4. Staccini P, Joubert M, Quaranta J-F, Fieschi M. Mapping care processes within a hospital: from theory to a web-based proposal merging enterprise modelling and ISO normative principles. *Int J Med Inform*. 2005;74(2–4):335–344. PMID: 15694640 https://doi.org/10.1016/j.ijmedinf.2004.07.003
5. Ruiz F, Garcia F, Calahorra L, Llorente C, Gonçalves L, Daniel C, et al. Business Process Modeling in Healthcare, Perspectives on Digital Pathology. *Studies in health technology and informatics*. 2012;179:75–87. https://doi.org/10.3233/978-1-61499-086-4-75

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