

Lappeenranta-Lahti University of Technology LUT
School of Engineering Science
Software Engineering
Master's Programme in Software Engineering and Digital Transformation

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DEVELOPMENT OF A BUG TRACKING FOR PROCESSING COMPLAINTS TO MEDICAL ORGANIZATIONS

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ABSTRACT

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Development of a bug tracking for processing complaints to medical organizations

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This master's thesis is devoted to the development of a system for processing requests to medical organizations based on the ideas and logic of the bug tracking systems. The work was written for the Medical information and analytical center of St. Petersburg. The main research question is how to develop a solution that can meet the needs of the object under study and improve its business processes, which has unique needs and a complex focus of work. The paper analyzes many literary sources, considers cases of using similar systems in other countries. Further, interviews with stakeholders were conducted. And the methods of graphical and interactive modeling were used to develop the design of the system. As a result, the attributes inherent in bug tracking systems were determined, and their possibility of using outside of IT was substantiated, a solution was developed that satisfies all business needs and an assessment of its effectiveness was given.

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TABLE OF CONTENTS

ACKNOWLEDGEMENTS	III
1 INTRODUCTION	4
1.1 BACKGROUND	4
1.2 GOALS AND DELIMITATIONS	4
1.3 STRUCTURE OF THE THESIS	6
2 POSSIBILITIES OF APPEAL PROCESSING AND BUG TRACKING SYSTEMS.....	8
2.1 BUG TRACKING SYSTEMS TECHNOLOGIES	8
2.2 WHAT IS CONSIDERED AN ERROR OR DEFECT IN IT AND OTHER AREAS	11
2.3 RELATIONSHIP BETWEEN BUG TRACKING SYSTEMS AND PROJECT MANAGEMENT SYSTEMS, PLUGIN CREATION	13
2.4 PRACTICAL USE OF BUG TRACKING SYSTEMS IN AREA NOT RELATED TO IT	14
2.5 CASE STUDY OF APPEALS PROCESSING IN DIFFERENT COUNTRIES	16
3 DESCRIPTION OF THE RESEARCHED OBJECT ACTIVITIES AND PROBLEM STATEMENT	20
3.1 CHARACTERISTICS AND ORGANIZATIONAL STRUCTURE OF MIAC.....	20
3.2 DESCRIPTIONS OF THE ACTIVITIES OF THE DEPARTMENT FOR WORK WITH CITIZENS' APPEALS.....	21
3.3 NORMATIVE DOCUMENTS THAT REGULATING THE MAIN ACTIVITIES OF THE DWA	23
3.4 ANALYSIS OF MAIN BUSINESS PROCESSES AS-IS	24
3.4.1 <i>Processing appeals.</i>	25
3.4.2 <i>Consulting citizens by telephone hotline.</i>	28
3.4.3 <i>Formation of reports on the work of the department.</i>	29
3.5 STATEMENT OF TASKS FOR THE AUTOMATION OF MIAC ACTIVITIES	31
3.6 FORMATION OF GENERAL REQUIREMENTS FOR AN APPEAL PROCESSING SYSTEM..	31
3.7 REVIEW OF EXISTING SOLUTIONS	35
3.8 JUSTIFICATION OF EXPEDIENCY TO DEVELOP OWN SOLUTION	37

4	SYSTEM DESIGN.....	39
4.1	USER CLASSES AND THEIR CHARACTERISTICS	39
4.2	DESCRIPTION OF TECHNICAL AND SOFTWARE	40
4.3	DESCRIPTION OF AUTOMATED FUNCTIONS	41
4.4	DESCRIPTION OF WEB INTERFACES.....	62
4.5	DESCRIPTION OF INTERFACES FOR INTERACTION WITH EXTERNAL SYSTEMS.....	73
4.6	DESCRIPTION OF THE ORGANIZATION OF INFORMATION BASE.....	79
5	RESULTS	83
5.1	RESULTS FROM IMPLEMENTATION ON BUSINESS PROCESSES	83
5.2	RESULTS OF THE EFFECTIVENESS OF THE DEVELOPMENT AND IMPLEMENTATION OF THE APPEAL PROCESSING SYSTEM	86
6	DISCUSSION AND CONCLUSIONS.....	93
7	SUMMARY	95
8	REFERENCES	96

LIST OF SYMBOLS AND ABBREVIATIONS

API	Application Programming Interface
BPMN	Business Process Management Notation
BTS	Bug tracking systems
DB	Database
DWA	Department for working with appeals
DHC	District health care center - Deals with legal issues of repaired medical organizations
GUI	Graphical user interface
IS	Information system
IT	Information technologies
LO	Leningrad Oblast
MIAC	Medical Information and Analytical Center
MO	Medical organization
MS	Microsoft
NIST	National Institute of Standards and Technology
OWCA	«Organization of work with citizens' appeals» - system under development
PaaS	Platform as a Service
SDK	Saint – Petersburg
SNILS	Software Development Kit
SPb	Saint – Petersburg
SaaS	Software as a Service
UML	Unified Modeling Language

1 INTRODUCTION

1.1 Background

Today, bug tracking systems are an integral part of the work of any IT solution development team, they help speed up the process of handling bugs in the process of creating software, as well as speed up the understanding and elimination of defects during the operation of software. This research was conducted to show that the classical logic of bug tracking systems is applicable not only in the IT field, but also in the civil sector, in such areas as education, medicine and many others. Where it is necessary to qualitatively track problems and defects during the execution of business processes.

This work was written for St. Petersburg State Budgetary Healthcare Institution Medical Information and Analytical center (MIAC) to improve the processes of processing citizens' appeals to medical organizations. The solution proposed in the work optimizes the operation of the object under study, in the future it will help to increase the efficiency of processes and will allow for better analytics of citizens' problems. And, as a result, it will improve the quality of healthcare in the country as a whole. This solution perfectly matches the main goals for which the MIAC was created:

- improving the processes of organizing medical care through the introduction of information technology";
- development of state information systems in the field of health care.

This work is based on a large number of literary sources, as well as on personal experience in the creation of this product from the first day of the inception of the project idea and up to the commissioning of industrial operation.

1.2 Goals and delimitations

The purpose of this work is to analyze the classic bug tracking systems market and develop own solution for the needs of the of the MIAC, using the best practices from existing bug tracking systems. The object of the research is the department for work with appeals of the St. Petersburg Medical Analytical Center. The main research question is how to develop a solution that can meet the needs of the object under study and improve its business processes. Main tasks that done during the research:

- study the theoretical aspects of using bug tracking systems;
- study main activities and organizational structure of MIAC;
- draw up and examine business processes for the work of the department for processing appeals to medical organizations (as is) in one of the modeling languages;
- form basic requirements for the information system;
- study the main solutions on the market and justifying the need to develop your own;
- create of a role model, a detailed description of the developing functions, user and program interfaces;
- build business processes for the department for processing appeals to medical organizations after the development and implementation of the solution (to be) in one of the modeling languages;
- study of the cost-effectiveness of the new system.

Within the framework of this research, it is not intended to write code for the software product, but all its functions and requirements from the side of system analysis are clearly worked out.

The main methods used in this study are:

1. For the initial collection and analysis of information on the issues and issues under consideration, methods of literature review and case studies were used. To study the necessary literature for the research, the method of building up information (Rus. апперцепирования) was used, this method assumes a constant supplement of the research progress with new information from other sources. The main thing is that all resources used as a supplement are associated with the chosen topic of the scientific project. Thus, this method involves linking the author's thoughts with other people's works, demonstrates the dependence of his point of view on other hypotheses. In this work, this method was used to compile a theoretical research base in the context of what such bug tracking systems are, how they are used, what elements they consist of. And the formation of hypotheses of the possibility of their use of bug tracking systems outside of IT. This choice of the method of literary research was chosen due to the lack of a large amount of comprehensive information on a given topic and the constant need for additions from various sources. The case study method was used for a detailed study of the best international practices in the field of development in the implementation of solutions for processing complains to medical organizations.

2. Method of interviewing. Interview, unlike other research methods, is a method of obtaining information from the «mouth» of primary sources. The interview is carried out with the presence of an interviewer prepared for the dialogue, and a more in-depth collection of data is carried out for further analysis and processing. This method, although it has shortcomings in the accuracy of data collection, but when developing a new product in the IT field, is one of the key methods of collecting information. When developing any solution at the analytic stage, interviews with stakeholders are always carried out. In this work, the interested parties are the work of the department for work with appeals of the MIAC, and in the course of their interviews 17 respondents were interviewed and general requirements for the system were drawn up. In addition to the main interview, several smaller respondents were also conducted to approve intermediate and final decisions.
3. Finally, in the practical part, methods of graphical and interactive modeling are used. These scientific methods make it possible to represent objects of the real world, or objects that will exist in the future, in the form of models of a certain accuracy. In this paper, the method of graphical modeling is used to describe business processes, as well as use cases and determine the functionality of the future system. The interactive modeling method (prototyping) is used to create a workable layout of the system for the possibility of approving a solution with stakeholders without the need to spend a lot of money for development at the early stages of the solution design..

1.3 Structure of the thesis

The study consists of three main chapters, as well as an introduction, conclusion, bibliography, and an appendix with general reporting forms. The logical narrative of the work is arranged from the theoretical part of the work, based on the studied literature, to the practical part, that describes the logic of the developing system.

The first chapter presents theoretical aspects of the research, describes the main elements and attributes of modern bug tracking systems. Analogies of IT attributes in such systems with objects of the real world are given. Shows an example of using the bug tracking system in education, on the example of organizing using the example of the teacher's work with students when completing assignments.

In the second chapter of the thesis, the practices of the best cases of using information systems for processing appeals in medical organizations are presented. Then the object of the study is described in detail - the department for work with appeals of the St. Petersburg State Budgetary Healthcare Institution Medical Information and Analytical center, including its business processes and regulatory documents. After that, the section presents the developed use cases for each of the participants in the processing of appeals, use cases is based on the interview of the interested parties. Then the requirements for the necessary system are formed. At the end of the section, a study of existing bug tracking systems is conducted and the need for a new solution for the object under study is considered.

The third chapter is a practical part of the research, in this part student represents in details all main components of the system, its functions.

The third chapter is a practical part of the study, which presents in detail: the roles of users, describes in detail the logic of the implementation of each of the functions necessary in the system, the system's web interfaces, as well as the integration interfaces. After that, the business processes after the implementation of the system are described and the economic efficiency of the project is substantiated.

2 POSSIBILITIES OF APPEAL PROCESSING AND BUG TRACKING SYSTEMS

Articles for research in this thesis were collected from multiple sources. The largest scientific libraries of Russia and the world were used to search for articles: Scopus, Elibrary, Cyberleninka, Research Gate, Google Scholar. List of the main topics on which the search for scientific works was carried out:

- medical information systems for appeal processing
- bugtracking systems in general
- bugtracking systems in areas not related to IT

The found articles were then filtered to meet the following criteria:

- articles need to be on English or Russian
- articles about bug tracking must not be older than 7 years
- cases of using processing systems in medical organizations should be clearly documented

In total, 35 articles were selected for this research, some of which do not have direct links, but were used to form the overall result of the research. Articles were distributed according to research topics in the following proportion11 articles about personalized gamification

- 12 articles about medical information systems for appeal processing
- 18 articles about bugtracking systems in general
- 3 articles about bugtracking systems in areas not related to IT
- 2 in related fields

2.1 Bug tracking systems technologies

Initially, Bug Tracking System is a computer application designed to ensure the quality of software and help programmers and other IT user who involved in the design and use of computer systems to track down software defects. [1] Such systems are used extensively by almost all software companies or institutions. While many bug tracking systems allow users to directly log a detected incident, many software companies use bug tracking systems solely for internal purposes. [2] Bug trackers often integrate with other tools such as email, version control, and other administrative tools.

One of the main components of a bug tracking system is a database that stores facts and a history of software failures - defects. [2] Defects can be detailed descriptions of the failure, the severity of the event, how it was reproduced, the development staff who intervene in the solution, the likely date of the fix, and the code that resolved the problem. [3] In most cases, BTS has a standard bug report in the following form:

- Who exactly notified about the problem;
- the date and time when the problem was identified;
- the significance of the problem;
- characterization of the inappropriate behavior of the program;
- who carries out the elimination of the problem;
- error structure.

This is a simple set of conditions for the BTS database, but in reality, many bug tracking systems provide much more detailed error logging, in many systems the following information is additionally added to the standard bug report templates [2]:

- The version of the product in which the defect was found;
- the criticality of the defect and the speed of the solution;
- characterization of steps in order to detect a defect (reproduction of inappropriate program behavior);
- expected outcome and actual outcome;
- who is responsible for the elimination of the defect;
- discussion of the existing solution to its outcome;
- the current status of the defect;
- the version of the product where the defect can be corrected;
- the criticality of the defect.
- In addition, you can attach files to enhanced bug tracking systems that help characterize the problem (such as a memory dump or screenshot) [4]. In some ways, they resemble project management systems.

As a rule, the following levels of criticality are used in the bug tracking system. The standard severity set usually consists of the following values [5]:

- Serious: Significant loss of functionality, such as broken output or difficulties that partially or completely prevent the program from being used;
- Minor: A minor loss of functionality or an issue that can be resolved;
- Trivial: an aesthetic problem, misspelling or misalignment of the text;

- Improvement: Request for a new feature or functionality;
- Normal: A minor part of the component does not work;
- Blocker: Prevents continuous development or testing of a program;
- Critical: Application crash, data loss, or severe memory leak.

It is important to understand that bug tracking systems can be fruitful not only for programmers and testers, but also bug reports can also be used by project managers, financial managers, persons responsible for safety, etc. In reality, such reports can allow represent information about the effectiveness of programmers, while working to improve the quality of the software and quality of business processes in the IT company.[6] While processing reports, users of bug tracking systems, needs account the criticality of errors and the difficulty of eliminating them. The manager must be aware that there are errors that can be difficult to eliminate due to the design of the system. It makes no sense to ask for an early elimination of errors in system modules: a poorly thought-out step to eliminate a single error can cause hundreds of other errors.

Error Life Cycle one of the most part useful part of bug tracking. Usually, systems will apply some variation of the bug "life cycle", the status of which can be determined by the current state, or the status where the bug exists. The characteristic bug life cycle contains such statuses as [6]:

1. New - the defect was registered by the tester
2. Appointed - assigned to the person in charge to eliminate the defect
3. Resolved - the defect goes back to the tester's area of responsibility. For the most part, it is accompanied by a resolution, for example:
 - fixed (fixes are included in version ...);
 - double (a defect that is in progress is repeated);
 - not corrected (acts in accordance with the classification, has a very low priority, correction is postponed until a further version, etc.);
 - not reproducible (requiring additional data on the conditions where the defect is found).
4. Further, the tester checks the corrections, depending on what the defect either goes to the assigned state (if it is characterized as corrected, but not corrected), or to the closed state.
5. Reopened - the defect was found again in a different version.

The classic task and bug tracking system applies a “lifecycle” focus for tasks and bugs, which is tracked by the status where the task or bug is found. Tracking the current status of the task (including new comments or attached files) can be done either manually or via email notification settings.

2.2 What is considered an error or defect in IT and other areas

A software error is like a flaw in the design of a software product that causes deviations between the expected outcome of the software product and the actual outcome. The defect may occur at the coding stage, or at the deployment stage because of incorrect configuration or information. A defect can also be something else that does not meet the expectations of the client and that may or may not be defined in the specification of the software product. So, a software defect can be [4]:

- the difference between the technical task for the program (functional specifications) and the actual behavior of the system;
- the difference between the work of the program and the generally accepted patterns;
- when the program does unexpected actions that are not described in the specification or standards.

What is important in the concept of a defect is a strong difference from the normative document according to which the program is obliged to work. The most difficult thing is to recognize an error in an area that does not have normative documents. Lack of documentation, or insufficient documentation, alas, usually always exists in the modern world.

In order to identify one or another defect, it does not matter when developing programs, fixing equipment or treating a patient, you need to take specific actions, compare the results with the expected ones, and make conclusions about whether there is a problem or not. In the IT field, this is called a test case. Each test case is compiled after the development of a general test plan, in fact, even before the program itself is written. In the civilian sector, this can be described as an internal investigation. However, in the absence of the necessary documentation and regulations, accompanying this or that process throughout its entire life cycle, it is impossible to quickly carry out such case or hold fast investigation[7]. In order to write documentation, a software developer will need a sufficient amount of time. This often happens when the project has an incomplete team: there is no technical writer, tester or

analyst in the team. However, if you draw up cases in advance, then the entire time of creating software, including testing, will be much less, due to the time savings in the next stages.

In spheres not related to IT, it is impossible to predict the all event turns, but collecting and analyzing data on regularly occurring problems is quite possible. So, for example, if 10 people reported that the store employee showed rudeness, it is worth checking the professional suitability of this employee. Or, if the support staff of the fitness center are constantly called and clients say that they can't enter the locker room, because the fitness manager forgot to activate the pass. Company needs to hang up the regulations in front of the employees, in which the stage of registration of a new client is indicated step by step.

Information technology usually uses the following plan for describing test cases:

- Test title (clearly reflecting its essence);
- reproduction steps (outlining the actions that the tester takes when conducting the test), then numbering each step;
- expected Outcome;
- the result obtained (what happened in reality);
- check mark and date of the test.

This is the simplest list to follow when describing test cases. In the civilian sector, as a rule, there are no generally accepted norms and steps for describing problems and regulation, and each company has its own forms for collecting and compiling appeal and error reports. At the same time, a book of complaints and suggestions can be considered as the simplest bug tracking system, which by law must be present at any company. And test cases can be considered company instructions and state laws.

When using bug tracking systems, it is important not to confuse bugs with the latest features of the program. In this concept, first of all, those qualities and properties of the program are combined that it does not possess, but from the point of view of the user it would not be in the way all the time [7]. Of course, the new qualities are extremely individual. For the most part, in a well-formed and planned project, it should not come across, because all the functionality of the program must be discussed before the start of creation a function, or in the worst case, supplemented during test operation. Especially with regard to such projects that are carried out for a specific client. Only the client ultimately determines what qualities, properties and functions the program should have.

Whereas in the civil sector, on the contrary, it is necessary to monitor not only that the formalized complaints / gratitude, or that the proposals correspond to the logic of the business and do not contradict the laws and regulations. But also listen to the ideas of customers that are completely new and not described anywhere, since the business is prone to stronger and more frequent changes than program.

2.3 Relationship between Bug Tracking Systems and Project Management Systems, plugin creation

The project approach brings the company down and effectively organizes and launches a built-in project structure in order to develop one or more business products to solve unique problems. [8-9] The project approach allows you to create an effective business model in a dynamic environment: it allows you to set clear goals and fulfill the requirements [10].

Project management systems allow accounting tasks, resources, documentation, organizing joint activities for creating projects, and planning work on projects. Planning is the stage of dispersing tasks among many employees, depending on the actual time and money spent. Most of the capabilities of project and task management systems focus on scheduling task[2]. Project management systems are used by both project managers and executors, as well as software creators. IT project management systems support one of the software creation methodology such as waterfall model, iterative model, agile software development models. The project management systems for other areas of business, in turn, contain the models that are necessary in the work of this particular business [11]. So, for construction project management systems, the most important elements are: resource management, supply management, calendar schedules, planned-actual analysis, etc. In order to support specific business methodologies, plugins are being developed that support task transition stages, auxiliary interface components, and metric calculations [1].

Metrics can be calculated in order to monitor the progress of creation and collect statistics on various information in the project management system. Maintaining creation methods can help communicate productively with the system and achieve problem resolution faster. Since different companies have different project management needs, developers of this type of software systems create large, comprehensive box-based solutions, but also constantly have to write additional plugins for companies to order. To create plugins, the project

management system provides a set of libraries, using which the plugin creator gets access to the specific capabilities of the system [1].

The main difficulty associated with creating plugins for a specific type of business is the relationship between plugins. The need for plugin linking occurs when one plugin provides functional resources used in other plugins. This can be especially heavy calculations of metrics, auxiliary information about projects, tasks, documents and other capabilities of the system extended by the plugin [14]. Access to this information should be guaranteed by the project management system itself and create an internal software layer that provides administration of installed plugins.

The current project and task management like Redmine, Jira, Trello systems can only guarantee a software layer among the system, but do not provide the ability to fully exchange information between plugins [15]. Project management systems, which are client-server applications, are in great demand at the present time. They are downloaded and run on company servers and are cleared and managed through a web browser. In addition, these systems can be deployed in the cloud and operate on the SaaS principle. For these subtypes of client-server systems, plugin development is carried out through using a system-supplied set of libraries or Software Development Kit (SDK). SDK - a development kit that allows software engineers to create applications for a specific software package, basic development kit software, hardware platform, computer system, game consoles, operating systems, and other platforms [2]. At the end of the plugin creation, the result can be uploaded to the company's server and will start functioning together with the main system.

BTS is widely used in software development enterprises that need to capture development problems and track the process of solving them. In this work, the main focus is on the development and use of such a system for the needs of the healthcare sector, as well as other cases of using bug tracking systems to gain an advantage in organizing and automating the workflow are considered [7].

2.4 Practical use of bug tracking systems in area not related to IT

Bug tracking systems - application programs that are mostly used by software development teams in order to simplify management over the steps of creating a project and eliminating errors that have occurred. Bug tracking systems provide significant benefits in organizing and automating workflow in the company. When a problem is detected or an application is

received from a customer for revision of the system, the task is generated manually or also can be automatically created from the incoming application (if necessary, customization and BTS resources) [5]. Let's consider the case of using the bug tracking system in the educational process [2]:

The teacher creates the learning tasks necessary for an exemplary performance. The task includes:

- an outline of an emerging problem;
- the expected time frame for resolving the problem;
- type of task (for example, "completion of chapter 3 of the diploma" or "new homework");
- the "criticality" of the task and its seriousness;
- attached files that demonstrate the problem at hand.

When using BTS, the teacher can specifically pose and describe all the necessary questions that are related to this project. In the form of attached files are the necessary literary publications that are required for preparation. For the most part, BTS has a system for assigning access rights. So, more than one employee can work on a single task at the same time. This advantage is very useful in organizing the joint work of students on a single project. There are opportunities to comment on the problem. Consideration of the problem occurs according to the principle of communication on forums or blogs. The student will be able to ask a question in the corresponding problem, describe the problems that arise and their solution. The teacher, in turn, has the opportunity to correct the errors that have arisen, to make comments on the progress of the work. This advantage makes it possible to conveniently structure the task, and, moreover, eliminates the need to specify and describe (or duplicate) task contexts. Ability to track the status of the task (problem). For each task there is a possibility to assign its status. Of course, for these tasks nowadays, we use special educational systems, such as Moodle, OpenOlat, WP Courseware, but by and large, inside these systems, they have the logic of a conventional bug tracking system with additional plugins.

With proper configuration of access rights and the notification system, any changes in the task (be it a comment, a new attached file, a change in deadline, etc.) will be seen by all connected participants: both students and the teacher himself. Change notifications will be sent via email.

In order to organize work on a large project, it is possible to "break" it into a number of subtasks. In the case of project development by several students, the teacher himself can organize the structure of subtasks and assign a specific student to a specific area of work. When working with a graduate student, it is possible to break one task (writing a thesis) into small subtasks (reviewing articles, performing calculations, analyzing the data stack, working on the economic part, etc.), which greatly facilitate the work and help to clearly trace the current state cases. In addition, some BTS have the ability to automatically generate reports useful to the teacher in order to assess the work done and the student's performance. So, in companies there is always an idea of the state of the task at a particular period, and in the academic environment, the teacher sees and monitors the work of students. The implementation of the work on the project and consultation with the teacher within the BTS framework can take place every day in a distance form. Due to the storage of absolutely all records, the student will gradually accumulate material for an explanatory note to the diploma. Now let's move to cases processing appeals in different countries, and see what attributes of bug tracking systems we can find in that processes. Now let's move to case studies of appeal processing systems in different countries.

2.5 Case study of appeals processing in different countries

Patient safety is a complex issue with many disciplines and involved and interacting processes, requiring an integrated approach to improve it. It is a fundamental principle of patient care and an indicator of quality, without safety there can't be any quality. Healthcare safety management spans many disciplines, so a comprehensive and multifactorial approach is needed to identify and manage actual and potential risks to patient safety. The problem of poor-quality treatment has long worried both citizens receiving treatment and doctors and organizations providing it. However, since the release of the Institute of Medicine (IoM) report in 1999 [16], patient safety has received a lot of international attention from the public, healthcare providers and policymakers.

One of the studies on which the report is based was conducted at Harvard in the 1980s, it says that almost 4% of patients suffered injury during their hospital stay, of which 70% caused temporary injuries, and 14% ended with the death of the patient [17]. IoM has estimated that between 44,000–98,000 people die each year in hospitals from adverse events that outnumber those from car accidents, breast cancer or AIDS [16]. The UK Department

of Health estimates that side effects occur in about 10% of hospital admissions, which equates to 850,000 events per year [18]. However, in Australia, the frequency of errors in treatment among hospitalized patients was 16.6% [19]. In a study by Bates, Side effects, associated with poorly selected drugs have been identified in 6.5% of patients admitted to a Boston University hospital. [20] Usually, after careful analysis of the safety problem, it is determined that the causes are related to fatigue or inadequate communication of personnel, ergonomics of medical equipment, staffing and equipment, supervision, or training. Unfortunately, it is not always possible during routine scheduled inspections of medical organizations to identify such problems in time, which is why it is extremely important to collect and analyze data on complaints and suggestions from patients themselves.

To solve this problem, it is necessary to create a high-quality system for registration, processing and analysis of complaints. A report from the Institute of Medicine (IOM) [16] found that complaints and appeal processing systems are a key strategy for learning from mistakes and avoiding repetition. This report found that such systems can serve two functions: they can focus on social responsibility (so that suppliers are held accountable for the safety of their operations) or, alternatively or additionally, provide suppliers with useful information to improve safety. It should be remembered that appeal processing systems are not designed to estimate the frequency of adverse events, but to correct them. Such systems are tools to improve safety culture, which is influenced by all environmental factors. Let's consider the cases of the implementation of such systems in healthcare in different countries:

Medication Errors Reporting (MER) - USA

It was developed by the Institute for Safe Drug Administration (ISMP) in 1975 and is currently administered by the US Pharmacopoeia, and was originally a set of rules, forms, analytics logic and reports. The information obtained is passed on to the Federal Drug Administration (FDA) and the specific manufacturer [21]. Since the creation of the system, more than 30,000 reports have been generated, 85% of which were created after project automation.

The appeal can be made by phone, mail or the Internet. Reporters can choose the form of notification, depending on their status and competence (citizen / doctor / pharmaceutical company, etc.), a distinctive feature of the system is that all appeals are given anonymously. The system is the predecessor of the next US MedMARx system and was created to collect information about events related to drug intake in hospitals. It differs from MedMARx in that organizations don't need to have contract with vendor.

MedMARx - USA

This system was created in 1998 and allows the collection and processing of appeals to hospitals that have voluntarily entered a contract with the National Coordinating Council for Reporting and Prevention of Medication Errors. Currently, over 15,000 public and private medical institutions are registered [22]. The collection of data into the system is carried out via the Internet and can be anonymous or public. It has a simple form of registration of an appeal that does not require specialized knowledge in medicine and allows any citizen to easily formulate his appeal, in addition, the system has a unique model of anonymity, thanks to which the user of the system can receive any information about the treatment carried out for the patient without his personal data. The patient, when drawing up the appeal, indicates the pin code stored in his medical card, fills in the appeal, where the main attributes are: Date and location of the error, Description of the error in free text form, reason list selector. After that, the system itself pulls up the analyst only that information about the patient, which is necessary for the consideration of this case [23].

Australian incident monitoring system (AIMS) - Australia

The Australian Authority for Patient Safety (APSF) is an independent non-profit organization dealing with issues patient safety, who developed and implemented the system. AIMS is a web-based electronic reporting system for collecting data on medical problems and potential incidents (related and non-drug incidents). It is designed for data collection, classification and analysis within the system in a single standardized format. AIMS collects events and allows notifiers to categorize them and provide detailed analysis; Allows anonymous, confidential and public appeals; potential incidents, forensics and health and safety reports. The main distinguishing feature of the system is the presence of two main work modules [24]:

- - Hospital Incident Notification: This information from the software is stored in the health department and a series of reports is generated from it to help medical organization leaders identify problems;
- - Tracking the incident. The system collects data from all organizations to create a common database that allows data to be compared between healthcare facilities. Data is identified and aggregated with the ultimate goal of defining prevention and solution strategies.

National Reporting and Training System (NRLS) - England

The NRLS was established in 2004 with the aim of promoting a culture of open communication and a process of learning about the problems that arise in the treatment of citizens. The main features of the system [25]:

- The requests in the system are anonymous, neither the patient nor the specialists associated with the problem have been identified;
- The statistical analysis of the NRLS determines the scale and severity of the identified problems in the area, and only they become the basis for future work; this system practically does not consider individual cases;
- At the exit from the system, one report is generated in two parts: the first part, training for hotline employees and doctors, shows statistics with the most frequent cases of calls and forms regulations on how to respond to them. The second part describes the results the impact of the incidents described, their severity, the location of the incident, the description of the incidents in each area of the application (primary care, pediatric care, ambulance).

Situation in Russia

The situation in Russia is at the moment, and Russia does not have a specialized IT solution that is associated with processing requests and analyzing them. But there are many state and non-state companies that keep records of such complaints and use various methods for processing, consider the work of the main Medical State Organization, which has a department responsible for processing medical appeals.

3 DESCRIPTION OF THE RESEARCHED OBJECT ACTIVITIES AND PROBLEM STATEMENT

3.1 Characteristics and organizational structure of MIAC

Currently, the digital transformation of healthcare is one of the key factors in the strategic development of Russia within the framework of the Digital Economy of the Russian Federation program. The implementation of the concept in the field of digitalization of healthcare is carried out through several government initiatives and programs, the most important of which are the following [26]:

- improving the processes of organizing medical care through the introduction of information technology";
- development of state information systems in the field of health care.

For these purposes, the government formed the State Budgetary Healthcare Institution "Medical Information and Analytical Center". This tasks realized by organizing, on the basis of modern computer technologies, an inter-sectoral system for collecting, processing, storing and presenting information, which provides a dynamic assessment of health status and information support for decision-making aimed to improve it. The institution carries out the following activities [27]:

- organizational and methodological guidance on the formation of a unified health care information system at the level of St. Petersburg and Leningrad Oblast, the creation and maintenance of automated health care management systems;
- coordination of the activities in medical statistics services in St. Petersburg and Leningrad Oblast and medical statistical support for health authorities;
- formation and support of state and sectoral statistical reporting in the field of health care in St. Petersburg and Leningrad Oblast;
- analysis of medical and statistical information on the state of health of the population and health care in St. Petersburg and Leningrad Oblast;
- improving the efficiency of using the information infrastructure of healthcare in St. Petersburg and the Leningrad Oblast;
- study and forecasting of processes and phenomena associated with human health;

- preventive focus and activities for the formation of a healthy lifestyle among the population of the St. Petersburg and Leningrad Oblast;

Let's move on to considering the organizational structure of the St. Petersburg State Budgetary Healthcare Institution "MIAC", that shown in Figure 1.

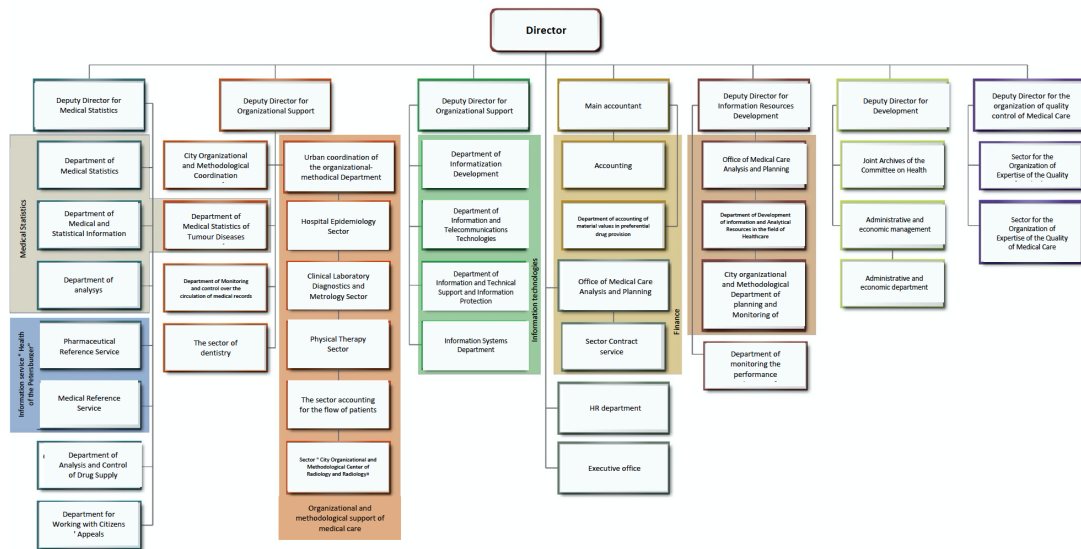


Fig. 1. Organizational structure of SPb SBHI "MIAC". [27]

The structure of GBUZ "MIAC" includes the following functional and structural divisions:

- Unit responsible for maintaining medical statistics;
- department responsible for organizational support of health care institutions;
- division responsible for information technology;
- department responsible for finance and human resources;
- department responsible for the development of information resources;
- administrative division;
- the unit responsible for the organization of quality control of medical care;

This thesis will examine in detail the activities of the unit responsible for the maintenance of medical statistics. And, more precisely, the department that goes into it, which deals with work with citizens' appeals for medical care

3.2 Descriptions of the activities of the department for work with citizens' appeals

The main task of the department for work with appeals (DWA) is ensuring registration, timely and high-quality consideration of applications and complaints of citizens. As well as consultation citizens on problems and issues that arose when receiving medical care in institutions of St. Petersburg and Leningrad Oblast. Organization and adoption of measures based on information received from citizens, as well as reporting in order to improve the quality of services provided in medical organizations. Functions performed by Department for Working with Citizens [27]:

- Conducting consultations of citizens, their legal representatives and other organizations who applied in writing, in person or by phone on the organization and provision of medical care in St. Petersburg;
- timely consideration letters and appeals of citizens, that received by the institution and the Healthcare Committee of the Government of St. Petersburg on the implementation of their legal rights to medical care. Preparation of responses to applicants;
- informing the population on issues of medical and social assistance within the administrative borders of St. Petersburg;
- providing information about the addresses and phone numbers of medical institutions that provide free medical care in the scope of the Territorial Program of state guarantees of compulsory medical insurance;
- informing the population about the procedure for providing and types of free medical care provided by health care institutions in the scope of the Territorial Program of state guarantees of compulsory medical insurance;
- provision of information on the procedure and types of medical services provided by public health institutions to citizens of St. Petersburg on a self-supporting basis.
- preparation of information for making managerial decisions based on the analysis of data on citizens' claims to the quality of medical care in hospitals in St. Petersburg;
- interaction with scientific, medical, public and other organizations on the protection and provision of citizens' rights to quality medical care;
- providing methodological, advisory assistance, information support and coordination of the work of state healthcare institutions of St. Petersburg in improving the reporting system on citizens' claims to the quality of medical care;
- participation in the preparation of orders, directives and other regulatory documents of the Health Committee on issues related to the activities of the department;

- participation in citywide organizational events held in the format of issues of quality of medical care;
- keeping records and providing established reporting forms on the issues of dissatisfaction with the quality of the organization and provision of medical care in St. Petersburg.

3.3 Normative documents that regulating the main activities of the DWA

Like any activity, the medical sphere is regulated by a number of laws, projects, documents at the state level. Also, there are documents and charters adopted at the level of the department for work with appeals. In addition to the project on digitalization of the economy, which includes the development of the health sector and the project of the Ministry of Health of the Russian Federation "Improving the processes of organizing medical care through the introduction of information technologies", it is necessary to mention other basic laws regulating medical activities, and the collection of appeals, in particular [26]:

- Constitution of the Russian Federation. Article 41;
- federal Law of November 21, 2011 No. 323-FZ "On the Fundamentals of Health Protection of Citizens in the Russian Federation.";
- federal law from 30.03.1999. No. 52-FZ "On the sanitary and epidemiological welfare of the population.";
- federal law of November 29, 2010 No. 326-FZ "On compulsory health insurance in the Russian Federation.";
- federal Law of 12.04.2010. No. 61-FZ "On the Circulation of Medicines";
- resolution of the Government of the Russian Federation of November 12, 2012 N 1152 "On approval of the regulation on state control of the quality and safety of medical activities.";
- federal Law "On Personal Data" from July 27, 2006 N 152-FZ;
- federal Law "On Technical Regulation" December 27, 2002 N 184-FZ;
- federal Law "On the Fundamentals of Health Protection of Citizens in the Russian Federation" dated 21.11.2011 N 323-FZ. [16];
- documents used directly by DWA:
- order of the Health Committee of 11.12.2006 No. 522 "On the organization of a telephone hotline";

- order of the Health Committee dated October 14, 2013 No. 407-r "On Amending the Order of the Health Committee dated December 11, 2006 No. 522-r" On the organization of a telephone hotline;
- order of the Health Committee dated December 14, 2015 No. 588-r "On amendments to the Order of the Health Committee from December 11, 2006 No. 522-r" On the organization of a telephone hotline ";
- order of the Health Committee from 13.08.2013 "On approval of the temporary procedure for the provision of electronic services to state institutions under the jurisdiction of the Health Committee for the provision of information on drug provision for certain categories of citizens entitled to receive state social assistance in the form of a set of social services ";
- federal Law No. 59 from April 21, 2006 "On the Procedure for Considering Applications of Citizens of the Russian Federation";
- order of the Health Committee of November 27, 2014 No. 844-r "On Amending the Order of the Health Committee of April 26, 2006 No. 174-r" On expanding the functions of the City Health reference service;
- order of the Healthcare Committee of 16.04.2008 No. 199-r "On amendments and additions to the order of the Health Committee of 11.12.2006 No. 522" On the organization of a telephone hotline ";
- order of the Healthcare Committee of St. Petersburg dated September 26, 2007 No. 492-r "On approval of accounting and reporting forms for working with citizens' appeals and instructions for filling them out";
- order of the Healthcare Committee of August 18, 2017 No. 267-r "On approval of accounting and reporting forms for working with citizens' appeals" and instructions for filling them out.

3.4 Analysis of main business processes AS-IS

After analyzing the activities of the investigated object, including the main documents, regulations and business processes, the need for an automated solution for high-quality business activities was identified. At the moment, most of the tasks in the department are performed manually.

During the analysis of the department's activities, the following main business processes were identified:

Processing appeals. (Registration of citizens' appeals, transmission of appeals to medical organizations and control of the received response) ;

consulting citizens by telephone hotline;

formation of reports on the work of the department.

Each process involves participants who works directly in the department for work with appeals of the MIAC (hotline, DWA operator), and external participants (MO Operators, district healthcare center (DHC) Operators, citizens-applicants, and others). Let's consider each business process separately.

3.4.1 Processing appeals.

Department for work with appeals process participants:

- Hotline operator - is engaged in registration appeals from citizens and transferring them to medical organizations;
- the operator for work with appeals - is engaged in monitoring the response from the medical organization.

External participants:

- citizens of the Russian Federation wishing to leave an appeal;
- operator of a medical organization - a person in the MO (chief physician, administrator, ...) responsible for processing citizens' appeals in his organization;
- district healthcare center operator - a person in DHC (Polyclinics and some other medical organizations are under control of the district health department, and all legal issues must be resolved through it.), responsible for processing citizens' appeals in their district.

Description of the process, the process diagram is shown in the figure 2:

Citizen's actions:

1. The citizen wants to leave an appeal for medical services that he received in a medical organization of St. Petersburg.
2. A citizen submits an appeal using one of the following options:
 - Written to the mail of the department for work with appeals;
 - e-mail to the department for work with appeals;

- oral by phone of the hotline of the department for work with appeals.

Hotline operator actions:

3. The hotline operator enters received information about the appeal into the Registration Form No. 2-OG (an example of the form in Appendix 1). Information is entered in a word document. Basic information, without which the appeal is not considered: the name of the applicant, the medical organization on which the appeal is forming, gender, district and address (the street is enough) of the applicant.
4. The hotline operator checks the entered information, prints out the document and then checks the affiliation of the medical organization to DHC. For finding this information, operator uses a pdf document, where the key combination “ctrl + f” searches for a medical organization.
 - If the MO belongs to DHC, the hotline operator puts the printed document in a paper folder named DHC+ name of the DHC» and also saves electronic version on the server in the folder with the current day and this DHC. Further, by e-mail, the hotline operator redirects the file with an appeal to the e-mail of the district health department to which the medical organization belongs;
 - if the MO does not belong to DHC, the hotline operator puts the printed document in the Health Committee folder and saves it on the server in the folder from the current day, then by e-mail it redirects the file with the appeal to the e-mail of the medical organization.
5. The hotline operator enters information about the registered appeal in the reports, Appendix 2, 3.

Actions of DHC operators:

6. Upon receipt of the complaint, the DHC Operator must arrange for a review and inform the applicant if it's necessary. And be sure to enter information about the actions taken in the registration form on the server. Informs DWA operator via e-mail.
7. If for any reason the DHC operator cannot form a response by himself, then he forwards the letter received from the hotline operator to the MO. Waits for a response from the MO operator and only after receiving an appeal and response, if the response suits him, he enters the information into the form file on the server and informs the citizen.

Actions of MO operators:

- ### DWA Operator Actions:

-
- The diagram is a swimlane process map divided into three horizontal lanes: Citizens, Appeals Management, and Appeals Processing. It details the steps from a citizen's initial appeal to the final outcome, including various decision points and feedback loops.
- Citizens Lane:**
 - Starts with a green circle labeled "Citizens".
 - Activity: "Make call to the hotline".
 - Decision: "Appeal can be by email?".
 - If "Yes", it goes to "Send an appeal by email".
 - If "No", it goes to "Send an appeal by mail".
 - Appeals Management Lane:**
 - Activity: "Appeal received" (green circle).
 - Activity: "Fill in the form by CG" (red circle with a stop sign, indicating a problem).
 - Activity: "Print the form".
 - Activity: "Markedly check, a MO sends to the DMC".
 - Decision: "Appeal is OK?".
 - If "Yes", it goes to "Save in the folder with the name of MO".
 - If "No", it goes to "Save in the folder with the name of DMC".
 - Activity: "Send appeal to the DMC by email".
 - Activity: "Send appeal to the MO by email".
 - Activity: "Contribute information to reports".
 - Ends with a red circle labeled "Appeal registration process end".
 - Appeals Processing Lane:**
 - Activity: "Appeal received" (green circle).
 - Activity: "Carry out checks, prepare a response" (green circle).
 - Activity: "Send appeal and response to the DMC by email" (green circle).
 - Activity: "Carry out checks, prepare a response" (green circle).
 - Activity: "Send appeal and response back to the DMC by email" (green circle).
 - Activity: "Carry out checks, decide if the appeal provides a response" (green circle).
 - Decision: "Can provide response?".
 - If "Yes", it goes to "Prepare response".
 - If "No", it goes to "Send appeal to the MO by email".
 - Activity: "Send appeal and response to the DMC by email" (green circle).
 - Activity: "Check response from MO" (green circle).
 - Decision: "Appeal is OK?".
 - If "Yes", it goes to "Send appeal back to MO by email".
 - If "No", it goes to "Check response from DMC".
 - Activity: "Check response from DMC" (green circle).
 - Decision: "Appeal is OK?".
 - If "Yes", it goes to "Print appeal".
 - If "No", it goes to "Check response from DMC".
 - Activity: "Prepare documents for analysis and reporting" (green circle).
 - Ends with a red circle labeled "Appeal processed".

Process problems:

- 27

- a huge amount of information is duplicated due to the need for constant re-saving and retyping of the form, the operators of MO and DHC often resubmit the forms.
- the hotline operator is forced to manually form the route of appeal, by searching the MO in the list, as a result appeals often fall to the wrong address.
- monitoring the fulfillment of the scheduled deadlines is practically impossible, which is why most of the participants in the process are negligent in the performance of their duties
- large costs for the salaries of operators to work with appeals, due to the need for a large staff to analyze and filter the receiving data.
-

3.4.2 Consulting citizens by telephone hotline.

Internal participants of the process:

- Hotline operator - are engaged in consulting citizens on issues that arise during treatment;
- DWA operator - collects results from all operators, generates a final report.

External participants:

- Citizens wishing to use the telephone consultation;

Description of the process the process diagram is shown in the figure3:

Citizen's actions:

1. Citizen has a need to get advice on issues about receiving medical care in institutions of St. Petersburg.
2. Citizen calls the MIAC hotline.
3. Hotline operator actions:
4. The hotline operator provides the necessary information to the citizen.
5. The hotline operator enters information about the type of conducted consultation in the personal report provided in Appendix 2.

DWA operator

6. The DWA operator collect all data from different HL operators and make final report.

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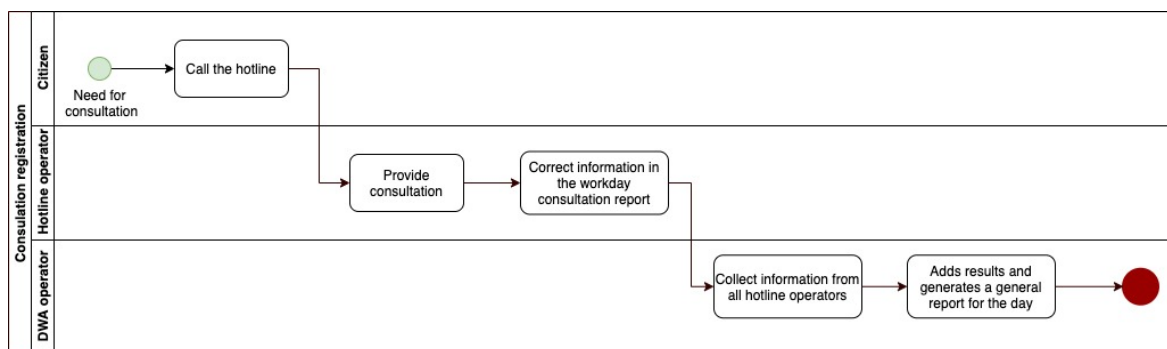


Fig. 3. AS-IS consultation processing process.

Process problems:

All information is entered manually in Google docs or MS Office tables and documents, which causes errors and leads to difficulties in the analysis and processing of the obtained data. Also, it is necessary to additionally collect summary information

3.4.3 Formation of reports on the work of the department.

Internal participants of the process:

- Chief operator for work with appeals - distributes blocks with MO types for ordinary operators, generates a final report;
- regular operators for work with appeals - fill out report blocks;
- operators for work with appeals - are engaged in the collection and formalization of data for responsible types of medical organizations about the received appeals.

Description of the process, the process diagram is shown in the figure 4:

Actions of the main operator on handling appeals:

1. After each month, the main operator collects information from all tables with daily reports.
2. Requests information from operators who did not provide it on time.
3. Divide blocks of responsibilities (by type of medical organization: hospitals, polyclinics, children's medical institutions, counseling and private centers, maternity homes and antenatal clinics, pharmacies, sanatoriums) between other operators

Actions of other operators:

4. Operators manually enter information on their block in a special 'Excel report.

Main operator actions

5. Collects data from each operator, checks it and enters into the final report

- *Description of the report:* The first page of the report is the title page. The second page is the dynamics of appeal for the month (a histogram for comparing the total number of complaints and consultations in comparison with the same period last year). The third page is table with the structure of all appeals and consultations. Fourth - (pie chart with the ratio of all reasons for consultation). Then there are 28 pages of the report, divided into blocks of 4 pages for each type of medical organization: Information (a table with the number of complaints for each medical organization in the context of the reasons for complaints and their validity), dynamics (a histogram for comparing the number of complaints against a medical organization in comparison with a similar period last year), structure (pie chart with the ratio of causes of complaints for this type of health care), Measures taken (Table with the number of measures taken in the context of medical organizations of this type). Finally, at the end of the reports, there is an auxiliary page on which data is entered for the formation of graphs. An example of report forms is shown in the appendix 4.

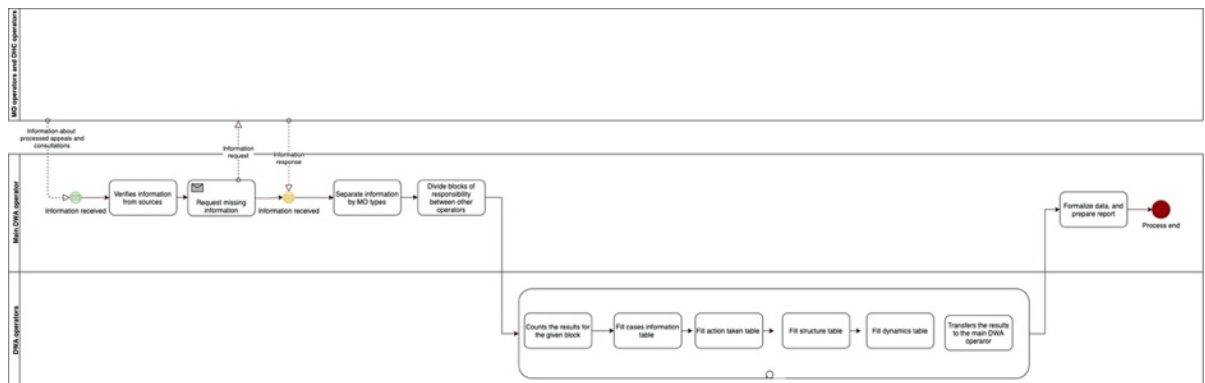


Fig. 4. AS-IS reporting process.

Process problems:

- All data for the report formation is based on daily reports, as well as on the basis of the location of the cards filled in at the stage of processing the appeal by the MO and DHC operators, which leads to losses and duplicates of information, and the quality of the information provided is low
- all pre-calculations and groupings of the received data are performed manually by the DWA operators on a calculator / Excel and other manual and semi-automated methods, that is why there are a lot of errors;

- all tabular blocks are filled in manually, while some of the information has to be duplicated in a different format to fill in the auxiliary table and create graphs;
- the time for filling out the report can be up to two weeks during periods when a large number of complaints are received and about 3-5 days with a normal load.

3.5 Statement of tasks for the automation of MIAC activities

To solve these problems, it was proposed to use an automated bug tracking and document management system. The system should monitor the effective organization of the activities of state and municipal health care institutions in St. Petersburg and ensure:

- Personalized accounting of citizens' appeals, including problems that arose when receiving medical care;
- systematization and analysis of citizens' appeals;
- accounting and analysis of measures taken by the heads the medical organizations on the issues raised by the applicants;
- control of the volume, as well as the timing of consideration of appeals;
- standardization and unification methods for collecting and processing information received from citizens;
- monitoring of citizens' satisfaction with the activities of medical institutions.
- automation of document flow between participants in the process of consideration of the application;
- automation of control and analysis of the results of the activities carried out in MOs based on the results of consideration of appeals;
- automation of planning, management and evaluation of the activities of services dealing with citizens' appeals;
- analytical processing of poorly ordered information based on the results of citizens' appeals in order to bring it to a standardized and / or unified form.

3.6 Formation of general requirements for an appeal processing system

Since in the process of processing applications, data is exchanged between users with different access levels and areas of responsibility in the system, a clear role model

should be provided. The role model should provide for 4 main roles - the main participants in the appeal processing: Hotline Operator, MO Operator, DHC Operator, DWA Operator. And also three additional ones: Administrator (responsible for managing the system, the bug tracking system should give the administrator the ability to configure access rights to appeals, that is, which users can view and edit appeals depending on their state, as well as transfer them to another state or delete them [32]), Controlling user (user responsible for the compliance of regulations - prosecutor's office, health committee), User of third-party systems (user leaving an appeal on the portal).

To determine the necessary functions, participants in the existing process were interviewed. The based received information, Use Case diagrams were drawn up for each of the roles. Use cases give a structured way of capturing the behavioral requirements of a system, so that you can reasonably create a design from them. They help you to answer some fundamental questions: What are the users of the system trying to do? What's the user experience? [30] Use Case - is a scenario technique for describing an interaction. A use case can both describe a user requirement and a description of people and companies in real life. [31]

The figure 5 shows the Use Cases for the main roles. The figure 6 shows the Use Cases for the additional roles.

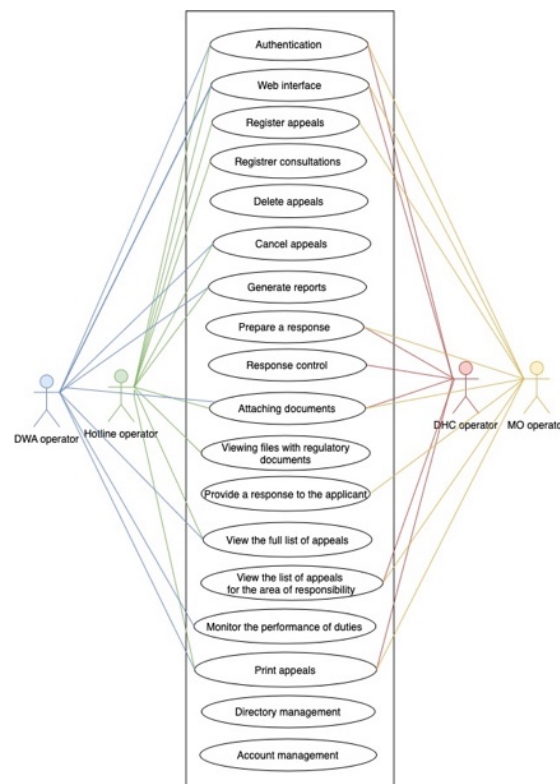


Fig. 5. Use Case of the necessary functions for the main roles.

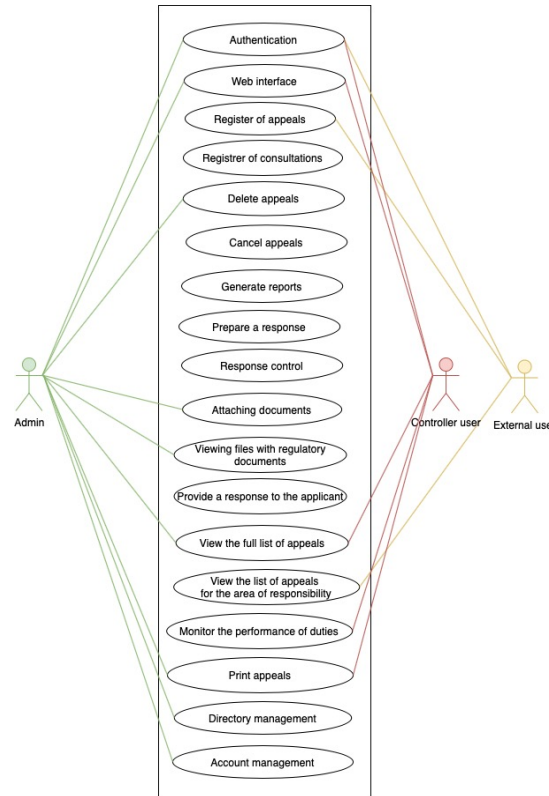


Fig. 6. Use Case of required functions for additional roles.

During the analysis of use cases, as well as collecting requirements from stakeholders, a list of the functionality required in the system was compiled:

- Users must be able to enter the system using the login + password combination stored in the system database;
- all users, except for a user of a third-party system, must have access to a web interface with elements that depend on the user's role;
- the system administrator must be able to create / edit users. In addition, rights must be added for each function in the system in order to be able to enable additional rights to the particular role;
- managing directories - the system administrator should be able to add / edit medical organization, DHC, reasons for contacting and consultations directories in the GUI of the system. In addition, it should
- be possible to upload the MO directory from the resources of the Netrik terminalology service;

- when registering an appeal in the system, it should be possible to use the address reference of SPB and LO for the correct entry of the address in accordance with legal norms;
- the system should have clearly regulated routes along which the appeal follows, depending on the type and source;
- in some cases, under one legal entity. Several MOs can work as a one legal entity, in such cases one operator responds on appeals to all controlled MOs. It is necessary to develop a mechanism in which the operator sees which particular MO the citizen is complaining about. Since at the moment the hotline operators do not always know about the existence of subordinate organizations;
- in the system, the user should have access to appeals that are in his area of responsibility;
- the system should have able to create an appeal in accordance with the form No. 2-OG;
- the system must have functionality that allows you to attach files to appeals and responses;
- the system should be able to quickly find and print the required appeal in the format of the form No. 2-OG;
- the system should be able to register the facts of consultations for the subsequent preparation of a report in the format shown in Appendix 2.
- the system should provide mechanisms for processing the appeal and preparing a response, in which the appeal can be redirected many times to the previous stages of processing. In this case, all interactions should be recorded in the comments;
- the system should provide for the possibility of using a qualified electronic signature based on Crypto PRO CSP 4.0 format;
- the system must have a mechanism for notifying the participants in the process about new appeals and coming to the end of the processing time;
- the system should have a mechanism for monitoring the work and implementation of the operator's regulations;
- the system should be able to use the embedding of the interface into other systems of the information and analytical center;
- the system should have mechanisms for integration with other systems, in particular with the Internet portal "Health of St. Petersburg", while all appeals coming from

third-party systems must have a route different from the standard ones (without the participation of DHC and DWA operators).

Non-functional system requirements:

- The system should be accessible only from the internal network of the information and analytical center;
- the system should work on the most commonly used browsers (Chrome, Opera, Mozilla) ;
- the ability to operate through the mobile browser Chrome;
- estimated number of users of the system - 400 people;
- the total cost of the system costs should not exceed 7 million rubles per 3 years of use, and not more than 1 million per year next 3 years;
- the system should use a MySQL database or similar syntax so that the system administrator in the information analytical center can easily edit / upload the necessary information;
- the system should have simple intuitive interface with minimal elements;
- it should be possible to check for errors in the entered values, check the conformity of the types of input information, input templates (for example, a mask for entering a phone number).

3.7 Review of existing solutions

For comparison, we will consider such bug tracking systems as Atlassian Jira, Redmine and YouTrack. The systems will be compared in terms of such parameters as:

- A set of information related to the processing of tasks (appeals) that are in the system;
- methods of user interaction with the system;
- compliance with the formed requirements.

Atlassian Jira is a commercial bug tracking system developed by Atlassian. The system is created in the Java language and is a client-server software delivered both to be installed on the company's server and in the form of a cloud solution. The system allows you to build work stages, build workflows, use reporting tools, project monitoring [32].

JIRA standardly allows you to build the following types of reports - repayment diagram, sprint report, performance diagram, report on generated and resolved requests, and others [33]. Because JIRA is, first of all, a bug tracking system that is focused on contacting users

involved in the development of IT solutions, and not for the civil sector, the main unit of the system is a defect lifecycle tracker.

A standard task consists of such fields as: Project, Request Type, Subject, Author, Description. In addition, it is possible to customize fields, add auxiliary fields, and create custom field views. At this time, JIRA is focusing on projects that are developed using flexible methods and as a standard creates projects with ready-made workflow and report templates. JIRA can highlight configurations - several settings for task transitions, behavior, field visibility, status sets, and more. JIRA uses SOAP and REST protocols to integrate with external services.

In addition, the API makes it possible to include in the response extended data about the object, settings for page-by-page queries and sorting. To increase the main internal resources, JIRA can offer a plugin system, which is based on OSGi technology, which allows you to connect java libraries with the jar extension as plugins. JIRA can provide the Atlassian SDK library to create modules. The plugin development stage is that the creator can override the class and implement the interface provided by the Atlassian SDK. Then, using the xml schemas provided by the SDK. extend the JIRA web interface and run on the server where JIRA is running. The Atlassian SDK system only implies an increase in the main resources of JIRA and cannot provide the ability to apply information from other extensions. OSGi granularity is often used to to implement modular systems. It can allow you to assemble applications from elements that are linked through services.

The scope of use of such a specification is quite wide: at the beginning it was developed for creating embedded systems (including for machines), but now on the basis of OSGi it is possible to develop universal stand-alone desktop applications (for example, the Eclipse SDK), corporate systems. JIRA can provide a wrapper over OSGi, the user of the modular system uses the interfaces provided by the Atlassian SDK and xml configurations, the schema of which can be defined by the JIRA modular system. JIRA's modular system, in addition, allows you to write plugins with the creation of REST APIs and servlets for them. In 2020 JIRA released their help-desk solution. Approximate price on Jira based on 400 users 190,000 rubles, per month.

Bug Tracking System Redmine - is a software that is delivered like web applications. The main focus of Redmine is error tracking, but auxiliary properties are also implemented, for example, Gantt Chart, project forums, file management, user fields, integration with version control systems, development of tasks by email, and more [34].

There is also an integration with documentation tools - built-in wiki engine, email consolidation, calendars, export to pdf, xls, as well as a standalone solution to work help desc. Maintaining the management of the system by a set of http requests - REST API and can provide access to such types of objects as: Tasks, Projects, Participation in projects, Users, Temporary events, News, Relationships between tasks, Versions, Wiki pages, Saved requests, Attached documents, Task statuses, Task trackers, Enumerations, Task categories, Roles, Groups, Custom fields. Also has some plugins but their number is many times inferior to Jira and independent writing plugins is much more difficult. Approximate price based on 400 users 70,000 rubles. per month.

YouTrack - software produced by JetBrains, is a bug tracking system, with admission as an online service. In it, you can carry out a full-text search for tasks.

YouTrack implements Scrum and Kanban methods, so the main functional resources are tailored for working with IT solution models and poorly structured for working with other business attributes. YouTrack can provide the ability to customize workflows. Unlike JIRA and Redmine, it cannot provide an opportunity to extend the main resources with plugins. There is a REST API that provides access to such types of objects as: Tasks, Projects, System Users, Groups, Roles, Permissions, Relationships between tasks, Statistics, Custom fields [35].

YouTrack has the ability to integrate with many JetBrains tools. In the area of reporting, YouTrack can bypass the typical version of JIRA, but not able to be expanded for absolutely any needs. YouTrack can provide access to 18 types of reports, divided into groups such as: Issue distribution, Timeline, Time management, State transitions, etc...

3.8 Justification of expediency to develop own solution

While reviewing the main players in the market for bug tracking systems, it was revealed that YouTrack is completely unsuitable for the needs of the appeal department. This product does not have the ability to expand the standard functionality and has a clear link to the IT sector and the management of projects using flexible methodologies.

The JIRA solution has the ability to create own solutions on its basis, and also has a ready-made solution for HelpDesc, which, in essence, is the necessary system. But the problem is in the price of the solution, because only a 3-year subscription for 400 users costs about 6.8

million rubles, which is already 95% of the maximum budget. While the development and configuration of plugins can reach an even greater amount, than the subscription price itself. The Redmine solution has a much more humane price of about 2.5 million rubles for 3 years of use, it also has the ability to integrate through the API, but at the same time it has much less opportunities for self-configuration and a limited set of plugins.

After analyzing all the systems, it becomes clear that one way or another in the basic functionality they are tailored for working with IT sectors and do not fit the requirements put forward by stakeholders. So, it is not possible to implement the routes, and not the appointment of a responsible executor, as is done in conventional bug tracking systems. And although theoretically it is possible to add plugins for these bug tracking systems, but it is much more correct and cheaper to develop a solution tailored directly to the specific needs of the appeals department. It will be much cheaper, faster and the most important final solution will be much more understandable for ordinary users than heavily modernized software that is not intended for this. In addition, the Medical information and analytical center is financed from the state budget, and it is much easier to obtain funding for the development of a domestic solution in the healthcare sector than for the purchase of a foreign one with subsequent modifications.

4 SYSTEM DESIGN

4.1 User classes and their characteristics

The system provides for a rigid role model, where the user's rights completely depend on the role assigned to him. The role is assigned to the user by the system administrator in the user settings. Role rights are set by the administrator in the role settings. There are 7 roles available in the system, the description of the roles is presented in the table 1.

Table 1. Roles, that defended in the system.

Role	The main tasks of the user in the system
Admin	Creation and editing users; Directory management; Removal of erroneous and invalid appeals. Also, the user has all the other functionality that exists in the system. In the work of the administrator, the rest of the functionality is not used, but they can be useful for testing and troubleshooting.
Hotline operator	Registration appeals; Providing consultations; Search and view the complete list of appeals; Cancellation appeals; Reporting formation.
Medical organization operator (MO operator)	Creation of appeals to controlled medical institutions; Preparation of responses to appeals to controlled MOs; Search and view the list of appeals for controlled medical institutions.
District health center operator (DHC operator)	Preparation of responses to appeals to controlled MOs; Redirecting appeals to controlled medical institutions; Control of responses to appeals from controlled MOs;

	Search and view the list of appeals to controlled medical institutions.
Operator of the department for work with appeals (DWA operator)	Control of responses to appeals received from MO and DHC; Control of the timing and quality of implementation of regulations Reports formation; Search and view the complete list of appeals.
Controller	Search and view the complete list of appeals. Control of the timing and quality of implementation of regulations
API user	Creation of appeals; Search and view the complete list of appeals. <i>The main feature of this user is the lack of access to the system's GUI; all user interaction with the system is carried out through the API interface.</i>

4.2 Description of technical and software

For database servers, the MariaDB DBMS 10.3.- branch from database management systems MySQLcommunity developed under license GNU GPL... MariaDB is developed and maintained by MariaDB Corporation Ab and the MariaDB Foundation[37].

The operating system is Ubuntu Server 15.04 - a powerful server platform, the main advantages of which are security and availability [38]. All components of the system, including the source code, are distributed with a license for free copying and installation for an unlimited number of users.

On servers, web applications are used:

- Operating system: Ubuntu 18.04;
- web servers: apache2, nginx, PM2.

Available technical characteristics of the server side:

- 8 vCPU 2.8 GHz;
- 16 GB RAM;
- 20 TB HDD RAID SAS;

The client part is implemented as a web application. Users can use any client device that supports the following browsers:

- Google Chrome 75.0 and later;
- Opera 62 and later;
- Mozilla Firefox 60 and later;
- MicroSoft Edge (Windows only).

Development tools:

- HTML - HTML (from the English HyperText Markup Language - "hypertext markup language") is a standardized markup language for web pages on the World Wide Web [39] ;
- PHP - it is a common open-source general-purpose programming language. PHP is specially designed for web development and its code can be embedded directly into HTML [40] ;
- TypeScript- programming language introduced by Microsoft in 2012 and positioned as a web application development tool that extends JavaScript [41].

4.3 Description of automated functions

Authentication function

The "Authentication" function provides the ability to use the GUI and data processing mechanisms designed to identify and authenticate users in the system. The function is available to a user who has an account in the system created earlier by the administrator. User identification and authentication is done through web-interface of the system by comparing the login and password entered by the user with those specified in the user account. The URL (web address) of the web interface is provided to the user by the system administrator. No data or functions of the system are available to the user without passing identification and authentication. The list of fields for the authentication form is presented in the table 2, the list of controls for the authentication form is presented in the table 3.

Table 2. List of input fields for user identification and authentication form.

Name	Data type	Note
E-Mail or Login	text	<50 characters
Password	text	> 8 and <50 characters

Table 3. List of controls for user identification and authentication form.

Name	Type	Acion
To come in	Button	Login to the system
Remember me	Checkbox	Save registration data for re-entry without re-entering this data

After successful identification and authentication, the user becomes available to the data and functions of the system corresponding to his access rights, which are determined by the attribute "Role" of his account.

Function User GUI

The function provides the ability to use the GUI, which is available to users after working out the "Authentication" function and provides mechanisms for data processing. Access to system data is provided in accordance with the user's role. The system's web user interface provides the following features:

- Viewing the list of appeals;
- filtering and sorting the list of appeals by the following parameters: appeal status; type of appeal, way of handling, type MO, applicant FULLNAME;
- search for appeals by the following parameters: registration number of the appeal; date of creation of the appeal; name of the MO; applicant FULLNAME;
- viewing the selected appeal from the list;
- printing out registration cards of appeals according to the above filtering parameters;
- creating and editing appeals
- preparation of responses
- setting up users and directories;
- reports generation with a breakdown by medical organization or by various topics and groups.

User creation function

The "Create User" function provides the ability to use the GUI and mechanisms for processing and storing data to create a new user of the system and assign him a role with a specific set of access rights. The function is available to a user authorized in the system with

“Administrator” rights. User account creation is carried out through the system web interface in the "Settings -> Users -> Add user" section. The list of rights for each of the user roles is determined by the system administrator. The list of fields for the form is presented in the table 4, the list of controls for the form is presented in the table 5.

Table 4. List of input fields for user creation form.

Name	Data type	Note
FULL NAME	text	<50 characters
Login	text	<50 characters
E-Mail	text	<50 characters
Role	list	The role defines the user's access rights. List of roles "Hotline operator", "Operator MO", "Operator DHC", "Operator for work with appeals", "Controlling User"
Password	text	> 8 and <50 characters
Password confirmation	text	> 8 and <50 characters

Table 5. List of controls for user creation form.

Name	Type	Acion
Add to	Button	Adding a user
Cancel	Button	Abort the process of adding a user

Function "Formation of a directory of medical organizations"

The function provides the ability to load and use the initial data on medical organizations into the storage area of reference data from an extended medical reference directory file in the .csv format. This directory is used for routing appeals, depending on the belonging of the MO to a particular DHC, as well as for generating reports depending on the types of MO. The directory can be viewed by a user with the "Administrator" role carried out through the WEB-interface of the system in the section "References -> MO". Structure of csv files for upload:

- Each line in the file is one line in the table;

- the separator of column values is the comma character;
- values containing reserved characters (double quote, comma, semicolon, newline) are surrounded by double quotes ("). If there are quotes in the value, they are represented in the file as two quotes in a row.

When a medical organization is selected, a form for editing the MO and attaching users opens. In the form, you can search for medical organizations according to the following criteria: MO type, DHC, Name. The list of fields for the form is presented in the table 6, the list of controls for the form is presented in the table 7.

Table 6. List of input fields for MO directory form.

Name	Data type	Multiplicity	Note
Filtering by MO type	list	0..1	
Filtering by DHC	list	0..1	List, based in DHC directory
Searching by Name	text	0..1	
Name	text	1..1	
External identifier	text		Used to update via CSV (only in edit mode)
Mo type	list	1..1	(only in edit mode)
Belongs to DHC	list	0..1	(only in edit mode)
Bound MO operators	checkbox list	0 .. *	List of linked users (only in edit mode)

Table 7. List of controls for MO directory form.

Name	Type	Acion
Add MO	Button	Manually adding MO
Load from CSV	Button	Opens a selection of a local repository for loading a list of MOs
Save	Button	Saves the MO change (only in edit mode)
Delete	Button	Deletes MO (only in edit mode)

Function "Formation of the address directory"

The function provides the ability to use the address directory when registering appeals in the web interface of the system. On the registration form of appeal, when entering data in the "Address" field, the address data entered by the user is automatically verified with those stored in the system database. The directory is formed on the database of "Federal Information Address System (FIAS)". The directory can be viewed by a user with the "Administrator" role through the system's WEB interface in the "Directories -> Addresses" section. The directory should have a clear hierarchy in accordance with the accepted standards "Settlement-> Street type-> Street-> House-> Building-> Building type-> Building". The list of fields for the form is presented in the table 8, the list of controls for the form is presented in the table 9.

Table 8. List of attributes in the address directory form.

Name	Data type	Note
Locality	text	Town/district name
Street type	text	Street/ avenue/ prospect/ square
Street	text	Street
House	int	House number
Building type	text	Building/ structure/ construction
Building	int	Building numer

Table 9. List of controls for appeal list form.

Name	Type	Action
Add a note	Button	Adds new recording

Function "Routes of the appeal"

The function "Routes of the appeal" provides the use of predefined routes-chains of processing the appeal in the system. Routes differ depending on the source of the appeal, its type and the involved participants in the process that required to prepare a response to the appeal. Thus, appeals registered through third-party systems or directly to the Ministry of Defense do not pass checks by DHC and DWA, and immediately after being processed, they

go to the archive. Moreover, they are visible in the DHC and DWA lists and can be viewed at any time. After an appeal is saved in the OWSA system, it is automatically sent along one of the processing routes. Standard appeal routes and their corresponding statuses are:

- "Registered on the hotline" -> "Sent to MO" -> "Processed" -> "Archived";
- "Registered on hotline" -> "Forwarded to DHC" -> "Processed" -> "Archived";
- "Registered on the hotline" -> "Forwarded to DHC" -> "Forwarded to MO" -> "Returned to DHC" -> "Processed" -> "Archived";
- "Registered in MO" -> "Processed" -> "Archived";
- "Registered by a external system" -> "Processed" -> "Archived"
- Scenarios with return appeals to eliminate the identified shortcomings:
- "Registered on the hotline" -> "Sent to MO" -> "Processed" -> "Returned to MO" -> "Processed" -> "Archived";
- "Registered on hotline" -> "Forwarded to DHC" -> "Processed" -> "Returned to DHC" -> "Processed" -> "Archived";
- "Registered on the hotline" -> "Forwarded to DHC" -> "Forwarded to MO" -> "Returned to DHC" -> "Returned to MO" -> "Returned to DHC" -> "Processed" -> "Archived";
- “Registered on the hotline” -> “Forwarded to DHC” -> “Forwarded to MO” -> “Returned to DHC” -> “Processed” -> “Returned to DHC” -> “Returned to MO ”-> "Returned to DHC "-> "Processed "-> "Archived ".

The scheme of processing routes predefined in the system is shown in Figure 10.

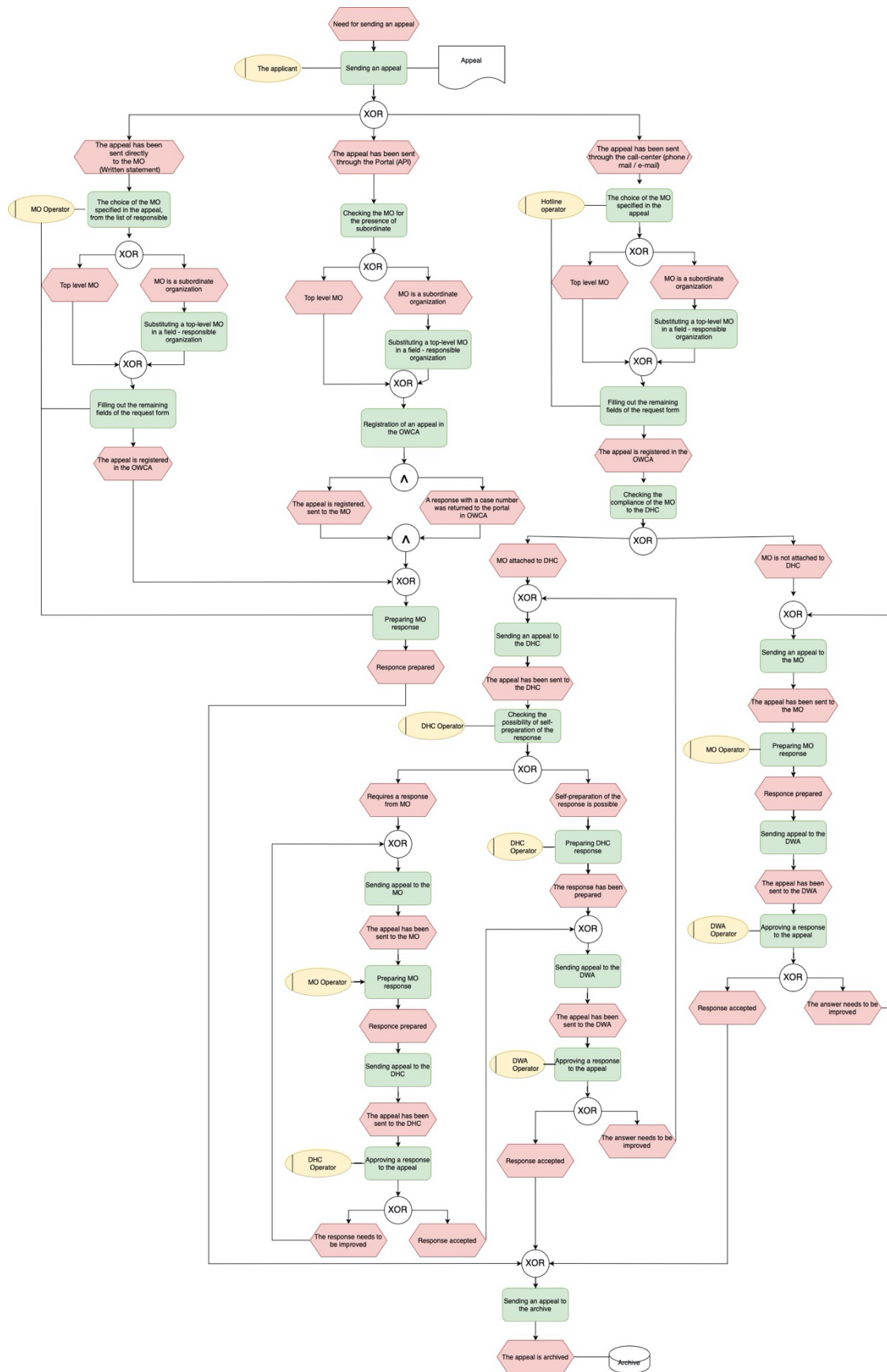


Fig. 7. Scheme of processing routes that are predefined in the system.

Responsible organization function

The function provides the ability to separate the field with the name of the organization on which the appeal was formed and the fields with the name of the responsible organization (hospital - subordinate polyclinic). The function is available to users with the roles "Administrator", "Hotline operator", "MO operator" and subordinate MO. Subordinate organizations are pulled from the MO directory of the service "Netrika Terminology". When choosing a medical organization, the second level of the list with subordinate organizations opens. After selecting the subordinate organization, the field displays comma-separated names (Main MO, Subordinate).

Function "Appeal list"

The function provides the ability to view the list of appeals that are in the user's area of responsibility. The details of each appeal are displayed in a separate row of the table. The division of the appeal list by pages is done automatically. You can navigate through the list and control the number of hits visible on the screen by changing the number of list entries displayed on the screen or by navigating through the pages. The records in the table sorted in ascending or descending order of values depending on the selected column for sorting. The sort indicator located next to the column heading, and looks like a directional arrow. You can search for an appeal by the following criteria:

- Appeal number;
- full name of the applicant;
- creation period of the appeal;
- addressed MO.

The form also provides the ability to open case selection markers to send them to the print form.

The list of fields that used in appeal list table in the table 10, the list of controls for the form is presented in the table 11.

Table 10. List of attributes in appeal list form.

Name	Data type	Note
#	Text	Appeal number
FULL NAME	Text	Applicant
A type	Text	Appeal type

Name	Data type	Note
Organization	Text	Appeal status
Date of creation	date	Date of ticket creation
Date of reply	date	Date of reply

Table 11. List of controls for appeal list form.

Name	Type	Action
Refresh	Button	Updates the list of hits
Search	Button	Opens a search form for appeal
Printing	Button	Opens hit selection markers for printing
Navigating the table	Table controls	sorting, pagination, page selection

Function "Print appeal"

The function provides the ability to simultaneously print processed appeals in accordance with the format of the form No. 2 - OG. The function is available to all users of the system. The function is implemented in two ways: printing a single appeal from the appeal view form and bulk printing of several selected appeals from the form with a list. The printing of the generated form of the appeal is carried out using the browser, in which the user works with OWCA. In most browsers, the key combination "Ctrl + P" opens a dialog box for sending an appeal to the printer.

Printing a specific appeal - the function is available after selecting a case from the list, in the form of viewing a case. Pressing the "Print" button opens the generated PDF form.

Mass printing allows users to simultaneously print one, several, or all appeals to a form that meet the search criteria. The function is available in the section "List of appeals - > Search". When user clicks on the "Print" button, selection markers appear in the list (as well as the "Select all" marker), and the button changes to "Print selected". When you click on the "Print selected" button, the selected appeals are sent to the print form.

Within the framework of MVP, only printing of a specific appeal is implemented, the function of mass printing will be developed in the second version of the system.

Function "Appeal Registration"

The function provides the ability to use the web interface to register an appeal. The function is available to users authorized in the system with the rights of "Administrator", "Hotline operator", MO operator". Registration of the appeal-complaint is carried out through the WEB-interface of the system in the section "Reception -> Add appeal".

After entering the necessary information into the appeal creation form and clicking the Add button, OWCA will save the entered data and assign a unique identifier to the appeal. Before appeal saving, OWCA performs a set of checks, including the sufficiency of the data entered to save the appeal. If the checks are successful, the appeal will be saved and a page with a list of appeals will open. In other cases, OWCA will highlight incorrect user-entered data. The list of fields for the form is presented in the table 11, the list of controls for the form is presented in the table 12.

Table 11. List of input fields for appeal registration form.

Name	Data type	Multiplicity	Note
MO type	list	1..1	Selected from a list of types
To MO	list	1..1	Selected from the list of MO names, when creating an appeal by the MO operator, only MOs are available for which he is responsible
Full name	text	1..1	<100 characters
Way of handling	list	1..1	Selected from the list of the local directory "Types of treatment (by method)" "Oral" "Written" "Electronic"
SNILS	text	0..1	
Date of Birth	the calendar	1..1	
District	list	1..1	Selected from the list of the local directory "Districts of St. Petersburg", if the applicant is not from St. Petersburg, then "not St. Petersburg"
Address	text	0..1	Introduced manually in release 1.0

Name	Data type	Multiplicity	Note
			In release 1.1, it is selected from the list of the local address directory based on the FIAS directory
Telephone	text	0..1	
Insured	text	0..1	Insurance company name and policy number.
Social status	list	0..1	Selected from the list of the local directory "Social status" pensioner, disabled, families with disabled children, resident of besieged Leningrad, disabled veteran of the Great Patriotic War, refugee, the large family, single mother (father), foreigner, child, others.
Power of attorney	Checkbox	0..1	Noted if the applicant is acting under a power of attorney
Problems and reasons for contact	Checkbox list	1..33	One or more checkboxes are marked. The list of reasons for contacting corresponds to the local directory "Types of Complaints" equal to problems in Form OG-2
Content of the appeal	Text	1..1	
Attached files	File	1..5	

Table 12. List of controls for appeal creation form.

Name	Type	Action
------	------	--------

Attach document	Button	Loading a document into the system from the user's computer
Save	Button	Saving the created appeal to the system database, Assigning the status "Sent to MO" or "Sent to DHC"
Do not save	Button	Exit to the main menu of the GUI system without saving the entered data.

Additional types of problems and reasons in the first releases of the system will be entered by the system administrator directly into the system database. In future versions of the system's development, it is planned to create a special form and mechanisms that allow using the system's GUI to edit the list of reasons for consultations.

Viewing and editing appeals is performed in a screen form similar to creation appeal form, available when viewing an appeal. To edit appeal, user need to open an appeal from the list and click the "Edit" button. The difference is that when you edit an appeal, the form is filled in automatically, with the details, that was previously registered in OWCA, and allows the user to supplement them or make changes.

The processing of an appeal can be interrupted at any stage of the route by assigning the status "Canceled" to it. This operation is available to users with the rights of "Administrator", "Hotline operator", "Operator for work with appeals". To cancel the appeal, the user need go to the "Reception" click to the "Remove appeal" control, after which a list of appeals will open with appeal search form. After selecting the case that you want to cancel, click the "Cancel appeal" control.

Attached Documents function

The Attached Documents function provides the ability to use mechanisms for loading and storing copies of documents attached to the appeal and responses to it in electronic form. Downloading documents can be performed by a user with the appropriate rights at each stage of processing a appeal by clicking on the corresponding control in the GUI. To add a file to an appeal or a response, user need to click "Attach file" in the appropriate section. The file can be deleted only by the user who added it, or by the system administrator. Function file requirements:

- The uploaded document is associated with the appeal and is available for viewing at any stage of the appeal processing;
- up to 5 documents with a total size of up to 50 MB can be attached to each appeal;
- deleting documents is allowed by users with the appropriate access rights.
-

Function "Consultation registration"

The "Consultation registration" function provides the ability to use the web interface for registration of consultations. The function is available to users authorized in the system with the rights "Administrator", "Hotline operator". To enter information about the consultation, the user needs to go to the menu item "Reception" -> "Consultation", system will open form in which it is necessary to select the type of consultation, and then press the button "Next" if the type of consultation "Hotline" was selected, or "Finish" if the type "Helpdesk" was selected. If user selects the type of consultation "Hot line" after choosing the type, user must also select the option of consultation and then click "Finish".

Additional types of consultations in the first release of the system will be entered by the system administrator directly into the system database. In future versions of the system's development, it is planned to create a special form and mechanisms that allow using the system's GUI to edit the list of reasons for consultations. The list of fields for the form is presented in the table 13, the list of controls for the form is presented in the table 14.

Table 13. List of input fields for consultation creation form.

Name	Data type	Multiplicity	Note
Consultation type	the choice	1..1	Selected from the list of types of consultations in the local directory "Types of consultations "Hot line", "Help desk"
Consultation option	the choice	1..11	Selected from the list of types of consultations in the local directory "Types of consultations;

Table 14. List of controls for appeal creation form.

Name	Type	Action
Done	Button	Saving information about the fact of consultation in the database of the system.
Reset	Button	Exit to the "Settings -> Consultations" menu without saving the entered data.

Function "Processing appeal"

The function provides the ability to use the web interface to prepare responses from the MO and DHC, control the response, and also to redirect the appeal further along the route. The web interface provides an opportunity for the user to point the measures taken in the MO to eliminate the subject of complaints, put markers on the successful provision of a response to the applicant by phone / email and the status of the validity of the appeal, attach documents to the response to the appeal.

To make the electronic document "MO/DHC response to MIAC" legal force, the functionality of signing the corresponding document with a strengthened qualified electronic signature of the head corresponding to the MO / DHC is used. The process of preparing a response in this case begins with pressing the button "Form an answer with EDS", as a result of which the document is signed with a strengthened qualified electronic signature. All users of the system who have the right to access the corresponding signed medical report are given the opportunity to print this document. Implemented information interaction with the use of CIPF Crypto PRO CSP 4.0, qualified certificates of electronic signature verification keys, made according to GOST R 34.10-2012 algorithms and providing:

- Formation of a qualified electronic signature of the data exchange file;
- verification of the qualified electronic signature of the data exchange file.

The list of fields for the form is presented in the table 15, the list of controls for the form is presented in the table 16.

Table 15. List of input fields for answer preparation form.

Name	Data type	Multiplicity	Note
Contact information		1..1	All fields filled in by the user at the stage of creating an appeal, described in the table 11.

Name	Data type	Multiplicity	Note
The complaint is substantiated	Checkbox	0..1	Complaint validity marker
The answer to the applicant is provided	Checkbox	0..1	Personal response marker to applicant
Taken measures	Checkbox list	1..21	Marker of action taken on the application
Answer	Text	1..1	
Attached files to the appeal	File	0..5	
Comment	Text	0..1	User comment on the appeal

Table 16. List of controls for answer preparation.

Name	Type	Action
Form an answer	Button	Activates the form for submitting a response without DS. After saving the answers, the button becomes inactive. To change an already formed response, you must click "Edit".
Form an answer with DS	Button	Activates the form for submitting a response with DS
Send to MO	Button	Sends an appeal to MO (only for DHC user)
Send to RZO	Button	Sends an appeal to DHC (only for DWA and MO user, if DHC is present in the route)
Send to OROG	Button	Sends an appeal to DWA (for MO and DHC users, if the next step is DWA)
Archive	Button	Sends an appeal to the archive, no further modification of the case is possible (only for DWA users)

Name	Type	Action
Cancel	Button	Sends an appeal to the archive with the "Canceled" status, further modification of the appeal is impossible, the appeal is not taken into account in reports (for DWA users)
Edit	Button	Opens the edit response form. After editing the answer, the previous answer saving to the log.

Appeal processing by the DHC operator:

Self-preparation of a response by the DHC operator -To respond to the appeal, the DHC operator clicks the "Form an answer" button, after which the "Answer" field becomes active, and the "Save" and "Cancel" buttons will appear in the place of the "Form an answer" button. To send a response to the control to the DWA operator, the DHC operator must enter the response to the appeal in the appropriate field and click "Save", then click the "Send to OROG" button. If necessary, the answer can be signed using an EDS. In case of accidental click on the field "Generate a response", you may click "Cancel"

Redirecting an appeal from DHC to MO - to redirect an appeal to the MO specified in the appeal, user pressing the "Send to MO" button on the appeal response form, after which it is possible to enter a comment to the appeal. To confirm the direction of the appeal to the MO, user needs to press the "Send to MO" button. After that, the appeal will be sent to the MO.

Control of the returned response from the MO - After the appeal is processed by the operator of the MO, it will be returned to DHC for control. While monitoring the received response, the DHC operator can:

–Edit the answer by clicking "Edit" after which the actions are similar to preparing the answer, only the answer field is not initially empty, but contains the answer entered by the operator of the MO. The text of the previous response is saved to the log of the change in the status of the appeal;

–return back to MO, in this case, the actions of the user and the system are similar to the item redirecting the appeal;

–submit control response to DWA with comment added. To do this, you must click the "Process" button, then enter a comment and click "Send to SWA".

Appeal processing by MO operator:

To prepare a response to an appeal, the operator of the MO must click on the " Form an answer " button, after which the "Answer" field will become active, and the "Save" and "Cancel" buttons will appear in the place of the " Form an answer " button. To send a response to control, the operator of the MO must enter the response to the appeal in the appropriate field and click "Save", then click the "Send to OROG" or "Send to RZO" button, depending on the next stage . If necessary, the answer can be signed using an EDS. In case of an erroneous click on the " Form an answer " field, you must click "Cancel". After clicking save, the system will automatically redirect appeal further along the route.

Appeal processing by DWA operator

After the appeal is processed by the MO / DHC operator, it is sent for control to the operator to work with appeals. In the process of monitoring the received response, the operator can:

- Edit the answer by clicking "Edit" after which the "Answer" field will become active, and the "Save" and "Cancel" buttons will appear in the place of the "Change" button. The text of the previous response is saved to the log of the status of the appeal;

- return back to MO / DHC. If the response is not satisfactory to the appeal operator, use can return it back to the responding MO / DHC. To do this, user needs to click the "Send to MO / DHC" button, after which can add a comment to the return of the appeal. To confirm the return of the appeal to MO / DHC, you must press the " Send to MO / DHC " button;

- archive. Save the appeal, response and log of statuses and comments to the OWCA archive. To do this, click the "Archive" button, after which it becomes possible to add a comment to the archived appeal. To confirm the transfer of the appeal to the archive, you must click the "Archive" button;

- cancel. Cancel the appeal. Send appeal to the archive with the status "Cancel", this status does not require a mandatory response to the applicant;

Function " Time control"

The "Time control" function provides the ability to control the timing of the preparation stages and provide answers to the applicant. The response time to the appeal is set by the system administrator in calendar days, the default value is 14. Notification templates are set by the system administrator when configuring the system. Notification is made by sending e-mail messages to the addresses of users specified during their creation. The list of possible statuses of control of the appeal period: new, response near timed out, response timed out.

Changes in statuses are made by the system automatically. Changing the status from "new" to "expiring response time" is made for the number of days set by the administrator until the day the response expires. The default value of this parameter is 3. The status of the appeal is displayed in the user GUI by color highlighting the appeals that are in the statuses "response expired" - highlighted in yellow and "response expired" - highlighted in red.

Monitoring control function

The function provides the ability to monitor the implementation of regulations by users by other OWCA users. The function is available to users with the roles "Administrator", "DWA Operator", "Hotline Operator" in the "Tasks" section. For implementation, a form with a list of appeal is used. The control is carried out by searching for appeal based on: there is / no violation, appeal number, the name of the MO, the full name of the responsible user, e-mail of the responsible.

Items in the Tasks list contain information about:

- Appeal number;
- the name of the organization at each stage of the route;
- routine and actual terms of document processing;
- the presence of violations of the terms;
- users name - participants in the business process of document processing.

This functionality is not critical for MVP and will be developed in the second version of the system.

Email Reply Function

The "Email Reply" function provides the ability to respond to the applicant at the e-mail address left by him as a requisite to the appeal. The mail message template is set by the system administrator when setting up its configuration. By default, the message should be sent only to those applicants who have formed an appeal using the service portal of a St. Petersburg resident (applications received via api). It is also possible to manually send a message from the appeal viewing interface by an operator working with appeals. The standard message template in the system looks like this:

Email subject: Reply to an appeal to a medical organization

The composition of the letter:

Hello!

You sent an appeal to the address of a medical organization * Name of MO * from the portal "Health of a St. Petersburg citizen" <https://www.gorzdrav.spb.ru/>:

Appeal No. ...

Departure date: ...

Type of appeal: ...

Message text: ...

The answer to your appeal: ...

Sender: ... (responding entity, DHC or IO)

This letter is generated automatically. Please don't answer it.

Function "Reporting Forms on Application Data"

The function "Reporting Forms on Application Data" provides the ability to form reports on the data registered in the system on the facts of receipt and processing of citizens' appeals. The system provides two types of one is using GUI for viewing the report. And more complex reports, for the formation of which it is necessary to upload data to document templates stored in the system repositories. List of reports predefined in the system, their content and formation criteria:

Hotline Operator Report - This report is equivalent to the paper report shown in the appendix 2. Filling out the report: hotline operator, number/% of the total registered complaints in the department, number/% of the total registered thanks for the department, number /% of the total for the department of consultations, number/% of the total for the department of canceled complaints.

Consultation Report - This report is equivalent to the paper report shown in the appendix 3. Report filling: type of consultation, number of consultations, % of the total number of consultations.

The report on the work of the telephone "hot line" for receiving citizens' appeals - is the main report of the system, equivalent to the report that is filled in monthly by the employees of the appeals department, which requires uploading to Excel. The list of forms of the report on the work of the telephone "hot line" for receiving applications from citizens is presented in the table 17. Example of the report in the appendix 4.

Table 17. List of report forms in Excel file.

Page	Name	Type / view	Data	Note
1	Title page		Name of the report, reporting period	
2	The absolute number of citizens' appeals for the period.	bar graph	Abscissa "Total", "Consultations", "Complaints"	Compared to the same period last year
3	The structure of appeals to the telephone "hot line" for the period in absolute numbers and the share of the number of complaints received.	Table	Values for each reason for complaints, as well as thanks and advice	Compared to the same period last year
4	Structure of consultations on thematic aspects for the period.	Pie chart	Number of consultations on consultation topics	

Page	Name	Type / view	Data	Note
Further tables by type: hospitals, clinics, children's medical institutions, counseling and private centers, genus. at home and antenatal clinics, pharmacies, sanatoriums				
5, 9, 13, 17, 21, 25, 29	Registered citizens' appeals to the "hot line" by type ...	Table	Values for each cause of complaints for each MO of a given type	
6, 10, 14, 18, 22, 26, 30.	The absolute number of complaints for the period by type ...	bar graph		Compared to the same period last year
7, 11, 15, 19, 23, 27, 31.	The structure of citizens' complaints for the period by type ...	Pie chart	Number of complaints by topic	
8, 12, 16, 20, 24, 28, 32.	Measures taken on complaints that have signs of violations of citizens' rights for the period by type ...	Table	Measure name, quantity, name of MO	

External participants function

The External Participants feature provides the ability to define the external participants required to prepare a response. Entering email address data to provide the user an individual link to the system GUI

The function is solved by providing an external participant (an employee of the Ministry of Defense or DHC, who controls the user) access to a specially formed session of the system's WEB interface to prepare a response, by using the capabilities of frames (frameset and frame HTML tags). Administrators of subsystems and portals are provided with information (system URL), using which the system GUI is integrated into the Web interface of another system or portal.

Functions "Service for receiving appeals and providing answers"

The function provides the ability to use a web service and data processing mechanisms designed to receive appeals from other REGIZ subsystems or other information systems in case the preparation of a response to a does imply an "exit" from the organization of the recipient of the request (these appeals and responses to appeals are accumulated for analytics purposes). In addition, the function provides the ability to transfer responses for processed appeals back to the systems that sent them. The function is implemented by using the REST API to exchange data with the "Internet Portal" system with the "OWCA" system in terms of transferring appeals from users of the patient's personal account of the Internet Portal to the OWCA system for subsequent processing and transmission of statuses and responses to appeals back to the "Internet Portal" system... Detailed integration logic is described in the chapter "Description of the interfaces for interaction with external systems".

4.4 Description of web interfaces

General requirements for web design:

- When developing a web interface, predominantly light styles should be used;
- The main sections of the web interface should be accessible from any page;
- The WEB interface must be optimized for viewing at a resolution of 1024 * 768, 1280 * 1024 without a horizontal scroll bar and without empty (white) fields for the main types of resolution;
- Control elements should be grouped in the same type - vertically - on all pages;

- The plug-in interface should be designed in the same style as the system kernel interface and should provide the ability to transparently move the administrator between the system modules and use the same control procedures and navigation elements to perform the same type of operations;
- The interface should use a horizontal menu, for some tabs it should be possible to use a dropdown from the menu.

Web interface elements and forms:

Authorization form - this page is available to all users of the system and is used to log in to the system. GUI example of the authentication form is presented on figure 8.

Fig. 8. An example of an authorization form.

The main menu of the system is the upper bar, that is available on all pages of the system. Some of the menu items have sub-items. To exit from the system, click the arrow next to the username and then select the "Exit" sub-item from the drop-down list. Requirements for filling the bar depending on the user's role presented in table 18, an example of the GUI form presented on figure 9

Table 17. Menu bar description.

Menu item	Available sub-items in the list	Role
Main		All (For Hotline operator = Reception, For other users = List of appeals)
Settings	–Users –Roles –MO –RZO	–Admin

	–External systems	
Directories	-Social statuses -Taken measures -Districts -Males	–Admin
Reports	Consultation report Hotline users report Complaints, sources of income and reasons for citizens' complaints Report on the work of the telephone "hot line"	
Add appeal		Hotline operator Admin MO operator
Reception		Admin Hotline operator
List of appeal		All
User name	Settings Log out	All

OROGMO

Main

Authorization

Email address or login

Password

☐ Remember me

Log In

Fig. 9. An example of the main menu form.

Form users - the form is used to view and edit users of the system. By pressing the "Add user" button, system opens form for creating new user. When a specific user is selected from

the list, a user editing form opens, similar to the creation form, but with the fields already filled in. GUI example of the user's form is presented on figure 10.

#	FULL NAME	Login	Role	Email
one	Admin	admin	Admin	
2	Seyfetdinova S.B.	seifetdinovaSB	Operator for work with calls	
3	Shevtsova Y.S.	shevcovaYS	Operator for work with calls	
four	Tregubov V.A.	tregubovVA	Operator for work with calls	
five	Golchin A.P.	golchinAP	Operator for work with calls	
6	Ismagilova L.V.	ismagilovaLV	Operator for work with calls	
7	Alekseev P.S.	alexeevPS	Operator for work with calls	
eight	Kugutina L.N.	kugutinaLN	Hotline operator	
nine	T.V. Alexandrova	alexandrovaTV	Hotline operator	
10	Belova V.I.	belovaVI	Hotline operator	

Fig. 10. An example of a user list page.

Fig. 11. Example of a page for creating system users.

MO directory - the form is used to view, edit and update the directory of medical organizations. By pressing the "Add MO" button, system opens block for entering information for a new MO opens. By selecting a specific MO from the list, a user editing form opens, similar to the creation form, but with the fields already filled in. GUI example of the MO directory form is presented on figure 12.

Editing the directory of Medical Organizations

Filtering MO

Filtering by MO type: Filtering by RZO: Search by name:

[+ Add MO](#) [Load from CSV](#)

FSBI RosNIIGT FMBA of Russia
[Medical organization of a special type](#)

SPb GBUZ "Maternity hospital No. 9"
[Maternity hospital](#)

LLC "Health Energy"
[Treatment and prophylactic medical organizations](#)

SPb GBUZ "Specialized neuropsychiatric orphanage No. 12"
[Nursing center](#) [Children's home, secondary specialized](#)

SPb GBUZ "Dental clinic No. 17"
[Pedagogical center](#) [Dental, pediatric children](#)

SPb GBUZ "CDC No. 85"
[Nursing center](#) [Innovative and drug units, including children](#)

SPb GBUZ "Medical and physical dispensary No. 3 (interdistrict)"
[Nursing center](#) [Medical and physical education](#)

SPb GBUZ "Dental clinic No. 4"

MO form

Internal identifier
1936

Name *
РЗО Пушкинского района

Unique identifier of the external directory

Type MO
▼

Type of MO reporting
▼

Belongs to RZO
Pushkin district

Bound MO operators [3](#)

[Save](#) [Delete](#)

<https://orog-prod.mobitech.ru/mo>

Fig. 12. Example of a MO manual page.

Forms of directories - these forms are intended for making entries in system directories, forms are presented in the form of tables, similar to tables stored in the system database. By pressing the "Add a note" above the system opens form for adding new note. GUI example of the directory form is presented on figures 13.

OWCA

Main

Settings

Directories

Reports

Add appeal

Reception

List of appeals

Admin

Directory - Social statuses

Add a note

#	Name	Created	Updated
one	Pensioner	2019-10-09 19:11:22	2019-10-09 19:11:22
2	Disabled	2019-10-09 19:11:22	2019-10-09 19:11:22
3	Families with disabled children	2019-10-09 19:11:22	2019-10-09 19:11:22
four	Resident of besieged Leningrad	2019-10-09 19:11:22	2019-10-09 19:11:22
five	WWII disabled	2019-10-09 19:11:22	2019-10-09 19:11:22
6	Refugee	2019-10-09 19:11:22	2019-10-09 19:11:22
7	The large family	2019-10-09 19:11:22	2019-10-09 19:11:22
eight	Lonely mother (father)	2019-10-09 19:11:22	2019-10-09 19:11:22
nine	Foreigner	2019-10-09 19:11:23	2019-10-09 19:11:23
10	Child	2019-10-09 19:11:23	2019-10-09 19:11:23
<div>Items per page: 101 - 10 of 11</div>			

Fig. 13. An example of a system manual page.

#	Name	Created	Updated
one	Pensioner	2019-10-09 19:11:22	2019-10-09 19:11:22
2	Disabled	2019-10-09 19:11:22	2019-10-09 19:11:22
3	Families with disabled children		2019-10-09 19:11:22
four	Resident of besieged Leningrad		2019-10-09 19:11:22
five	WWII disabled		2019-10-09 19:11:22
6	Refugee		2019-10-09 19:11:22
7	The large family		2019-10-09 19:11:22
eight	Lonely mother (father)	2019-10-09 19:11:22	2019-10-09 19:11:22
nine	Foreigner	2019-10-09 19:11:23	2019-10-09 19:11:23
10	Child	2019-10-09 19:11:23	2019-10-09 19:11:23

Fig. 14. An example of a form for adding a record.

List of appeals form - the form is used to display a table with appeals from the database with the ability to navigate and paginate. Every row is working as a control element, when clicked, the appeals page opens. In addition, the form has an expandable form for searching / filtering appeals, which can be opened by clicking the "Search" button. And also, the ability to open select markers for bulk printing. GUI example of the list of appeal form is presented on figures 15 - 18.

#	FULL NAME	A type	Organization	Status	date of creation	Date of reply
1821542028042021	Gruzdova Valentina Konstantinovna	A complaint	RZO Krasnoselsky district	Sent to RZO	04/28/2021	05/12/2021
1821134328042021	Karmanova Tatiana Viktorovna	A complaint	SPb GBUZ "City Mariinsky Hospital"	Sent to MO	04/28/2021	05/12/2021
182016328042021	Akhmedova Galiya Gabdelmashitovna	A complaint	SPb GBUZ "Children's City Polyclinic No. 71"	Sent to RZO	04/28/2021	05/12/2021
1019350528042021	Popovich Nadezhda Ivanovna	A complaint	SPb GBUZ "City Hospital No. 40"	Sent to RZO	04/28/2021	05/12/2021
78619222828042021	Tsarikov Denis Eduardovich	Thanks	RZO Moskovsky district	Sent to RZO	04/28/2021	05/12/2021
78519120928042021	Buravtsova Yulia Sergeevna	A complaint	SPb GBUZ "City Dental Clinic No. 33"	Sent to MO	04/28/2021	05/12/2021
147219030828042021	Alieva Anaisi Elshanovna	A complaint	SPb GBUZ "City Polyclinic No. 21"	Sent to RZO	04/28/2021	05/12/2021
78618301128042021	Queen Natalia Alexandrovna	A complaint	SPb GBUZ "City Polyclinic No. 8"	Sent to RZO	04/28/2021	05/12/2021
147218234528042021	Egorova Alexandra Sergeevna	A complaint	SPb GBUZ "City Polyclinic No. 60 of the Pushkin District"	Sent to RZO	04/28/2021	05/12/2021
147218142628042021	Syromyatnikova Daria Sergeevna	A complaint	SPb GBUZ "City Hospital No. 26"	Sent to MO	04/28/2021	05/12/2021

Fig. 15. An example of the form list of appeals.

List of appeals

Refresh Search Printing

Search for appeal

Appeal number FULL NAME

Date creation from Date creation to

To MO

Search Clear

#	FULL NAME	A type	Organization	Status	date of creation	Date of reply
1821542028042021	Gruzdeva Valentina Konstantinovna	A complaint	RZO Krasnoselsky district	Sent to RZO	04/28/2021	05/12/2021
1821134328042021	Karmanova Tatiana Viktorovna	A complaint	SPb GBUZ "City Marinsky Hospital"	Sent to MO	04/28/2021	05/12/2021

Fig. 16. An example of a list of appeals search form.

List of appeals

Refresh Search Canceling Printing Print the list of requests

<input type="checkbox"/>	#	FULL NAME	A type	Organization	Status	date of creation	Date of reply
<input type="checkbox"/>	38422455515022021	Vitaly Vitaly Vitalievich	A complaint	Children's Center for Rehabilitation Medicine and Rehabilitation	Canceled	02/15/2021	03/01/2021
<input type="checkbox"/>	38422443815022021	Dmitriev Dmitry Dmitrievich	A complaint	SPb GBUZ "Children's Dental Clinic No. 4"	Canceled	02/15/2021	03/01/2021
<input type="checkbox"/>	38422430815022021	Vasiliev Vasily Vasilievich	A complaint	SPb GBUZ "Nikolaevskaya hospital"	Sent to RZO	02/15/2021	03/01/2021
<input type="checkbox"/>	39905441213022021	Ivanov Ivan Ivanovich	A complaint	LLC "Health Energy"	Archived	13.02.2021	02/27/2021

Items per page: 10 11 - 14 of 14 |< < > >|

Fig. 17. An example of a form of mass printing of appeals.

Reception form - the form is used as the main screen for users with the "Hotline operator" role, the main functions used in the work of the hotline operator are available on the form: creating an appeal, consultation, canceling appeal, creating thanks, viewing the repository with regulatory documents. GUI example of the reception form is presented on figure 18.

OWCA Main Settings Directories Reports Add appeal Reception List of appeals Admin

Add appeal

Consultation

Cancel appeal

Thanks

Other

Fig. 18. Example of a page with a reception.

Appeal creation form - a form for creating an appeal, it opens after selecting the "Add appeal" menu item, the form is used to enter information about the appeal in specialized fields. After creating an appeal, user can view it in a similar form of viewing appeals. GUI examples of the creation and viewing form is presented on figures 19 – 20.

OROGMO Main Settings Directories Reports Add appeal Reception List of appeals Admin ▾

New appeal No. 102090529042021

Registration date: 04/29/2021

Check-in time: 02:09

Type MO

Request type
Thanks

To MO
It is necessary to fill in

FULL NAME
It is necessary to fill in

SNILS

Way of handling
Written

Male
It is necessary to fill in

Email

Insured

Date of Birth

District
It is necessary to fill in

Address
It is necessary to fill in

Telephone

Social status

☐ Power of attorney

Problems and reasons for citizens' appeal:

☐ Organization of medical care

☐ Problems with preferential drug provision

☐ Organization of primary health care in APU

☐ Lack of a drug in the pharmacy

☐ Organization of inpatient medical care

☐ Refusal to issue a prescription for deferred provision

☐

You must select items

Content of the appeal

☐ The complaint is substantiated

Attached files to the appeal

Attach files

Add to

Fig. 19. Example of the form for creating an appeal.

Contact No. 116370102052021



Registration date: 08/02/2021

Check-in time: 16:37

Request type Complaint	
To MO Hospital № 123	
FULL NAME Ivanov Ivan	
SNILS 001-001-001 00	Way of handling Written
Male Men	Email
Insured Insurance 123	Date of Birth
District Central	Address Spb Ispitateley 20-22
Telephone +79117776655	Social status

☐ Power of attorney

Problems and reasons for citizens' appeal:

☐ Organization of medical care

☒ Organization of primary health care in APU

Content of the appeal

Text

☐ The complaint is well founded

☐ The answer to the applicant is provided

Taken measures:

Answer

Edit

Fig. 20. An example of a form for viewing an appeal.

Consultation registration form - the form opens after selecting the "Consultation" item in the Reception section, the form is used to enter information about the consultation. GUI example of the consultation form is presented on figures 21 - 22.

Fig. 21. An example of a consultation registration page 1 stage.

Fig. 22. An example of a consultation registration page 2 stage.

Report forms - these forms are designed to generate reports on appeals and consultations stored in the system database. Report forms are opened after users go to the "Reports" section of the menu and select a specific report. GUI example of the report form is presented on figure 23.

Fig. 23. An example of a report form.

Answering form - the appeal creation form, opens after the user selects the appeal from the list on the "List of appeals" form, the form consists of a part of the appeal information entered by the user who created the appeal and a special block for generating a response. The controls differ depending on the user's role. GUI example of the response form is presented on figure 24.

OWCA Main List of appeals DHC Operator

Content of the appeal

Appeal text...

☐ The complaint is substantiated ☐ The answer to the applicant is provided

Taken measures:

Answer

Attached files to the appeal

Attached files to answer

Form an answer Form an answer with DS

Change of status

Send to MO Send to DWA Leave a comment

Leave a comment

Attach files

Edit

Status change log

Status changed: Forwarded to
Hot Line Operator :: 2021-04-29 02:48:42

Fig. 24. Example of a page for answering to the appeal.

4.5 Description of interfaces for interaction with external systems

The developed system provides interaction and integration with other information systems through the REST API. ...

The integration created with the aim of receiving and processing complaints submitted by citizens on the portal “St. Petersburg's Health”.

Users of third-party systems have the following options:

- Create a new ticket;
- View the list of left appeals;
- View appeal.

Authorization of requests to the appeal handling system is carried out by means of JWT (JSON Web Token - RFC7519)... All requests, except for the authorization one, must contain a JWT token in corresponding header: Authorization: Bearer <passphrase>... Example: “Authorization: Bearer

eyJ0eXAiOiJKV1QiLCJhbGciOiJIUzI1NiJ9.eyJpc3MiOiJodHRwOlwvX ...” [42].

For primary authorization (obtaining a jwt token), a third-party system transfers the login and password of its system to OWCA. OWCA verifies the received data with those stored in the database in the third-party systems section, and if the data is found in the response, it gives the JWT for authorization. All further requests contain this token. Logins and passwords for third-party systems are issued by the OWCA administrator.

The OWCA provides two main scenarios for interaction with other ISs: creating a new appeal by means of a POST request from a third-party system to OWCA and transferring appeals from OWCA to a third-party system using a GET request.

Creating an appeal according to data from a form filled in by the user in a third-party application. The interaction scheme is shown in Figure 25:

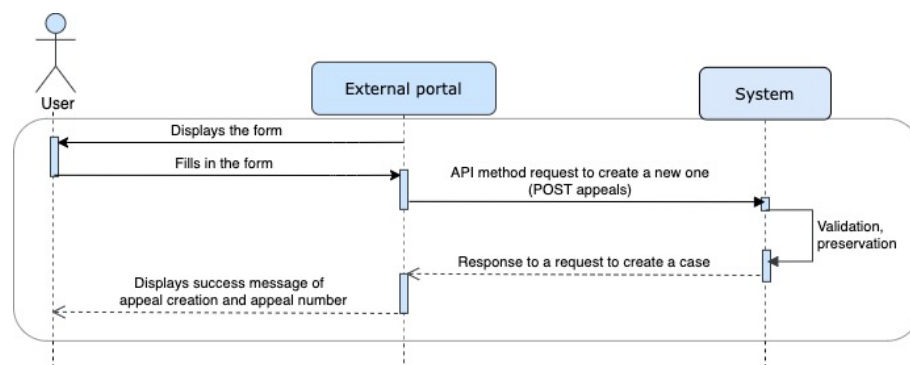


Fig. 25. The scheme of interaction during appeal registration.

The user of the third-party IS goes to the form for creating appeals, fills out the form. The third-party system transfers the information entered by the user, which is equivalent to the form used in OWCA, in addition the third-party IS transfers the unique identifiers of the system and the user who created the application. In the future, they are used to search and display a list of appeals of the user. If the appeal is successfully registered, OWCA will reply with the appeal number, by which it is possible to find the appeal in OWCA in the future. The list of transmitted information of the request and response «POST appeals» is presented in the tables 17 - 18.

The user of the third-party IS goes to the form for creating appeals, fills out the form. The third-party system transfers the information entered by the user, which is equivalent to the form used in OWCA, in addition the third-party IS transfers the unique identifiers of the system and the user who created the application. In the future, they are used to search and display a list of appeals of the user. If the appeal is successfully registered, OWCA will reply with the appeal number, by which it is possible to find the appeal in OWCA in the future. The list of transmitted information of the request and response «POST appeals» is presented in the tables 18 - 19.

Table 18. POST appeals request parameters.

No.	Parameter	Type	Criticality	Description
1	system_id	string	1..1	Identifier of the IC making the request
2	ext_user_id	string	0..1	A user identifier in IS, provides in the context of user authorization in IS
3	mo_type_id	int	0..1	MO type
4	organization_id	string	1..1	MO identifier
5	fio	string	1..1	Full name
6	snils	string	0..1	Snils number
7	gender_id	int	1..1	Gender of the applicant
8	insured	string	0..1	Name of company and number of police
9	birth_date	date	1..1	Date of birth, format: DD.MM.YYYY

10	district	string	1..1	District
11	address	string	1..1	Address
12	phone	string	1..1	Phone
13	email	string	0..1	Email
14	social_status_id	int	0..1	Social Status Code - Regulator corresponds to the 1-OG form
15	poa	boolean	0..1	Availability of credentials
16	appeal_body	text	1..1	Description text
17	problem_types	array	1..33	Troubleshooting codes and troubleshooting requirements
18	appeal_date	date	1..1	Date and time of appeal registration, format: DD.MM.YYYYTHH: mm: ss
19	files		0 .. *	Container with information about the required files (most files are less than 100 mm)
19.1	file_name	string	0..1	File name
19.2	file_body	string	0..1	File, encoded in base64

Table 19. Response to POST appeals request parameters.

No.	Parameter	Type	Criticality	Description
1	registration_id	int	0..1	Number of registered items in OWSA, is displayed in the context of the registration registration process
2	answer_code	int	1..1	Question answer code

Receiving from OWCA the appeals list of the user of external system. Receiving appeals from OWCA consists of three requests. First of all, the third-party system requests a list of user appeal with brief information on each request. If it's necessary, the third-party system asks for a specific appeal, and finally, if the user has need to view / download a file stored in OWCA by a third-party system can request it.

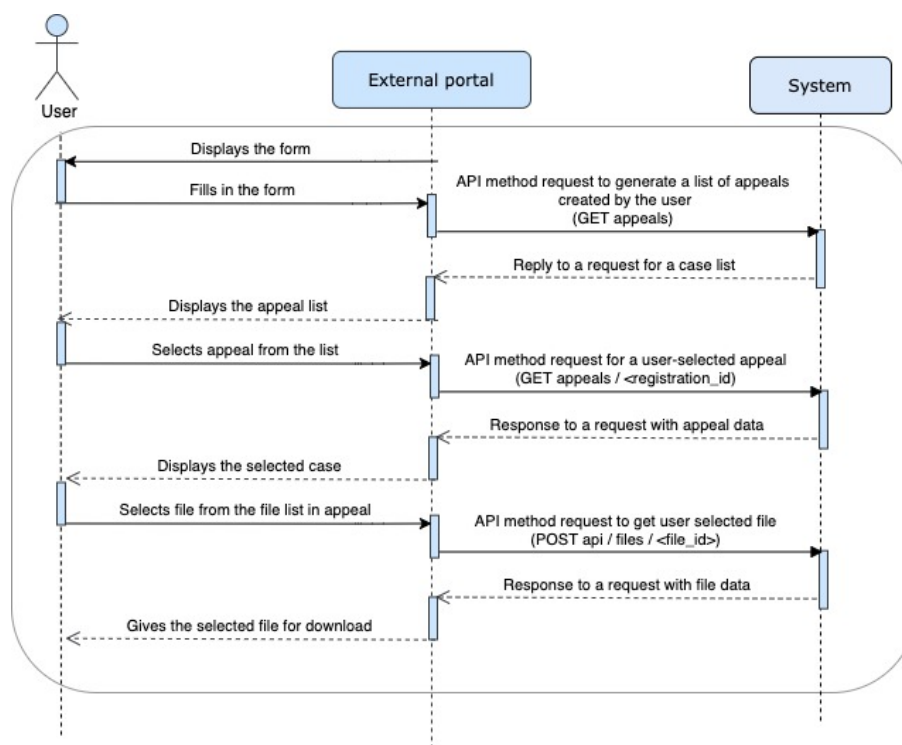


Fig. 26. Interaction diagram when viewing appeals through the API.

The user of the third-party IS goes to the form with the list of appeals in the third-party system. The third party IS sends the appeal list request to OWCA. In response, OWCA sends a list of appeals for this user. The list of appeals is formed on the basis of the totality of the IS identifier and the user identifier received from the IS when creating requests.

The user of the third-party system selects appeal from the received list, the third-party system sends a request to receive the selected appeal to OWCA. In response, OWCA sends information about the selected appeal. The request for appeal data is made using the appeal identifier received from OWCA when generating the list of appeals.

If necessary, the user of the third-party system can select from the received appeal or the response one of the attached files, then the third-party system sends a request to receive the selected file to OWCA. In response, OWCA sends the selected file. The data request is made according to the file identifier received from OWCA when generating the list of files in circulation. The list of transmitted information of the «GET appeals» request and response is presented in the tables 20, 21.

The list of transmitted information of the request and response « GET appeals/<registration_id> » is presented in the tables 22, 23.

The list of transmitted information of the « <GET files/<file_id>» request is presented in the tables 24, 25.

Table 20. GET appeals request parameters.

No.	Parameter	Type	Criticality	Description
1	system_id	string	1..1	Identifier of the IS making the request
2	ext_user_id	string	1..1	User identifier in the IS, the functionality is available only to an authorized user of the IS
3	limit	int	0..1	Maximum number of appeals to be sent

Table 21. Answer to GET appeals request parameters.

No.	Parameter	Type	Criticality	Description
1	answer_code	int	1..1	Request response code
2	data		0 .. *	Container with information about the hits found
2.1	registration_id	int	1..1	OWCA Registered Case Number
2.2	organization_id	string	1..1	MO identifier "
2.3	appeal_date	date	1..1	Date and time of access, format: DD.MM.YYYYTHH: mm: ss
2.4	answer_date	date	1..1	Date and time of response, format: DD.MM.YYYYTHH: mm: ss
2.5	status	string	1..1	Appeal status
2.6	text	string	1..1	Part of the appeal text (first 100 characters)
2.7	problem_types	array	1..*	Codes of types of problems stored in DB
2.8	ext_user_id	string	1..1	User identifier in the IS, the functionality is available only to an authorized user of the IS

Table 22. GET appeals /<registration_id> request parameters.

No.	Parameter	Type	Criticality	Description
1	registration_id	int	1..1	OWCA Registered Case Number

Table 23. Answer to GET appeals request parameters.

№	Parameter	Type	Criticality	Description
1	answer_code	int	1..1	Request response code
2	registration_id	int	1..1	OWCA Registered Appeal Number
3	appeal_answer	text	0..1	Full text of the answer
4	answer_date	date	0..1	Date and time of response (DD.MM.YYYYTHH: mm: ss)
5	text	string	1..1	Message text
6	actions	array	0..23	Action Codes from DB
7	answer_files		0 .. *	Container with information about the file attached to the response
7.1	name	string	1..1	File name
7.2	file_id	string	1..1	File ID
7.3	size	int	0..1	File size in bytes
7.4.	type	string	0..1	Mime file type
8	appeal_files		0 .. *	Container with information about the files attached by the applicant
8.1	name	string	1..1	File name
8.2	file_id	string	1..1	File ID
8.3	size	int	0..1	File size in bytes
8.4.	type	string	0..1	Mime file type
9	eds		0..1	Container with information about the EDS of the employee who provided the answer
9.1	key	string	0..1	EDS certificate number of the employee who provided the answer
9.2	fio	string	0..1	Full name of the employee who provided the answer, according to the EDS
9.3	position	string	0..1	The position of the employee who provided the answer, according to the EDS
9.4	valid_from	date	0..1	The start date of the EDS certificate of the employee who provided the response

9.5	valid_to	date	0..1	The expiration date of the EDS certificate of the employee who provided the response
10.	problem_types	array	1..14	Codes of types of problems and reasons

Table 24. –GET files/ <file_id> request parameters.

No.	Parameter	Type	Multiplicity	Description
1	file_id	string	1..1	Identifier of the file attached by the applicant / attached to the response

Table 25. Answer to GET files/ <file_id> request parameters.

No.	Parameter	AType	Multiplicity	Description
1	file	string	0..1	Base64 encoded file

4.6 Description of the organization of information base

Database order and tools

When maintaining the OWSA databases, no measures specially designed for this system that go beyond the regular operations of working with the DBMS as a whole are not required.

It is necessary to periodically monitor the availability of free space in the physical disks in use, as well as monitor the system logs of the DBMS.

Database protection tools from destruction

The following technologies and techniques are used to ensure the smooth operation and protection of databases at the hardware level:

- Different physical drives are used to store operating system files, DBMS executable files, transaction log files, log files and data files;
- to store operating system files, DBMS executable files, log files, a RAID array is used, which protects information from damage;
- data files and transaction log files are stored using a RAID 5 array (or RAID 10 is allowed), which provides the database with sufficient protected storage for files with good data recovery characteristics in the event of a hardware failure of one of the hard drives;
- database backups are created and placed on separate drives.

At the DBMS program level, protection is carried out according to the following scenarios:

- transaction logging to keep data in a consistent state at all stages of work. In the event of a hardware failure, the transaction log is used to automatically restore the database to a consistent state;
- logging of actions, which allows you to track all user actions for a certain period of time. The activity log is used for security auditing, dispute resolution, and disaster recovery using a database backup.

Database protection tools against unauthorized access

Protection against unauthorized access is carried out at the physical and logical levels.

The physical layer includes configuration changes on network equipment to prevent unauthorized access to the database. The policy is "everything that is not allowed is prohibited." In this case, only developers, administrators and users working through special software from certain network addresses have access to the DBMS.

At the operating system level, security is guaranteed by the differentiation of rights by roles and users. The administrator has access to the data files. At the database level, the authentication and authorization procedure is carried out, user rights are delimited at the level of roles, which, in turn, have a number of standard privileges. Description of the main elements of the systems DB is presented in the table 26.

Table 26. List and description of objects of the subject area of the OWCA system database.

No.	Description of the object	DB table name	Description of the object
1.	Reference types of appeals	appeal_types	Contains information about the types of appeals, configured by the administrator.
2.	Consultation types reference	consultation_items	Contains information about the types of consultations, in future releases it is planned to be displayed in the system GUI.
3.	Reference of types of measures taken	actions_takens	Contains information about the measures taken to handle, in future releases it is planned to be displayed in the system GUI.
4.	Reference of MO types	lpu_types	Contains information about the types of hardware, in future releases it is planned to be displayed in the system's GUI.
5.	Gender reference	males	Contains information about the available sexes of the applicant, configured by the administrator.

No.	Description of the object	DB table name	Description of the object
6.	MO Directory	organizations	Contains information about Medical Organizations, configured by the administrator.
7.	DHC Handbook	rzos	Contains information about the available sexes of the applicant, configured by the administrator.
8.	Directory of social statuses	social_statuses	
9.	Directory of districts of St. Petersburg	districts	Contains information about the available areas of the floor of the applicant of the appeal, configured by the administrator.
10.	User Roles Reference	roles	Contains information about user swarms, configured by the administrator.
11.	Contact information	appeals	Contains basic contact information
12.		appeals_actions_takens	Contains measures taken to address
13.		appeal_status	Contains information about the status of the appeal
14.		appeal_response	Contains responses to appeals
15.		comments	Contains comments on appeals
16.		appeal_problems	Contains handling problems
17.		appeal_attaches	Contains meta-information of files attached to hits
18.		appeal_response_attaches	Contains meta-information of files attached to answers
19.	User information	users	User information
20.		role_user	User roles
21.	Counseling counter	consiultaiton_counters	Considers consultations to report on consultations
22.	Directory of addresses of St. Petersburg	fias_cities	Directory of settlements
23.		fias_house_types	Building types reference
24.		fias_street_types	Street type reference
25.		fias_streets	Street Directory
26.	Information about third-party systems communicating with OWCA	systems	System information
27.		system_problems	Problems and reasons for contacting third-party systems
28.		user_organization	Third-party system users

In accordance with the business processes of the OROGMO system, the following information is subject to regular updating:

- Appeal data;

- data about the statuses of appeals;
- responses to appeals;
- comments to appeals;
- data on the measures taken to appeal;
- information about user accounts, user roles, user organization and user authority;
- user activity logs;
- reference books MO and DHC;
- metainformation of files attached to responses and appeals;
- reference book of third-party systems;
- counters of consultations,
- directory of addresses.

5 RESULTS

5.1 Results from implementation on business processes

After the development and implementation of the appeal processing system, the main business processes themselves and their participants will remain, but an additional participant will appear in all processes - the OWSA System, the system takes over all the processes of document circulation, preparation of reports necessary for the activities of the department to work with appeal. In addition to the basic processes described in detail, the system will also simplify some of those that were not considered in this work in such detail and are internal or accompanying sub-processes. Such as, timing control, printing appeals, generating a motivation report and others.

The processing of the appeal:

The description of the process is presented below, the process diagram is shown in the figure27:

Citizen's actions:

1. The citizen wants to leave an appeal for medical services that he received in a medical organization of St. Petersburg.
2. A citizen submits an appeal using one of the following options:
 - Written to the mail of the department for work with appeals;
 - e-mail to the department for work with appeals;
 - oral by phone of the hotline of the department for work with appeals;
 - on the internet portal.

Hotline operator actions:

3. The hotline operator enters the received appeal information into the Form No. 2-OG in the OWSA system interface (an example of the form in the appendix 1.

Actions of DHC operators:

4. Upon receipt of the appeal, the DHC Operator must arrange for a review and inform the applicant national if necessary. If possible, independently forms the answer.
5. If, for any reason, the DHC operator cannot form a response himself, then he translates the appeals in the system to the MO operator.
6. Actions of MO operators:

7. Upon receipt of the appeal, the operator of the MO must organize an inspection, if necessary, inform the applicant citizen. And form the answer.

DWA Operator Actions:

8. DWA operators check received information and, if necessary, return the appeal to the previous stage.

System action:

9. Checks the entered data at all stages, if any operator of the hotline has entered insufficient information, does not allow to save the appeal.
10. Checks the routes of the appeal, redirects the appeal further along the route.
11. Prepares information for the reports independently

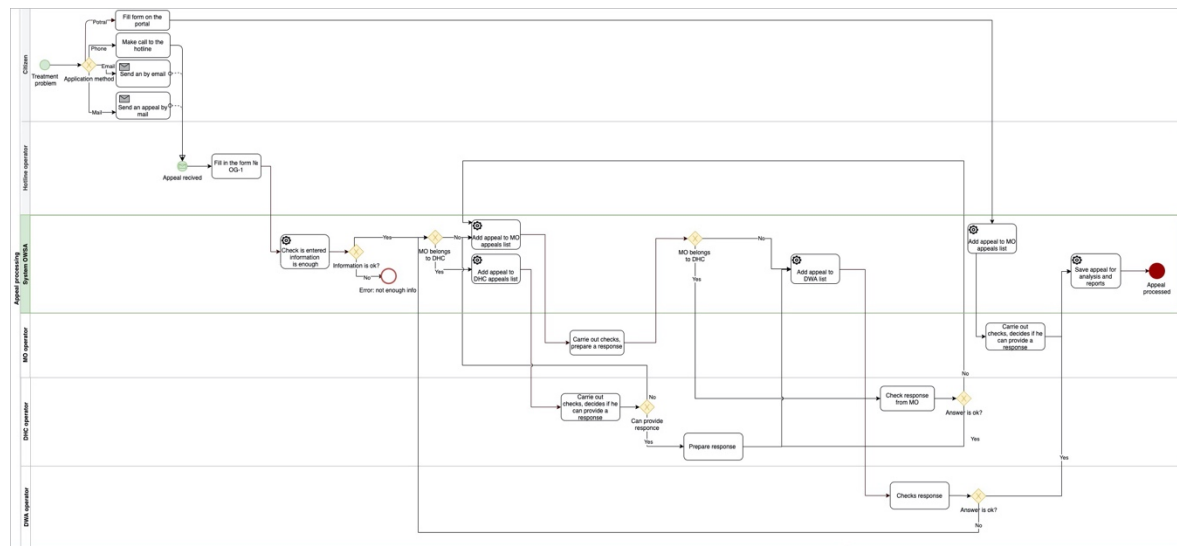


Fig. 27. AS IS appeal processing.

The main difference of this process after the implementation of the system is its continuity, cause before implementation we had two independent processes. Also, there is no need to constantly wait and re-send electronic messages from participant to participant, all these actions are performed by the system, as well as information validation. As a result, the number of mistakes and duplicates decreases in many times. Also, the number of required employees of the hotline and the department for work with complaints is decreasing. In addition, because of implementation of the system, the applicant now may submit an from another systems, which does not interfere with the functions of the department for working with complaints.

Consulting citizens by telephone hotline.

The description of the process is presented below, the process diagram is shown in the figure28:

Citizen's actions:

1. Citizen has a need to get advice on issues that have arisen when receiving medical care in institutions of St. Petersburg.
2. Citizen calls the MIAC hotline.

Hotline operator actions:

3. The hotline operator provides the necessary information to the citizen
4. The hotline operator enters information about the type of conducted consultation in the web-form.

System action:

5. Prepares all information for analysis

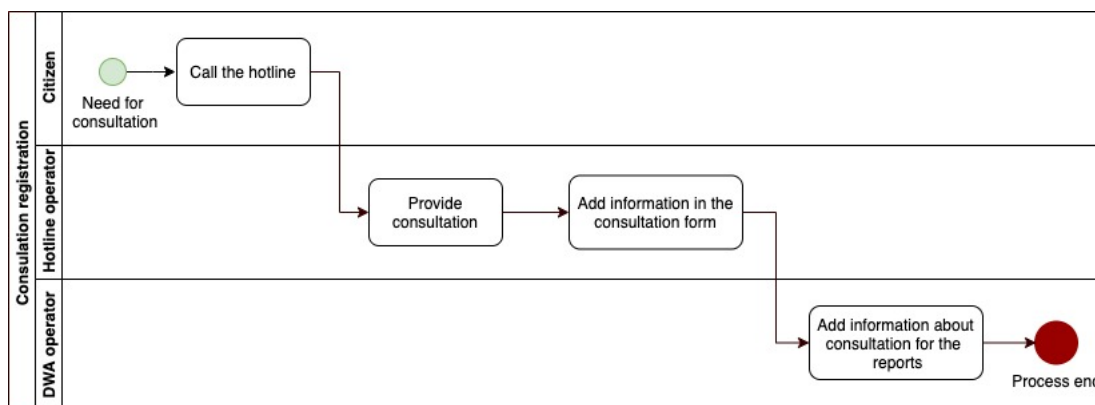


Fig. 28. TO-BE consultation processing process.

Process improvement results: the need for a DWA employee to collect data from operators has disappeared, in addition, instead of a google document, where hotline operators manually change numbers and may make typos, all calculations will be performed by the information system.

Formation of reports.

The description of the process is presented below, the process diagram is shown in the figure29:

Actions of the main operator of working with appeals:

1. The user logs into the system, enters the dates for which it is necessary to generate a report.

2. The system instantly generates a report.
3. The user uploads the Excel file with the report.

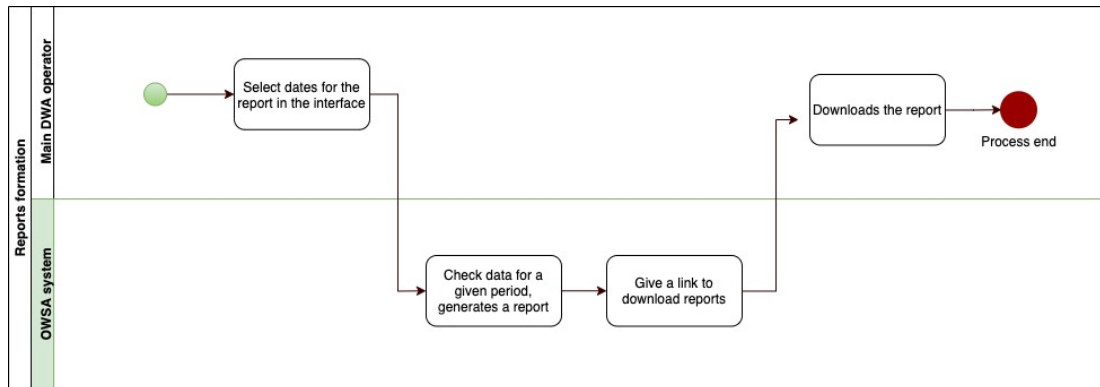


Fig. 29. TO-BE reporting process.

Process improvement results: Generating and uploading a report takes a matter of seconds, instead of several days of manual calculation. To generate a report, only the work of the main operator is enough. The number of erroneous calculations is minimized (errors are possible during development / testing, due to the great complexity of this report)

5.2 Results of the effectiveness of the development and implementation of the appeal processing system

Management using financial indicators does not always provide sufficient information to make correct and timely management decisions [42].

Therefore, the effect of implementation information system at the enterprise can be divided into two components:

- Quality results;
- quantitative results.

As a result of the development of new system for processing citizens' appeals to medical organizations, the following qualitative advantages can be distinguished:

- Improving the convenience of operators involved in the management of appeals and consultations;
- Increasing awareness of department for work with appeals about delays and poor-quality work of MO and DHC staff;
- Increasing the satisfaction of citizens with the answers provided to them and the measures taken;

- Citizens receive a new way to leave an appeal (Internet portal).
- Multiple reduction in errors and duplicates due to the absence of the need to make manual calculations and mailings;
- Improving the quality of reporting, as a result of improving the quality of analytics and medicine in general, due to a more effective impact on the problems of citizens;
- Among the quantitative results of the implementation of the system, the following were noted:
 - Reducing the time spent on creating and transferring to the gate;
 - Reducing the cost of the department for work with appeals, due to the lack of the need to constantly increase the staff due to lack of resources for reporting and monitoring obligations.

Table 27 shows the time spent on key activities in the pre- and post-implementation processing process.

Table 27. Comparison of time costs for main activities.

Indicator	User	Before implementation	After implementation
Registration of an appeal by phone	Hotline operator	9 min	3 min
Registration of a written appeal	Hotline operator	10 min	4 min
Preparation of response (excluding checks)	DHA Operator, MO Operator	30 min	5 min
Response control (excluding checks)	DHA Operator, DWA Operator	35 min	5 min
Formation of a report on consultations	DWA Operator, Hotline Operator	3 hours	2 min
Preparing data for the reports	Hotline operator, MO operator DWA operator	3 hours	-
Formation appeal report	DWA operator	40 hours	2 min

In order to determine the costs of creating and maintaining the system for processing appeals, the method of calculating the total cost of ownership TCO was applied. The total costs can be represented as the sum of two terms [43]. TCO is calculated using the formula (1):

$$TCO = DC + IC, \quad (1)$$

where DC is direct costs;

IC – indirect costs.

Direct costs are calculated using the formula (2):

$$DC = HS + M + S + D, \quad (2)$$

where HS is the cost of hardware and software;

M - management costs;

S - support costs;

D - development costs;

Indirect costs are calculated using the formula (3):

$$IC = EU + DT, \quad (3)$$

where EU is the costs associated with user activities;

DT - Downtime Costs.

The direct costs of developing and implementing appeal handling system are presented in Table 28.

Table 28. Direct costs of system implementation.

Indicator	Description	Cost, rub.
Hardware costs	The system is not demanding on hardware, it will use part of the capacity of the MIAC data center in the amount of: - 8 vCPU 2.8 GHz - 16 GB RAM - 20 TB HDD RAID SAS	150 000
Software costs	Full cost of all stages of development	3800 000
Management and support costs	Support contract 5% of development per year	190 000
Installation costs, setup and training of the system	Initial training and setup are included in the full price, additional is paid at the rate of 700 rubles / hour, but will be included in indirect costs	0

Indirect costs cannot be fully predicted, but this system is reliable and it is planned to draw up a bilateral SLA for all failures and errors within the framework of the support agreement. Also, the cost of technical support (electricity, hardware) will be negligible. So we can assume that indirect costs will not add 10% of the development price = 380,000 rubles. Then the total cost of ownership (initial investment): $TCO = 150\,000 + 3\,800\,000 + 190\,000 + 380\,000 = 4\,900\,000$ (rub.).

This project, like the department itself, is financed from the state budget and does not imply financial profit, but it will reduce some of the costs by eliminating the need for additional employees who are recruited from year to year.

To assess the investment profitability of the project, let's use dynamic methods for calculating the net present value (NPV).

NPV shows the investor's net income or losses from putting money into a project compared to keeping money in a bank and is calculated using the formula (4) [45]:

$$NPV = \sum_{t=1}^n \frac{CF_t}{(1+R)^t} - \sum_{t=1}^n \frac{I_t}{(1+R)^t}, \quad (4)$$

where CF_t – cash flow in period t ;

I_t – the amount of investment in the t -th period;

R – discount rate;

n – the total number of periods.

The calculation of the discount rate was made on a cumulative basis. For this, the following were determined: the size of the risk-free rate, as well as the size of premiums for various types of risks, and all this was adjusted for the inflation rate.

As a risk-free discount rate, took the weighted average interest rate on an annualized basis for the 6 largest banks for April 2021, calculated based on the annual interest rates established in deposit agreements and the volume of deposits attracted in the reporting month for non-financial organizations, with a maturity of up to 1 years, including "on demand" [45]:

$$i_6 = 4.33\%.$$

For the risk premium, technique developed by the Japanese scientist Y. Honko, in which investments are classified depending on the rate of return [46]. The amount of the risk adjustment depending on the investment purpose in table 29.

Table 29. Methodology for determining the risk premium by J. Honko.

Investment purpose	Total risk adjustment, %
Forced investment	–
Maintaining market positions	1%
Renewal of fixed assets of the company	7%
Saving running costs	10%
Development of new projects	15%
Innovative projects	20%

In this case, a new project is being developed, hence the risk premium is $i_r = 15\%$.

The discount rate for the risk premium is calculated as [46]:

$$i_g = i_6 + i_r = 4.33\% + 15\% = 19.33\%.$$

The discount rate adjusted for inflation is calculated using the formula (5):

$$R = (1 + i_g) * (1 + S) - 1, \quad (5)$$

Where S – annual inflation rate.

As of April 2021, the annual inflation rate was 5.28%. Then the discount rate is:

$$R = (1 + 0.1933) * (1 + 0.0528) - 1 = 0.256 = 25,63\%$$

The department for work with appeals does not have constant revenue and is financed by the state budget in accordance with its costs. Therefore, as an inflow, we take the difference from the savings on salaries of employees who will not have to be hired additionally. The cost differences are presented in table 30.

Table 30. Costs for salary of department employees.

Year	Costs for salary without implementation	Salary costs with implementation	System operating costs	Income in comparison
2020	8 640 000	8 640 000	4 900 000	- 4 900 000
2022	10 800 000	8 640 000	570 000	1 590 000
2023	10 875 000	8 700 000	570 000	1 605 000
2024	11 600 000	8 700 000	570 000	2 330 000
2025	12 352 000	9 425 000	570 000	2 358 000
2026	12 352 000	9 425 000	570 000	2 358 000

Table 31 shows the net present value of the project for the development and implementation of a bug tracking system for processing complaints, depending on the period (year from the start of the project). On the basis of Table 31, a diagram of the dependence of NPV on the period was constructed at a discount rate of $R = 0.2563$, shown on figure 30.

Table 31. Dependence of NPV on the period.

Indicators	Years					
	0	1	2	3	4	5
NFC Net Flow = Inflows - Outflows	-4900000	1590000	1605000	2330000	2358000	2358000
Discount ratio.	1,0000	0,7905	0,6249	0,4940	0,3905	0,3087
Net Present Income NPV = NFC * DF	-4900000	1265621	1016924	1175103	946608	753489
Cumulative NPV	-4900000	-3634379	-2617455	-1442352	-495744	257745

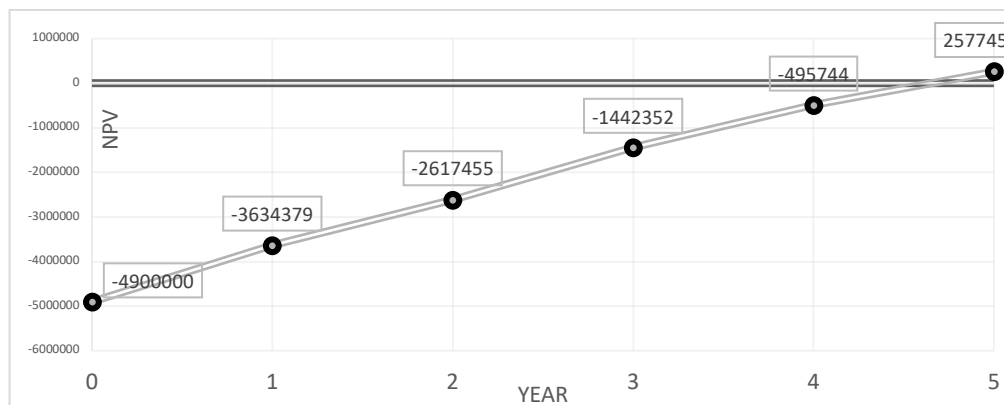


Fig. 28. Diagram of dependence of NPV on the period.

The graph shows that even if we calculate the economic efficiency from reducing the cost of salaries for employees of the department for work with appeals, the project will be able to pay off by the middle of the 4th year. The discounted payback period, at a discount rate of 25.63%, is 5 years, since by the 5th year NPV becomes positive.

During the analysis of economic efficiency, it was revealed that even though the project is mainly created to improve quality indicators and payback in government projects is not always a priority. The project will fully pay off by 5 years of operation.

6 DISCUSSION AND CONCLUSIONS

In this research, an analysis of using bug tracking systems technologies for processing citizens' appeals to medical organizations by the Medical Information Analytical Center was carried out. During analysis of the subject area, the theoretical aspects of the use of bug tracking systems were considered, the main components of bug tracking systems were studied. Thus, it was determined that when processing complaints, it is possible to use a life cycle almost similar to what is considered the standard life cycle of an error, according to Aranda J. and Venolia G. in the article «The secret life of bugs: Going past the errors and omissions in software repositories»: New, Appointed, Resolved (can be :fixed, double, not corrected, not reproducible), closed, reopened. Also comparison between the processing of bugs / defects in bug tracking systems for IT sphere and complaints / problems in the civil sector was made. Analysis of the works of Khon L.T. and Leape L. showed that a qualitative analysis of citizens' appeals can not only make life easier for applicants and employees, but also reduce the number of accidents associated with medical errors. So according to D.W. Bates, D.J. Cullen, N. Laird after analyzing the data of the American treatment processing system, serious shortcomings were identified with the prescription of substandard drugs in some hospitals, and after the audit, the number of drug poisonings in these hospitals decreased by 3 times, whereas without such a system, no one could notice this for years.

In the process of analyzing the work of the MIAC and drawing up the organizational structure and business processes of the work of the department for processing complaints, serious problems were identified associated with a huge amount of manual labor. The business processes were drawn and studied using BMPN, after studying the business processes of the department's work, as well as interviewing the department's stakeholders, use cases and general requirements for the necessary system were drawn up. After that, the current bug tracking systems were analyzed. The justification for the need developing own solution was made - the OWSA system (Organization of work with citizens' appeals).

For the developing solution, a role model was created that includes both participants in the processing of appeals and external participants-applicants who leave appeal through external integrated systems. After that, all necessary functions in the system are described, including their implementation logic and the necessary control elements. Requirements for the web interface and layouts of the main forms were drawn up. The logic for the integration with external systems by using the REST API was worked out, including a detailed description of all transmitted fields in requests and responses.

The developed solution meets all functional and technical requirements, and also additionally has functionality that is not negotiated within the requirements, but will also improve the appeals processing, and as a result, improve the quality of medicine in SPb as a whole. The system will significantly save the time required to complete all the main business processes of the department for work with appeals in St. Petersburg MIAC and minimize the percentage of errors. Moreover, despite the absence of the need for mandatory economic efficiency of state projects that aimed at improving the lives of citizens, it was calculated that this project will pay off within 5 years, due to the savings on the salaries of the department employees. In the future, it is planned to develop the system and build a boxed solution for various business areas on its model.

In future work, it is planned to improve the existing system and build a boxed solution for various business areas on its model. At the moment, the theoretical and research part of the work is being prepared for publication in the E3S Web Conferences journal Vol 4.

The scientific novelty of the research is the validity of using the logic of classic bag tracking systems, which are used in the development of IT solutions, in the civil or commercial sectors not related to development. The tasks and questions of the thesis have been solved, the goal has been achieved, the scope of the results has been determined. Prospects and directions of research are grounded. The results obtained show signs of scientific novelty.

7 SUMMARY

This master's thesis is devoted to optimizing the processes of managing calls to medical organizations by creating an information system according to the logic similar to classical bug tracking systems. The applied nature of the work allows the organization responsible for processing requests - SPb GBUZ MIAC - to optimize its work, increase the speed and quality of processing and analysis of citizens' problems, and, as a result, improve the level of healthcare in the region.

The study consists of three main chapters, as well as an introduction, a conclusion, a list of literature used by the student, a list of his own publications and an appendix with general reporting forms.

The first chapter provides theoretical aspects of the research, describes the main elements and attributes of modern bug tracking systems. Analogies of IT attributes in such systems with objects of the real world are given. The case of using the bug tracking system in education is shown. This chapter shows that the student has done a lot of research in the scientific literature on a given topic.

In the second chapter of the study, cases of various foreign practices of systems for processing requests to medical organizations are presented, the object of the study is described and studied in detail - the department for work with requests of St. Petersburg State Budgetary Healthcare Institution MIAC. Its business processes are considered, a market research of bug tracking systems is carried out and a justification is given for the need to develop a new solution for the specific goals of the object under study.

The third chapter is of a practical nature, in it the student describes all the main components of the system, examines in detail its functions and interaction interfaces. And also the economic efficiency of the project has been substantiated.

The research results can be used in the development of the country's health care system, as well as easily transferred with minor adjustments to other areas of business.

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APPENDIX 1

*Registration form №. 2- OG***Table 32.** – Registration form №. 2-OG

1	Registration number:	
2	Registration date:	
3	Check-in time:	
3	To the medical organization:	
5	Way of handling:	
Personal information about the applicant		
6	SNILS:	
7	FULL NAME:	
8	Male:	
9	Insured:	
10	Date of Birth:	
11	District:	
12	Address:	
13	Telephone:	
14	Social status:	A pensioner, a disabled person, families with disabled children, a resident of the besieged Leningrad, a disabled person of the Second World War, a refugee, a large family, a single mother (father), a foreigner, a child, and others.
15	Power of attorney:	
Problems and reasons for citizens' appeal:		
16	1. Organization of medical care	
16.1	1.1 Organization of primary health care in APU	
16.2	1.2 Organization of inpatient medical care	
16.3	1.3 Organization of ambulance	
16.4	1.4 Organization of medical care for mothers and children	
16.5	1.5 Quality of care	
16.6	1.6 Sanitary and technical condition of the medical institution	

16.7	1.7 Ethics and deontology of medical personnel	
17	2. Collection of funds	
17.1	2.1 Charging money for free medical care provided under the government guarantee program	
17.2	2.2 Violation of the procedure for the provision of paid services	
17.3	2.3 Taking money without a contract	
18	3. Problems related to drug provision	
18.1	3.1 Problems associated with the operation of the health facility	
18.2	3.2 Problems related to the operation of the pharmacy	
18.3	3.3 Problems related to the register	
19	4. Problems associated with the availability of health care	
19.1	4.1 Long waiting times for medical care	
19.2	4.2 Denial of medical care	
19.3	4.3 Denial of hospitalization	
19.4	4.4 Refusal to accept an emergency call	
19.5	4.5 Failure to call a doctor at home, leave the ambulance and emergency team	
19.6	4.6 Lack of coupons for an appointment with a doctor	
19.7	4.7 Accessibility of health care facilities for people with disabilities	
20	<u>Content of the complaint:</u>	
21	<u>Answer:</u>	

APPENDIX 2

Consulting form.

Table 32. Consultation registration form

No.	CRITERIA	QUANTITY	%
1	Total number of phone calls received by MCC: of which consultations		
2	on the organization and rules of CHI		
3	on the procedure for obtaining medical care, health resort care, HTMP		
4	on the rights of citizens to receive free medical care		
5	on the organization and provision of paid services		
6	according to the procedure for appealing against unlawful actions of officials of health care facilities		
7	according to the procedure for obtaining disability, social benefits, etc.		
8	on drug supply		
9	on issues of pain therapy (all requests) including pain relief in oncology		
10	oncology		
11	on issues of refusal to provide medical care included in the CHI program		

APPENDIX 3

Report for calculation of motivation

Table 33. Hotline Operator Activity Report form

№	FULL NAME	Complaints		Thanks		Consultations		Canceled appeals	
		Ammount	%	Ammount	%	Ammount	%	Ammount	%
1	Total	4	100	4	100	40	100	1	100
2	Ivanov Aleksey	1	25	1	100	0	0	0	0
3	Petrov Ivan	1	25	0	0	20	50	1	100
4	Vasiliev Stepan	2	50	0	0	20	50	0	0

APPENDIX 4

Report on the work of the telephone "hot line" for receiving citizens' appeals

Отчёт о работе телефонной "горячей линии" по приему
обращений граждан по вопросам доступности, организации и
качества оказания медицинской помощи в медицинских
организациях Санкт-Петербурга
за период с 1.3 по 1.4 2021 года

Санкт-Петербург
2021

Fig. 29. Title page of the report.

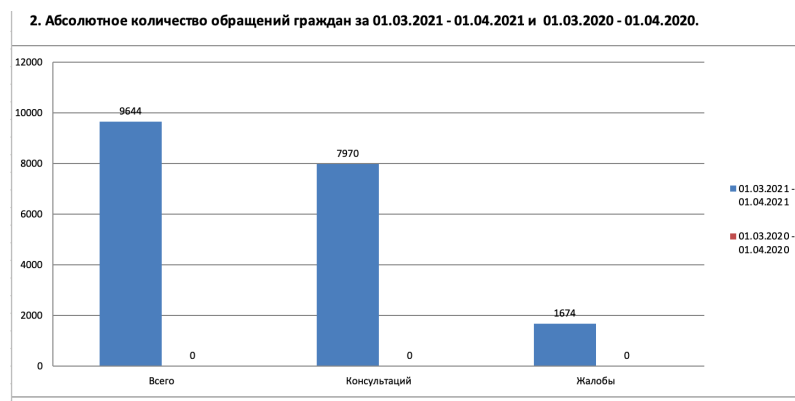


Fig. 30. 2nd page Absolute numbers of the appeals.

3. Структура обращений на телефонную «горячую линию» в абсолютных числах и доля от количества поступивших жалоб за 01.03.2021 - 01.04.2021.		
	За 01.03.2021 - 01.04.2021	За 2021
1. Организация медицинской помощи	1087 (11.19 %)	2648 (10.82 %)
1.1. Организация первичной медицинской помощи в АПУ	644 (59.25 %)	1584 (59.82 %)
1.2. Организация стационарной медицинской помощи	318 (29.25 %)	783 (29.57 %)
1.3. Организация скорой медицинской помощи	52 (4.78 %)	120 (4.53 %)
1.4. Организация медицинской помощи матерям и детям	1 (0.09 %)	2 (0.08 %)
1.5. Качество медицинской помощи	18 (1.66 %)	36 (1.36 %)
1.6. Санитарное и техническое состояние лечебно-профилакти	9 (0.83 %)	21 (0.79 %)
1.7. Этика и деонтология медицинского персонала	45 (4.14 %)	102 (3.85 %)
2. Проблемы с льготным лекарственным обеспечением	196 (2.02 %)	422 (1.72 %)
2.1. Отсутствие лекарственного препарата в аптеке	194 (98.98 %)	409 (96.92 %)
2.2. Отказ в постановке рецепта на отсроченное обеспечение	0 (0 %)	0 (0 %)
2.3. Отказ в выписке льготного рецепта	2 (1.02 %)	10 (2.37 %)
2.4. Обеспечение лекарственными средствами лиц отказавши	0 (0 %)	0 (0 %)
2.5. Обеспечение пациентов лекарственными препаратами лиц	0 (0 %)	0 (0 %)
2.6. Вопросы, связанные с организационными мероприятиями	0 (0 %)	3 (0.71 %)
3. Взимание денежных средств	1 (0.01 %)	4 (0.02 %)
3.1. Взимание денежных средств за бесплатную медицинскую	0 (0 %)	0 (0 %)
3.2. Нарушение порядка оказания платных услуг	1 (100 %)	3 (75 %)
3.3. Взимание денег без договора	0 (0 %)	1 (25 %)
4. Проблемы, связанные с лекарственным обеспечением	10 (0.1 %)	19 (0.08 %)
4.1. Проблемы связаны с работой МО	1 (10 %)	1 (5.26 %)
4.2. Проблемы связаны с работой аптеки	8 (80 %)	17 (89.47 %)
4.3. Проблемы связаны с регистром	1 (10 %)	1 (5.26 %)
5. Проблемы, связанные с обезболиванием	1 (0.01 %)	7 (0.03 %)
5.1. Проблемы, связанные с обезболиванием	1 (100 %)	7 (100 %)
6. Проблемы, связанные с доступностью медицинской помо	118 (1.21 %)	237 (0.97 %)
6.1. Длительное ожидание оказания медицинской помощи	24 (20.34 %)	37 (15.61 %)

Fig. 31. – 3^d page Structure of the appeals

[illegible]

5. Зарегистрированные обращения граждан на "горячую линию" по стационарам с указанием числа имеющихся признаков нарушений за 01.03.2021 - 01.04.2021.										
ЛПУ	Всего жалоб	Организация стационарной медпомощи в АПУ	Организация стационарной медпомощи	Организация скорой медпомощи	Организация медицинской помощи матери и детям	Количество медицинской помощи	Снижение и темпические состояние лечебно-профессионального персонала	Этика и дисциплина медицинского персонала	Отсутствие лекарственного препарата в аптеке	Ошибки в постановке диагноза на основании обследования
СПБ ГУЗ "Городская больница №20"	7	0	3	0	0	0	1	0	0	0
СПБ ГУЗ "Тимовская больница №3"	16	5	4	0	0	0	1	0	0	0
СПБ ГУЗ "Городская больница №33"	0	0	0	0	0	0	0	0	0	0
СПБ ГУЗ "Вишневская больница"	4	0	3	0	0	0	1	0	0	0
Всего	30	5	12	0	0	0	2	1	0	0
	60	24	19	0	0	0	4	2	3	0

10. Абсолютное количество жалоб граждан на амбулаторно-поликлинические учреждения районного подчинения за 01.03.2021 - 01.04.2021 и 01.03.2020 - 01.04.2020.

Учреждение	2021	2020
Городской район	53	0
Краснодарский район	68	0
Выборгский район	100	0
Адмиралтейский район	28	0
Московский район	45	0
Центральный район	24	0
Калининский район	86	0
Нижний район	52	0
Фрунзенский район	52	0
Петродворцовый район	4	0
Котловский район	16	0
Курортный район	93	0
Краснодарский район	47	0
Воскресенский район	57	0
Петродворцовый район	5	0
Котловский район	1	0
Путинский район	28	0

11. Структура жалоб граждан на амбулаторно-поликлинические учреждения взрослой сети за 01.03.2021 - 01.04.2021.

ЛПУ районного подчинения

Категория	Процент
Организация медицинской помощи	60%
Проблемы, связанные с лекарственным обеспечением	19%
Проблемы, связанные с доступностью медицинской помощи	11%
Организация медицинской помощи при COVID-19	10%
Жалобы граждан на организацию вакцинации	0%

107

25. Меры, принятые по обоснованным жалобам, связанным с деятельностью Родильных домов и Женских консультаций за 01.03.2021 - 01.04.2021.		
Наименование меры	Количество	Наименование ЛПУ
Увольнение	1	Детская поликлиника №1
Всего	1	

Fig. 36. Example of 8th, 12th, etc. pages Measures taken.