

Medical Center for Remote Monitoring of COVID-19 patients: organization experience and efficiency assessment

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ABSTRACT

Aim. To summarize the experience of organizing and evaluating the efficiency of the Medical Center for Remote Monitoring of patients with COVID-19 and community-acquired pneumonia in Tomsk.

Materials and methods. The project of the Medical Center for Remote Monitoring was developed on the basis of data from theoretical and empirical analyses of the current state of the healthcare system in the Tomsk region and the epidemiological situation with regard to COVID-19. The Center efficiency was assessed based on the analysis of quantitative and time indicators of the load on the emergency medical service and outpatient service. Statistical processing of the results was carried out using the Statistica 12.0 software package.

Results. On October 20, 2020, in Tomsk, on the premises of the Emergency Medical Unit, a Medical Center for Remote Monitoring was established. It was aimed at providing remote consultations for patients with COVID-19 and community-acquired pneumonia. According to its algorithm, operators of the Center assessed a patient's condition on a point scale using standardized speech modules to make a decision on the tactics of their support. During the second wave of COVID-19, when the Center operated, a statistically significant decrease in the load on the ambulance service (average number of calls per day, average waiting time for all calls and coronavirus-related calls) as well as on the outpatient service (average number of house calls per day, including calls for acute respiratory diseases) was registered.

Conclusion. The work of the Medical Center for Remote Monitoring based on the described model is associated with a decrease in the load on the healthcare system in an unfavorable epidemiological situation due to high COVID-19 incidence. This experience can be spread to other regions of Russia and adapted for other categories of citizens.

Key words: telemedicine technologies, remote monitoring, new coronavirus infection, COVID-19, lean technologies, effectiveness, emergency medical care, outpatient service.

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Медицинский центр удаленного мониторинга пациентов с COVID-19: опыт организации и оценка эффективности

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РЕЗЮМЕ

Цель. Обобщение опыта организации и оценка эффективности деятельности Медицинского центра удаленного мониторинга (далее Центр) для пациентов с COVID-19 и внебольничными пневмониями в г. Томске.

Материалы и методы. Разработка проекта Центра осуществлялась на основе данных теоретического и эмпирического анализа текущего состояния системы здравоохранения Томской области и эпидемиологической ситуации по COVID-19. Эффективность деятельности подразделения оценивалась по результатам анализа количественных и временных показателей нагрузки на систему оказания скорой медицинской помощи и амбулаторно-поликлиническую службу. Статистическая обработка результатов проводилась с помощью пакета прикладных программ Statistica 12.0.

Результаты. В г. Томске на базе ОГАУЗ «Станция скорой медицинской помощи» 20.10.2020 организован Центр, алгоритмом работы которого предусмотрена оценка операторами состояния пациента по балльной шкале с использованием стандартизованных речевых модулей для принятия решения о тактике его сопровождения. На фоне работы подразделения в период «второй волны» COVID-19 зарегистрировано статистически значимое снижение уровня показателей нагрузки на систему оказания скорой медицинской помощи (среднее количество обращений в сутки, среднее время ожидания по всем вызовам и вызовам, связанными с COVID-19, и амбулаторно-поликлиническую службу (среднее количество вызовов на дом в сутки, в том числе по поводу острых респираторных заболеваний)).

Заключение. Работа Центра по представленной модели ассоциирована со снижением нагрузки на систему здравоохранения в период неблагоприятной эпидемиологической ситуации по COVID-19. Данный опыт может быть распространен на другие регионы России и адаптирован под иные категории граждан.

Ключевые слова: телемедицинские технологии, удаленный мониторинг, новая коронавирусная инфекция, COVID-19, бережливые технологии, эффективность, скорая медицинская помощь, амбулаторно-поликлиническая служба.

Конфликт интересов. Авторы декларируют отсутствие явных и потенциальных конфликтов интересов, связанных с публикацией настоящей статьи.

Источник финансирования. Авторы заявляют об отсутствии финансирования при проведении исследования.

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INTRODUCTION

Active implementation of telemedicine has been one of the significant global trends in healthcare development in recent years. The new coronavirus (COVID-19) pandemic has given a new impetus to the use of remote technologies in the field of health protection, which came to be seen not only as an auxiliary tool to reduce financial and time costs of medical care provision and increase its accessibility for residents of remote areas, but also as an integral part of comprehensive measures to combat COVID-19, contributing to social distancing and prevention of cross-infection, reducing the load on the healthcare system, and saving personal protective equipment [1–3].

An all-round revision of organizational approaches to medical care delivery, involving the expansion of existing and the launch of new telemedicine programs, affected the primary healthcare system, the system of specialty care, and the work of palliative care institutions. One of the examples may be experience of Toronto Cardiac Clinic (Canada), where an expanded remote monitoring program for heart failure patients was launched in March of 2020. It intended to replace the majority of face-to-face meetings with a doctor with video conversations or phone calls and to use the Medly mobile application for remote clinical support [4]. Other examples include restructuring of the telemedicine program at the Federico II University Hospital of Naples (Italy), where 75% of outpatient visits of patients with chronic liver diseases were replaced with remote appointments during the lockdown [5], and provision of online antenatal care in China [6].

In the context of the pandemic, the care for COVID-19 patients has become an independent field of application of remote monitoring technologies. However, insufficient knowledge about the clinical and epidemiological aspects of COVID-19, nonexistence of procedures for handling such patients remotely and apparent resource constraints have set a challenging task for public health officials – to develop effective solutions from scratch by trial and error. In the absence of clear regulation, the implemented activities differed significantly with respect to the groups of patients, the tools used, and the categories of medical professionals involved. These activities encompassed opening telemedicine centers for COVID-19 treatment and consulting patients with negative PCR test results [7], COVID-19 virtual monitoring clinics for obstetric patients [8]; organizing of centralized hotlines for screening of patients with suspected

COVID-19 [9]; setting up telerehabilitation units for patients who have had this infection [10].

Now Russia has already gained significant experience in using remote technologies to combat COVID-19. At the beginning of the pandemic, according to the requirements specified in the Order of the Ministry of Health of the Russian Federation “On the temporary procedure for organizing the work of medical organizations in order to implement measures to prevent and reduce the risks of spread of the new coronavirus infection COVID-19”, which is a key industry document governing medical care delivery in the conditions of the COVID-19 spread [11], remote consultation centers for anesthesiology and resuscitation were established for adults and children. They operated in the doctor-doctor format both at the federal and regional levels.

It is worth noting that until November 23, 2020, this order did not regulate the issues of remote medical care delivery directly to patients with the new coronavirus infection, i.e. in the doctor-patient format. For this reason, relevant units were established in the regions and functions were assigned to them taking into account solely regional specifics, such as resource constraints; the existing experience in using remote monitoring technologies and the general level of computerization of the industry; the existing system of interaction between healthcare organizations and laboratories, territorial bodies of the Russian Federal Service for Surveillance on Consumer Rights Protection and Human Well-Being (Rospotrebnadzor), and the Statutory Health Insurance Fund, etc.

Taking into account the ongoing pandemic and the risks of such epidemiological threats in the future, the analysis of unique regional practices and foreign experience of using remote monitoring technologies for COVID-19 patients seems to be a relevant area of research, the results of which can serve as the basis for development of appropriate guidelines and operating procedures both at regional and federal levels. The Tomsk region was one of the first to organize centralized remote care for this category of patients.

The aim of this article was to summarize the experience of organizing a Medical Center for Remote Monitoring of patients with COVID-19 and community-acquired pneumonia on the territory of Tomsk and assess its effectiveness.

MATERIALS AND METHODS

The information base used for the development of the basic provisions for the Medical Center for

Remote Monitoring of patients with COVID-19 and community-acquired pneumonia (hereinafter referred to as the Center) encompassed the data derived from theoretical and empirical analyses of the current state of the healthcare system in the Tomsk region and the existing epidemiological situation regarding the new coronavirus infection COVID-19.

The population of the Tomsk region as of 01.01.2020 accounted for 1,079,271 people, of which 597,819 people reside in Tomsk. At the time of the project launch, there were 72 state healthcare organizations in the region (69 of them were regionally governed), including 53 institutions in the city of Tomsk (50 of them were regionally governed). The capacity of outpatient organizations accounted for 16,816 visits per shift, the bed / population ratio was 85.4 per 10,000 people. In accordance with the requirements specified in the Order of the Ministry of Health of the Russian Federation "On the temporary procedure for organizing the work of medical organizations in order to implement measures to prevent and reduce the risks of spread of the new coronavirus infection COVID-19" and regional enactments approved on its basis in the Tomsk region, all the necessary measures were taken to adapt the medical infrastructure to the pandemic (re-profiling of hospitals, allocation of respiratory emergency medical teams (EMT) and indi-

vidual medical workers in outpatient organizations to provide medical care for patients with symptoms of acute viral respiratory infections (AVRI)).

To assess the epidemiological situation regarding COVID-19, the research used data from "stopcoronavirus.rf", an official Internet resource designed to inform the population about the coronavirus infection (COVID-19). Effectiveness of the Center was assessed by analyzing quantitative performance indicators as well as by studying the dynamics in indicators of the load on the EMT and outpatient service.

Indicators were monitored in the period from 01.07.2020 to 19.01.2021 based on the operational data of the Healthcare Department of the Tomsk Region (HDTR) and subordinate healthcare institutions. Statistical processing of the research results was carried out using the Statistica 12.0 software package. Data are presented as the median and the interquartile range $Me (Q_1; Q_3)$.

RESULTS

To assess the potential load on the healthcare system associated with the progression of the COVID-19 pandemic, we analyzed average monthly values of a daily increase in confirmed cases of the new coronavirus infection in the Tomsk region in the period from July 2020 to January 2021 (Fig. 1).

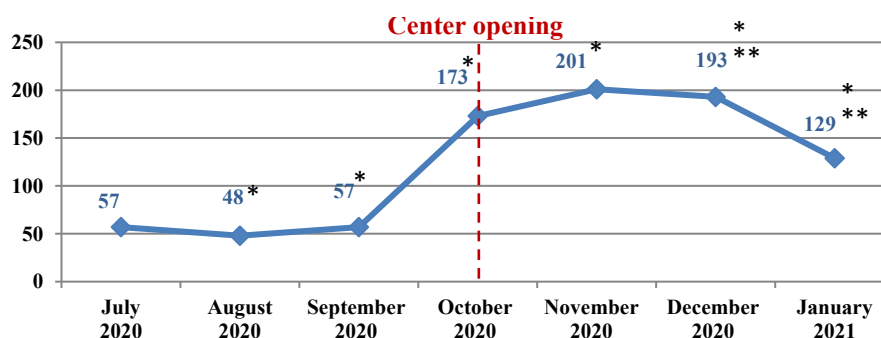


Fig. 1. Dynamics of average monthly values of the daily increase in confirmed cases of the new coronavirus infection in the Tomsk region: * $p < 0.0001$ in comparison with the previous month, ** $p < 0.0001$ in comparison with October 2020

The time trend of this parameter was characterized by rather low values in the summer months, an increase in September 2020 and a drastic increase in October 2020. The maximum values of the indicator were recorded in November 2020, after which the trend curve began to decline. All changes between the average levels of the time series were significant in contrast to the previous period ($p < 0.0001$). It is worth noting that, despite a significant decrease in the average number of infected people per day in Decem-

ber 2020 against November 2020, the December level remained significantly higher than the October one ($p < 0.0001$), i.e. in the first months after the opening, the Center operated in a worsening epidemiological situation regarding COVID-19, under the conditions of the so-called second wave of the new coronavirus infection.

For the Tomsk region and for most regions, the intensity of the second wave of COVID-19 jeopardized the stability of the healthcare system. Almost all areas

of work with citizens were on the verge of destabilization, from information support (HDTR regional hotline for AVRI, influenza, and the coronavirus infection operating in the region experienced serious overloads) to the emergency medical care delivery.

Despite the taken measures involving the engagement of medical workers and deployment of additional capacities to provide care for people with COVID-19, a drastic increase in the number of affected people provoked an obvious shortage of resources, which was determined by a rise in the number of COVID-19 cases among medical workers and their sickness leaves. The situation was aggravated by increased panic among the population due to the inability to reach medical organizations and increased waiting time for a doctor and EMT. Moreover, while in the districts of the Tomsk region, the problems were less pronounced due to the small size and low density of the population, in the regional center, the situation was critical and required immediate decisions, one of which was the establishment of the Center.

By the decision of the operational headquarters, the project for the establishment of the Center was developed urgently. The algorithm of work of the Center was approved by the order of the HDTR of 19.10.2020 No. 1085 "On the organization of work of the Medical Center for Remote Monitoring". The Center was set up on the premises of the Emergency Medical Unit (EMU) and started functioning on 20.10.2020.

The organizational structure of the Center included the Director, operators (graduate students of the medical university and resident doctors who performed the main scope of work on remote consulting of patients), and chief on-call doctors (mainly specialists over 65 years old as well as those with contraindications for working directly in medical organizations, whose main task was to provide methodological support for operators and advice for citizens who inquired about treatment issues, for example, to explain doctor's prescriptions, etc.). Everyone employed in the Center underwent advanced training in provision of medical care for COVID-19 patients at Siberian State Medical University in the amount of 36 hours. Based on the results of the first month of the Center's operation, the functionality of senior operators was added. Their duties included advising ordinary operators in case of difficulties, induction training of new employees, and writing internal reports on the activities of the unit.

The main task of the Center was to provide remote consultations for patients with COVID-19 and community-acquired pneumonia, who were already put

under observation on an outpatient basis or in a day care hospital. It was done in order to reduce the load on polyclinics and EMT and to make resources available to serve patients in need of initial medical examination. Patients were informed about the activities of the Center by means of specially designed leaflets, containing contact information, reasons for contacting the Center, and advice on preparing for a remote consultation, as well as via the media and social networks.

The key reasons for contacting the Center included: deterioration of a patient's condition; the emergence of symptoms in asymptomatic patients; lack of face-to-face or remote monitoring of the patient's condition by a healthcare organization in which the patient was kept under observation. The internal processes of the Center were organized using lean management methods and tools, such as work standardization, visualization, and value stream mapping.

It is worth noting that the work of the operators was carried out in the medical information system of the Tomsk region (MIS TR): patient identification, creation of a medical record for the provided service "Consultation of the operator of the Medical Center for Remote Monitoring", which was also available to a doctor who followed up on a patient in the outpatient setting. That ensured the continuity of information between the Center and outpatient clinics.

Operation of the Center in a test format (the first week) proceeded during the daytime with a subsequent switch to a round-the-clock service. The main task of the operator was to assess the patient's condition in order to make a decision on further patient management tactics. The project team members developed speech modules for adults and children, that included grading of the severity of the patient's condition based on their inclusion in risk groups, complaints, and a number of objective parameters available for measurement by the patient independently (blood pressure level, respiration and heart rate, glucose meter readings in patients with diabetes mellitus, etc.).

So, with a total score of less than 7, the patient's condition was assessed as stable, and oral recommendations were given regarding continuation of the prescribed treatment. If there were questions not related to the clinical aspects of the patient's condition, for example, the need to obtain reference information on the rules of self-isolation, working hours of healthcare facilities in high alert mode, etc., the patient's call was forwarded to the HDTR hotline for AVRI, influenza, and coronavirus infection for informational support.

With a total score of 7–14, the patient management tactics involved transfer of the appeal to an outpatient clinic in order to organize a personal doctor's visit. The appeal was transferred by an operator in the medical information system of the Tomsk region (MIS TR). For this purpose, each polyclinic set up "virtual respiratory rooms" and appointed employees responsible for handling the transferred calls. During the period of the maximum incidence rate (from November 23, 2020), these appeals, according to the appropriate agreement, were transferred by the Center to the emergency medical service of a private orga-

nization (Medika–Tomsk LLC) and processed within two hours.

A total score of 15–26 in adults and 15–30 in children required transfer of the appeal to the EMU to organize a visit of the EMT and provide emergency medical care.

Regardless of the patient management option, the patient was informed about the need to contact the Center in case of deterioration of the general condition and if they had additional questions.

The general scheme of the Center's operation is shown in Fig. 2.

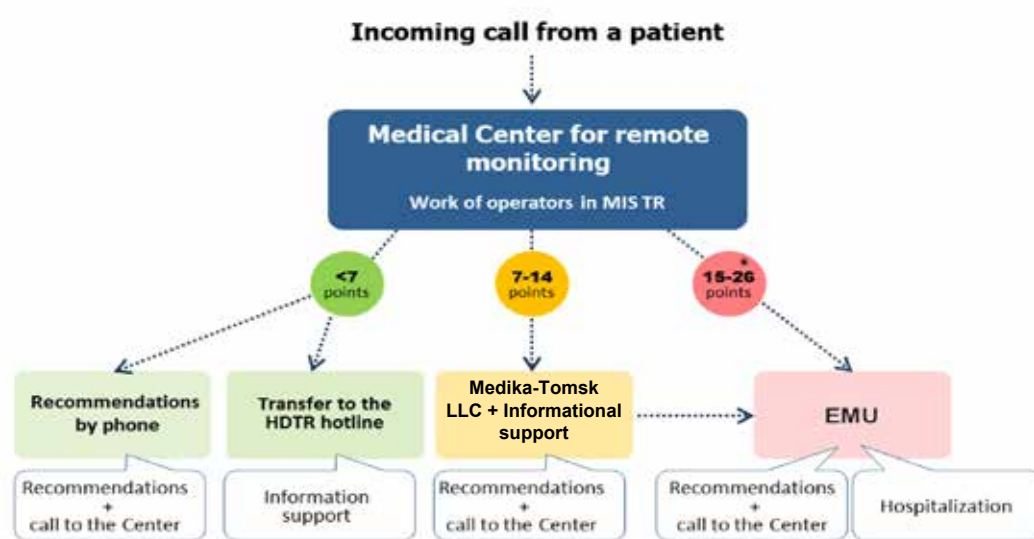


Fig. 2. The general scheme of the Center's operation

The control over the appeals transferred to outpatient clinics and EMU was carried out on a daily basis by a senior on-call doctor in the Center in the MIS TR. For each unhandled call, the operator made an outgoing call to the patient in order to clarify the severity of their condition and make a decision on patient management tactics in accordance with the above-described scoring system. The Director of the Center daily carried out a summary analysis of its performance and sent this information to the HDTR and the operational headquarters of the Tomsk region to ensure the ability to quickly respond to emerging problems and develop proposals for further improvement of the Center's performance.

Analysis of the Center's performance indicators. From 20.10.2020 to 19.01.2021, the Center received 70,883 calls. 94 calls were transferred to EMU, 1,514 calls – to outpatient clinics, and general recommendations were given during 69,275 calls.

4,801 calls in total (both during and after a remote consultation) were redirected to the HDTR hotline for AVRI, influenza, and coronavirus infection.

The average duration of one consultation in the test mode of the Center reached 11.05 (7.12; 15.08) minutes, and due to the measures implemented to achieve the target interaction between the Center and healthcare organizations, it decreased to 5.5 (4.95; 5.92) minutes by November 2020 and thereafter did not change significantly.

Reasons for contacting the Center were the following: deterioration of the condition – 7,936 calls (11.2%); a doctor failed to come / call – 3,577 calls (5.1%); asymptomatic COVID-19 course – 475 calls (0.7%); newly detected COVID-19 – 2,621 calls (3.7%); onset of symptoms in asymptomatic patients – 5,404 calls (7.6%); problems with a sickness leave certificate – 7,319 calls (10.3%); problems with the PCR test, including the inability to find out its results – 13,530 calls (19.1%); contact with a COVID-19

positive person – 4,966 calls (7.0%); other reasons – 25,055 calls (35.3%). The “other reasons” category included a wide range of issues not related to assessment of COVID-19 patient condition, such as receiving subsidized medicines; forced time extension for receiving high-tech medical care; the need for volunteer help;

negative result of a COVID-19 PCR test for the employer; the possibility of receiving free drugs, etc.

Analysis of the load on the EMT. The data of the load parameter analysis on the EMT at the time of the Center’s operation are set out in Table 1 and Figures 3 and 4.

Table 1

Dynamics of the load parameters on the EMT, $Me(Q; Q_3)$						
Month, year	Number of EMT calls, units/day	Number of served EMT calls, units/day	Number of EMT calls transferred to the next day, units	Waiting time for all EMT calls, min.	Number of served calls related to COVID-19, units/day	Waiting time for EMT calls related to COVID-19, min.
July, 2020	1,044.00 (966.00; 1,129.00)	547.00 (522.00; 567.00)	0.00 (0.00; 2.00)	70.03 (56.03; 85.03)	104.00 (91.00; 113.00)	158.03 (102.03; 204.03)
August, 2020	974.00* (868.00; 1,053.00)	548.00 (528.00; 569.00)	0.00 (0.00; 0.00)	53.03* (41.03; 62.03)	88.00* (74.00; 97.00)	73.02* (63.03; 118.04)
September, 2020	1,176.50* (1,045.00; 1,295.00)	589.50* (558.00; 614.00)	0.00* (0.00; 24.00)	74.53* (51.03; 90.03)	130.00* (117.00; 145.00)	157.82* (68.25; 239.32)
October, 2020	1,857.00* (1,559.00; 2,035.00)	566.00 (548.00; 608.00)	187.00* (139.00; 208.00)	123.04* (101.03; 172.03)	192.00* (182.00; 209.00)	282.03* (216.03; 349.03)
November, 2020	1,225.00* (977.00; 1,618.00)	547.00 (523.00; 596.00)	31.00* (0.00; 164.00)	99.04* (68.03; 125.03)	193.50 (176.00; 204.00)	139.53* (95.04; 230.03)
December, 2020	942.00* (862.00; 982.00)	545.00 (517.00; 592.00)	0.00* (0.00; 0.00)	51.03* (38.03; 55.03)	171.00* (145.00; 185.00)	70.04* (46.03; 90.03)
January, 2021	994.00 (913.00; 1,083.00)	531.00 (520.00; 583.00)	0.00 (0.00; 0.00)	45.05 (37.05; 59.06)	124.00* (111.00; 133.00)	62.06 (40.05; 96.06)

* $p < 0.05$ in comparison with the previous month (here and in Table 2)

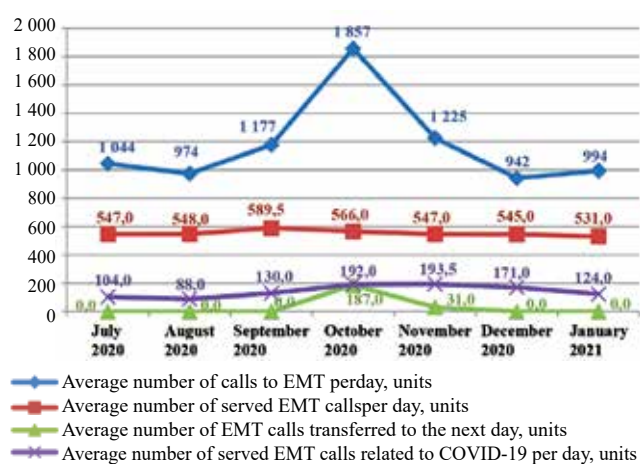


Fig. 3. Dynamics of quantitative indicators of the load on the EMT

The average number of calls to EMT per day in August 2020 significantly decreased as opposed to the previous month, and from September, there had been a significant parameter increment with a peak value

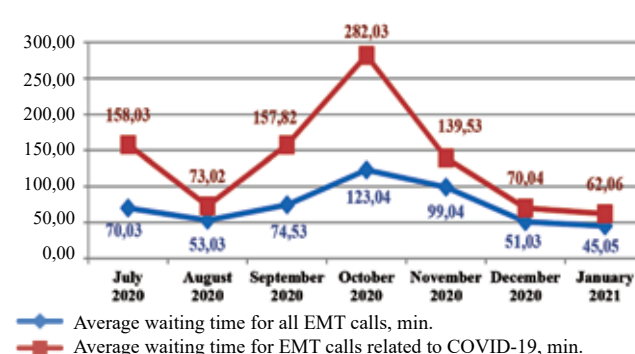


Fig. 4. Dynamics of time indicators of load on the EMT

in October 2020, which reflected a drastic increase in the load on the EMT caused by the second wave of the pandemic. However, in November and December 2020, a significant decrease in the average number of calls to EMT was recorded as opposed to the previous periods, despite the unfavorable epidemiological situation with the COVID-19 incidence. In January 2021, the parameter level stabilized, showing no sig-

nificant changes in comparison with December 2020. A significant decrease in the average number of calls beginning from November 2020 confirmed effective performance of the Center, which took upon itself the reception and processing of part of the calls, earlier received directly by the EMU.

The average number of served EMT calls per day during the researched period did not show statistically significant dynamics (except for a significant increase in September 2020 in comparison with the level in August 2020). No further parameter increment in the conditions of the deteriorating epidemiological situation as well as its subsequent decrease due to the opening of the Center can be explained by the limited maximum number of EMT on duty per day, related among other things to COVID-19 cases found among medical professionals of EMU during the peak of the pandemic. For example, throughout the study, the daily number of EMT on duty varied from 35 to 42.

During the period of active work of the Center (November 2020), there was also no significant decrease in the dynamics of the average number of served EMT calls related to COVID-19 per day for a similar reason. A subsequent significant decrease is mainly asso-

ciated with a natural decrease in the load on the EMT due to a decline in the number of cases.

At the same time, the average number of EMT calls transferred to the next day, as an indicator of an obvious failure of the adaptive capabilities of the system under the conditions of the extreme load, significantly decreased during the first weeks of the Center performance (by November 2020) after a rise in the incidence rate in October 2020. Moreover, these calls have not been registered since December 2020.

The time parameters of the EMT work had big sensitivity in terms of reflecting the load on the EMT against the background of the Center operation. An average waiting time for all EMT calls after a significant increase in September and October 2020, compared to the previous months of the Center operation, significantly decreased in November and December of the same year, while the average number of COVID-19 cases continued to increase. A similar trend was observed in the analysis of the average waiting time for EMT calls related to COVID-19.

Analysis of the load on the outpatient clinics. The data of the analysis of the load on outpatient organizations against the background of Center operation are set out in Table 2.

Table 2

Dynamics of load parameters on the outpatient service, $Me(Q_1; Q_3)$		
Month, year	Average number of house calls, units/day	Average number of house calls regarding acute respiratory diseases, units/day
July, 2020	1,186.00 (355.00; 1,280.00)	308.000 (117.00; 345.00)
August, 2020	1,060.00* (288.00; 1,191.00)	278.000 (125.00; 352.00)
September, 2020	1,391.50* (560.00; 1,571.00)	567.000* (282.00; 711.00)
October, 2020	2,562.00* (1,177.00; 2,965.00)	1,034.000* (557.00; 1,356.00)
November, 2020	2,249.00 (730.00; 2,465.00)	904.500 (365.00; 1,048.00)
December, 2020	1,723.00* (656.00; 1,900.00)	594.000* (272.00; 663.00)
January, 2021	708.00* (552.00; 1,449.00)	299.000* (228.00; 452.00)

Dynamics of the parameters of the load on the outpatient clinics as a whole showed the same trends as parameters of the load on the EMT, but without a significant difference between the levels in October and November 2020. This can be explained by the fact that in the first weeks of the Center operation, its activities were designed exclusively for providing remote consultations for patients with confirmed diagnosis of COVID-19 infection with clinical manifestations of the disease to determine patient management tactics. At the same time, a large number of visits to the outpatient clinics was associated with the need to monitor the condition of asymptomatic carriers and people after COVID-19 exposure. Transfer of these functions to the Center in November 2020 significantly reduced

the burden of the outpatient clinics, which was confirmed by a significant decrease in the values of both analyzed parameters under the conditions of the increased COVID-19 incidence.

DISCUSSION

Performing a retrospective assessment of the experience in establishing the Center, the following factors can be pointed out that have made a significant contribution to its successful performance. First, the existence of a medical university in the region, which made it possible to urgently recruit the main team of operators from graduate students and resident doctors. Publicly available sources describe different approaches to staffing of such organizations: from engaging

volunteers [7] to official employment of specialists as medical personnel, which happened in many Russian regions [12–14].

The legal basis for the performance of duties by operators in the Tomsk region was a civil law contract. We believe that in the context of the rapidly growing pandemic and the need to quickly create a new structure, this legal basis is optimal. On the one hand, it provides legal guarantees for both parties in the contract. On the other hand, it allows for flexible management of the Center structure by changing the proportion of doctors and operators and the number of employees depending on top-priority tasks. The second factor was high level of IT development in the industry. The third factor was regional experience of using lean technologies in healthcare, which was repeatedly described in our previous articles [15–19]. The use of proven lean management tools made it possible to quickly set up and standardize the main processes of the Center already at the start of its work.

In the Tomsk region, the Center was organized on the premises of EMU. This site was selected due to suitable floor spaces and the ability to ensure prompt transfer of the most complicated calls requiring emergency medical care delivery. As alternative options for the placement of such structures, a Medical Prevention Center [12], a Physical Therapy and Sports Medicine Center [20], and a Clinical Hospital [13] can be considered.

In some regions of the Russian Federation, health authorities decided not to use the centralized format of organizing medical assistance for this category of patients using telemedicine technologies, developing them instead on the premises of all medical organizations providing primary health care [14]. Obviously, the issue of location does not have a universal solution and shall be resolved in each particular case individually, taking into account the regional specifics, such as available resources and epidemiological situation. In our opinion, centralization would be preferable if the region has a sufficient level of IT development and widespread implementation and sufficient functional capabilities of regional medical information systems. In addition to the traditional advantages, this approach is associated with resource saving and increased manageability and enables to create a single input channel for information about the most urgent problems arising in the process of medical and informational support of patients included in monitored groups. A detailed analysis of these groups can form the basis

for both selective prompt response measures and long-term systemic improvements.

Despite the apparent obviousness, the issues of the effectiveness of such centers are not so unambiguous. In theory, introduction of a new structure and involvement of additional staff should relieve the existing healthcare system in the fight against COVID-19. However, the risks of the opposite effect are always high in reality: creation of an additional load on the primary care and the EMT system due to transfer of irrelevant cases (overestimation of the severity of the patient's condition, transfer of a call to an outpatient clinic for which only informational support is needed), lack of continuity in the transfer of information, and duplication of functions of the telemedicine center and outpatient clinics following an imperfect interaction scheme.

The analysis of the Center performance given in this article confirms its effectiveness both for reducing the load on the system of emergency medical care delivery and for optimizing the work of the outpatient service in the region. In addition to the general factors described above, a number of organizational decisions also contributed to the improvement of the Center performance.

As mentioned earlier, the vast majority of calls were processed by providing general recommendations on the phone, i.e. they did not require face-to-face contact between a patient and a medical professional, and the category "other calls" had the largest share in the structure of reasons to contact the Center. To ensure high-quality counseling by operators on this block of issues, the project team carried out a preliminary analysis of the most common reasons for contacting call centers of hospitals, EMU, or HDTR, which could potentially be processed by the Center. Response measures were thought out and appropriate scripts were developed for quick response to frequently asked questions.

As a temporary measure aimed at ensuring the availability of medical care during the periods of the most dramatic rise in disease incidence, handling of house calls was outsourced to private medical organizations. It is worth mentioning that the majority of the available scientific studies on the use of telemedicine technologies in relation to COVID-19 patients mention the clinical efficacy and safety of these tools [21] and describe individual quantitative indicators of work of such units [7, 8]. At the same time, there are practically no publications that would assess the systemic effects of their performance, which increases the value of our results.

In our opinion, the prospects for the Center operation are associated with the possibilities of its adaptation for remote monitoring of patients with chronic non-infectious diseases. Currently, the region is already conducting a comprehensive review involving the use of the resources of the Center for these purposes. Scientific substantiation and assessment of the effectiveness of the measures implemented in this area will be the object of our further research.

CONCLUSION

The conducted research shows a positive systemic impact provided by the Center activities, which is manifested through a decrease in the load on the primary health care system and EMT during the unfavorable epidemiological situation following high COVID-19 incidence. The experience of the Tomsk region in organizing a system for remote monitoring of patients with COVID-19 and community-acquired pneumonia can be recommended for use in other regions of the Russian Federation, taking into account the proven effectiveness. It is advisable to adapt the solutions used within the described project to deliver remote consultations to other categories of citizens.

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