

Original Research

Development of an Automated System for Managing the Movement of Pharmaceutical Products in Pharmacies

Clara D. Shertaeva , Gulnara I. Utegenova , Olga V. Blinova , Rabiga M. Anarbaeva , Aigul Zh. Serikbaeva , Sholpan L. Akhelova , Ayat U. Agabek , Aidana D. Orynbayeva , Sayora K. Jabarkulova , Bayan I. Tursubekova 

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Abstract

Background: In the contemporary context, a factor in the successful development of pharmaceutical organizations is the active use of information and communication tools both for work with customers and suppliers, and in the internal processes of economic activity. On the one hand, the introduction of IT technology allows us to ensure compliance with the requirements of the legislation of the Republic of Kazakhstan. On the other hand, it opens up great opportunities for improving the level of service for pharmacy visitors, contributes to the formation of greater loyalty to a particular pharmacy organization and, therefore, makes it more competitive and cost-effective. **Aim:** development of an automated control system for the movement of pharmaceutical products in pharmacies. **Materials and methods:** we used basic research, including an analysis of the external and internal information system of a pharmacy organization (ISPO); informatization processes in the pharmaceutical market, pharmacy resources; scientific approaches to the study - systemic, logical-structural, process, marketing, regional. The objects of the study were pharmacy organizations, pharmaceutical workers in pharmacies, and software products. **Results and discussion:** To conduct the study, a design was developed that includes a research program to improve the information and communication activities of retail pharmaceutical organizations. Following the program, the authors developed a questionnaire survey to study the informational needs of pharmacy workers. Based on the results of the research, the main directions for the use of information technologies in pharmacy were determined. The authors compiled a portrait of an IT user and identified the strengths and weaknesses, opportunities and threats of using IT in pharmacies. Based on the Salesforce program, a modified system for controlling the movement of pharmaceutical products in pharmacies has been created.

Keywords: information technologies; information products; marketing research; sociological research; automation of operations; salesforce

Clara D. SHERTEVA. Doctor of Pharmaceutical Sciences, Professor, Head of the Department of Organization and Management of Pharmaceutical Business, South Kazakhstan Medical Academy, Shymkent, Republic of Kazakhstan. klara_shertaeva@mail.ru

Gulnara I. UTEGENOVA. PhD, Associate Professor of the M. Auezov South Kazakhstan University, Shymkent, Republic of Kazakhstan. gulnara64.64@mail.ru

Olga V. BLINOVA. Candidate of Pharmaceutical Sciences, Ass. Professor of the Department of Drug Technology of the South Kazakhstan Medical Academy, Shymkent, Republic of Kazakhstan. blinova67@mail.ru

Rabiga M. ANARBAEVA. Candidate of Pharmaceutical Sciences, Ass. Professor of the Department of Drug Technology of the South Kazakhstan Medical Academy, Shymkent, Republic of Kazakhstan. rabiga.rm@mail.ru

Aigul ZH. SERIKBAEVA. Candidate of Pharmaceutical Sciences, Ass. Professor of the Department of Drug Technology of the South Kazakhstan Medical Academy, Shymkent, Republic of Kazakhstan. aluau@mail.ru

Sholpan L. AKHELOVA. PhD, Associate Professor of Astana Medical University, Astana, Republic of Kazakhstan. aksholpan@yandex.ru

Ayat U. AGABEK. master's student of Pharmaceutical Business, South Kazakhstan Medical Academy, Shymkent, Republic of Kazakhstan. agabekaiat@mail.ru

Aidana D. ORYNBAYEVA. Senior lecturer of the Department

of Organization and Management of Pharmaceutical Business, South Kazakhstan Medical Academy, Shymkent, Republic of Kazakhstan. aidana_orynbayeva@mail.ru

Sayora K. JABARKULOVA. Senior lecturer of the Department of Organization and Management of Pharmaceutical Business, South Kazakhstan Medical Academy, Shymkent, Republic of Kazakhstan. Sayara_f@mail.ru

Bayan I. TURSUBEKOVA. PhD, Associate Professor of the South Kazakhstan University, Shymkent, Republic of Kazakhstan. btursubekova@list.ru

RELEVANCE

In modern conditions, information support has become an important area, which consists of the collection and processing of information necessary for making informed management decisions. The transfer of information about the position and activities of the enterprise to the highest level of management and the mutual exchange of information between all mutual divisions of the company are carried out based on modern electronic computers and other technical means of communication.¹⁻³

It should be noted that for pharmacy organizations, unlike for the other sectors of the economy, the specificity of information resource management consists of the combination



of the traditional function of information consumption, which ensures the proper development of pharmacy organizations, with the information generation, i.e. provision of information services to patients and healthcare workers. The introduction of IT technologies allows us to ensure compliance with the requirements of the legislation of the Republic of Kazakhstan, as well as wonderful opportunities for improving the level of service for pharmacy visitors. Consequently, it contributes to the formation of greater loyalty to a particular pharmacy organization, increasing the competitiveness and cost-effectiveness of the company.⁴⁻⁸

According to modern scientific views on the information resource, the head of the pharmacy organization must ensure that the structure, objectives and business processes correspond to the integrated external and internal information flows, and intra-pharmacy information products are in close connection with intellectual capital - the knowledge of pharmaceutical specialists.⁹⁻¹² At the same time, there are problems with choosing the right information products and technologies that the pharmacy really needs, their effective research and planning of an updated resource.

In this regard, managers of pharmacy organizations need not only relevant theoretical knowledge but also an accessible methodological apparatus that allows them to assess the current state and direction of development of information systems to ensure the effective performance of their economic and social functions by pharmacy organizations (PO), which is an urgent task.

Purpose of the study:

Development of an automated system for managing the movement of pharmaceutical products in pharmacies

MATERIALS AND METHODS OF RESEARCH

According to the developed program, we used the method of sociological research - a survey; questionnaires were prepared. The respondents were pharmacists of the Turkestan region, who are engaged in dispensing medicines and other pharmacy products to the population.

The study design included the following steps:

- design a questionnaire;
- formation of a group of respondents;
- distribution to respondents;
- data analysis;
- identification of consumer preferences;
- identification of needs in information and computer technologies (ICT).

The following were used as the main characteristics of the respondents: gender, age, level of education, territorial affiliation, work in a network or non-network organization, and position.

One of the central questions was the identification of the

availability of computer equipment and the programs used (questionnaire).

There were also questions on self-assessment by pharmacists of the compliance of the level of knowledge in information technology obtained during training at a university with the necessary work in a pharmacy organization and to determine the degree of satisfaction with the knowledge of working with a personal computer obtained by pharmacists at a university. The need to conduct classes on computer literacy and the study of information technologies used in pharmacy.

The technological resource of the pharmacies studied was evaluated by us according to 3 parameters:

1. availability of software products;
2. provision of PO with Internet access;
3. Type of Internet connection.

To reach the aim of the research we have used the following methods: basic research, including analysis of the external and internal information system of a pharmacy organization (ISPO), informatization processes in the pharmaceutical market, PO resources; scientific approaches to the study – systemic, logical-structural, process, marketing, regional, informational.

Content analysis, direct observation, sociological, mathematical-statistical and marketing methods were also used.

The objects of the study were regulatory documents, pharmacy organizations, pharmaceutical pharmacy workers, and software products.

RESULTS

Our SWOT analysis of the use of IT technologies in pharmacy organizations, that is, the identification of strengths and weaknesses, as well as opportunities and threats, demonstrates that there are more positive aspects and opportunities when using IT than weaknesses and threats (Table 1). Accordingly, the use of IT in the activities of pharmacy organizations is necessary and will help improve the competitiveness of pharmacies.

In accordance with the results of the SWOT analysis, for research, we developed a scheme for improving the activities of pharmaceutical organizations based on the use of modern Internet technologies (Figure 1)

Analysis of the use of IT by pharmacy organizations resulted in the vast majority of pharmacies using programs created based on "1C" as software (Table 2). This is due to their wide functionality, taking into account industry specifics and the convenience of working with them. In addition, their widespread use may be due to the fact that companies involved in the sale and installation of equipment for automating the work of pharmacies offer the installation of just such software.¹³ In particular, one of the most used programs based on 1C is 1C-Rarus: Pharmacy Management, which has the following main features:

Accounting for medicines



- accounting of pharmaceutical groups, dosage forms, Unified Urban Classifier
 - indication of the international non-proprietary name, dosage
 - inclusion in the mandatory assortment, Vital and Essential
- Drugs

 - accounting for various units of measurement
 - registration of certificates and expiration dates, falsifications
 - ability to keep analogues (interchangeability) of goods

Table 1. SWOT analysis of the use of IT technologies in pharmaceutical organizations	
Strengths	Weakness
The reduction of the time spent on project preparation and approval	System development requires a certain number of programmer man-hours
Exclusion of errors in calculations and the human factor	The functioning of the system requires the allocation of a separate server and work to maintain it
Accurate customer management, the improvement in the quality of relationships, and, consequently, sales	Implementation of the system takes time to train employees and adapt them.
Fast and accurate supplier selection	
Fast, error-free and transparent payroll	
Single format of project documents	
The reduction of the time to perform various functions (accounting, reporting)	
Opportunities	Threats
Ability to quickly adapt new employees	Weak or non-existent Internet prevents access to the use of IT
The ability to obtain comprehensive information about the project and its current state at any time and from anywhere in the world.	Program failure can lead to downtime or complete or partial loss of data.
Possibility of effective control of various operations.	The lack of electricity can paralyze the work if there is no autonomous source.
Possibility of joint performance of certain tasks.	Remote access to the database increases the risk of information leakage.

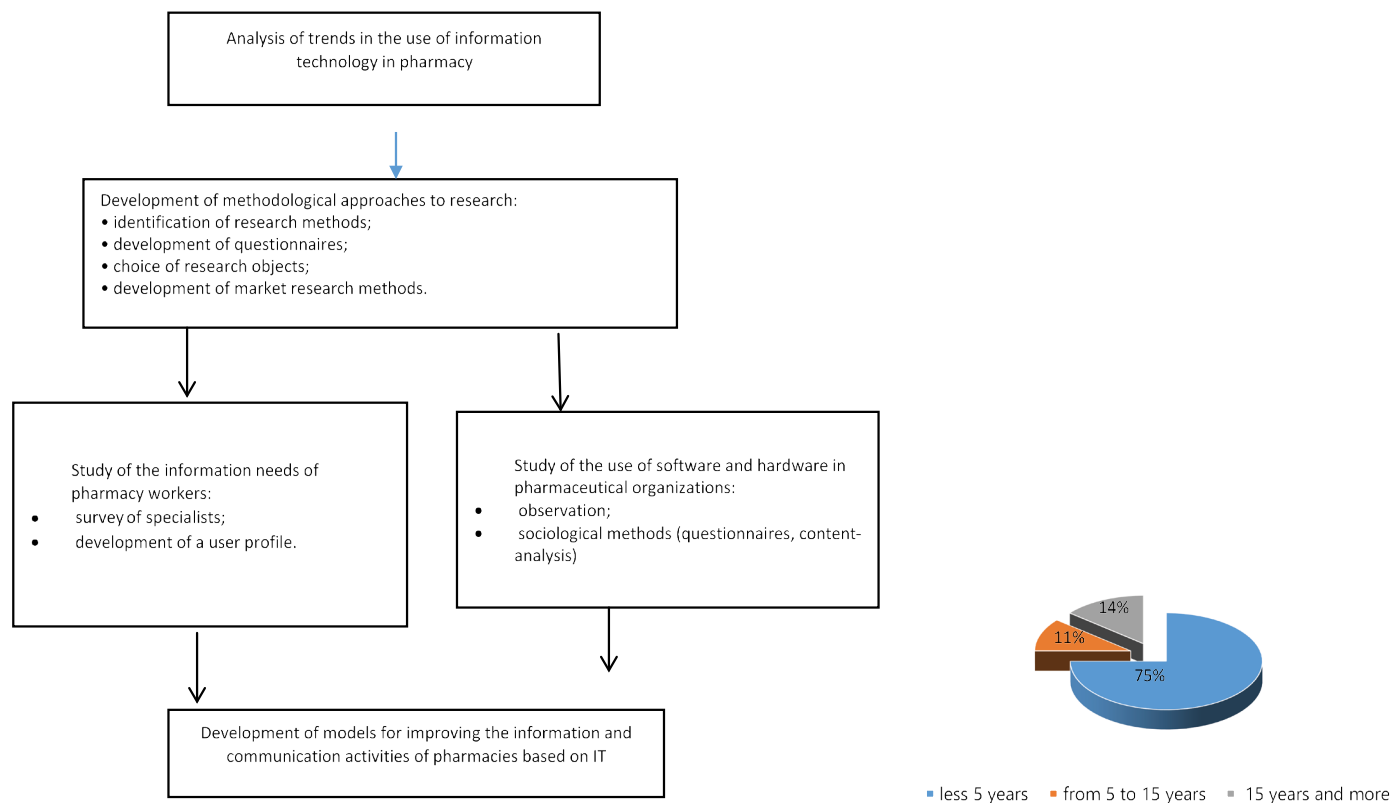


Figure 1. Design of a study on the use of modern IT in pharmaceutical organizations & Distribution of respondents by total length of service in a pharmacy organization

Supply

- *ability to download and analyze price lists, and invoices of contractors from an external file*
- *formation of an order to the supplier based on the calculation of the needs of the pharmacy and the analysis of the proposals of suppliers*
- *receipt/return of goods in the context of series, with the possibility of marking each series*

Warehouse and trading floor

- *the setting of retail prices in the context of series*
- *inventory of warehouses, movement and write-off of goods in the context of series*

Management of the pricing system, discounts and markups

- *a flexible system for assigning discounts and markups allows you to assign discounts and markups according to numerous rules: for documents in general and a separate product or group of goods, use discount cards and the amount of accumulation on them*
- *setting markup rules following the law*
- *setting prices by departments*

Bank and cash desk

- *printing of payment orders*
- *accounting of cash flow, at the box office and on current accounts*
- *preparation of regulatory cash reporting*

Retail sales

- *registration of retail sales of goods and services using commercial equipment*
- *connection to the system of authorization of non-cash payments by bank cards*
- *management of access rights to cash register functions*
- *the possibility of paying for the purchase in cash, utilizing payment cards, on credit (with the possibility of specifying a loan agreement with the creditor bank), club cards, or coupons, at the expense of the institution*
- *registration of the return of goods by buyers*

Operational reporting

- *reports on the balance of goods (by series, expiration dates, etc.), retail and wholesale sales, discounts and gifts, the number of sales by sales consultants, the movement of cash and non-cash funds, mutual settlements with suppliers and other reports*

Analytical reporting

- *a wide range of analytical reporting will allow you to quickly assess the situation for the company as a whole, for individual divisions or individual pharmacies and make the right decisions.*

Connecting commercial equipment

This configuration supports the following classes of retail equipment:

- POS-terminals (Point of Sale - trading place);
- fiscal registrars (FR);
- Authorizers of non-cash payments;
- electronic scales;
- barcode scanners and magnetic card readers;
- displays of the buyer;
- programmable keyboards;
- printers of labels and price tags;
- data collection terminals (TSD);

Thus, the description of the organization of the automation of the workplace of pharmacists revealed the most used software of pharmacies in our city. (Programs created on the basis of "1C", "1C-Rarus: Pharmacy Management")

Further, we conducted a sociological study to identify the functions and use of information systems in pharmaceutical organisations.

633 respondents were interviewed using self-developed questionnaires. As a result of processing the questionnaires, the following data were obtained. Most of the respondents were women (90% of the total number of respondents). Among the surveyed consumers, people from 25 to 40 years old prevailed - 62%. In terms of territorial affiliation, most of the respondents belonged to the city of Shymkent - 93%, to regional centres - 7%. All the interviewed respondents had higher pharmaceutical education. According to the total length of service in a pharmacy organization up to 5 years, the number of respondents was 75%, from 5 to 15 years - 11% and more than 15 years - 14%.

Based on the results of the survey, a portrait of an Internet user specialist was formed.

In the work of pharmacists, there is a need for both electronic media and pharmacy information technologies: 96% of respondents use computers in their work, while only 4% do not (Figure 2).

The analysis of the intellectual resource was carried out based on the results of a survey of PO specialists in 2 parameters:

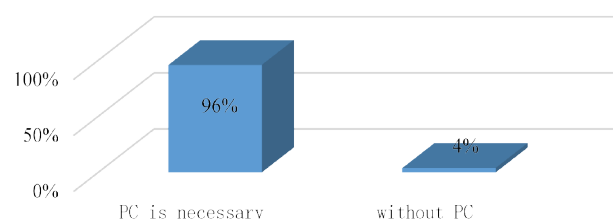


Figure 2. Usage of a personal computer (PC) in a pharmacy organization for work

1) the share of specialists with pharmaceutical education - PC and Internet users;

2) the degree of satisfaction with the professional information needs of pharmacy workers.

Respondents are employees of public pharmacies.

First of all, for the development of IS PO, it is necessary to have professional personnel who can work on a PC, including on the Internet. The proportion of specialists with pharmaceutical education, PC and Internet users turned out to be equal to 50.9%, i.e. makes up half of the staff. Therefore, there is a need to train 50% of pharmaceutical personnel to work on a PC and the Internet.

Pharmacists note the desire to use a personal computer in their work (Figure 3) and electronic storage media when providing pharmaceutical assistance in a pharmacy (Figure 4).

Figure 5 shows the data on self-assessment by pharmacists of the compliance of the level of knowledge in information technology, obtained during the education, necessary in work in a pharmacy organization. Only 20% of respondents indicated that the level of knowledge fully complied with

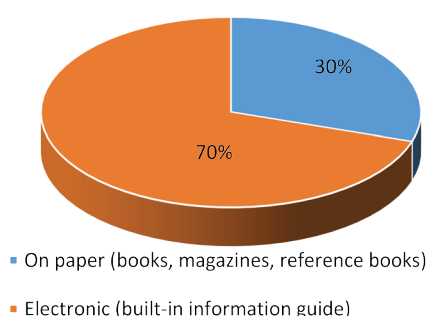


Figure 3. Carrier preference in pharmaceutical counseling

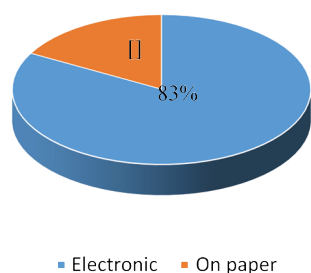


Figure 4. Preferred information and reference medium

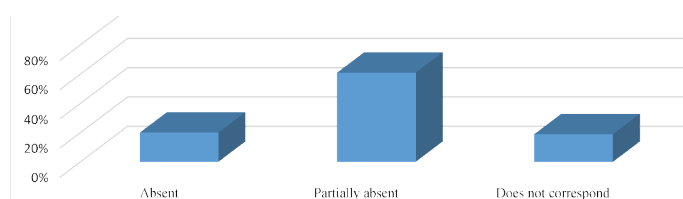


Figure 5. Correspondence of information technology knowledge obtained during training, necessary in the work of a pharmacist

the requirements of practical pharmacy, 19% of respondents indicated that it did not, and the most significant part of the respondents (61%) noted partial compliance, which shows the need to improve the program of teaching information technology in the preparation and organization of a course of pharmacists in pharmacy.

The study determined the degree of satisfaction with the knowledge of working with a personal computer, received by pharmacists at the university, on a 7-point scale. The study showed that 11% of respondents were completely satisfied, and the rest of them were partially satisfied, or completely dissatisfied with the education on working with a personal computer (Figure 6).

The survey showed that 98% of respondents wanted to take an additional course in computer literacy for personal and professional purposes, and only 2% did not have a desire to learn computer literacy (Figure 7).

Thus, the results of the study show the relevance of computer literacy and information technologies subjects in postgraduate and additional professional pharmaceutical education.

Further, according to the set goal, we more deeply investigated the state of information systems in the pharmacies of the region (questionnaire No. 2).

The analysis of these questionnaires resulted in the following data:

The studied pharmacies use eight types of equipment for IT technology: personal computers (100%), cash registers (100%),

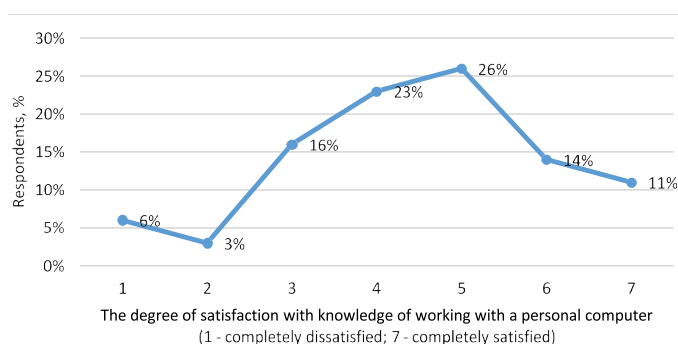


Figure 6. Degree of satisfaction with computer knowledge, received in educational institutions

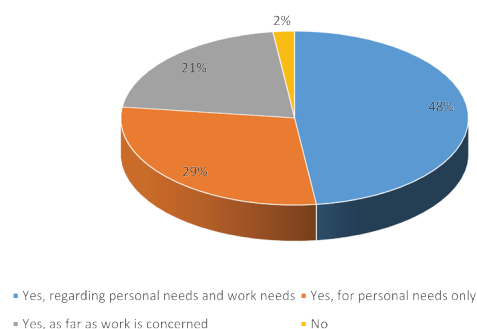


Figure 7. Desire of pharmacists to take additional computer literacy training

payment terminals (100%), and Price Checker (57%). About 29% of all surveyed pharmacies use a scanner, a mobile phone and a tablet, respectively.

The printer is used by only 14.3% of respondents (Figure 8).

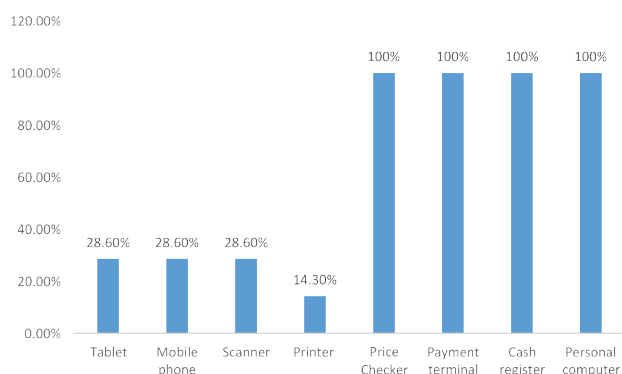


Figure 8. Use of equipment for IT technologies in pharmacies

The overview of the responses to the question «What operating programs do you use?» found that everyone (100%) uses the Windows program, 85.7% of respondents were responsible for using 1C programs - warehouse and cash register software, only 14.3% use the «remote access to a PC» program, and do not use Linux at all 0%) (Figure 9).

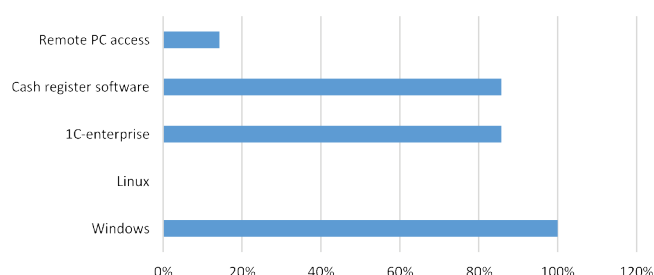


Figure 9. Use of operational programs by respondents

Medicines and medical products in 57.1% of pharmacies are ordered through dedicated websites, through the auto-order program - 14.3%, directly from distributors through the sales department (Atamiras) - 14.3%, Amanat also 14.3% of the studied pharmacies (Figure 10).

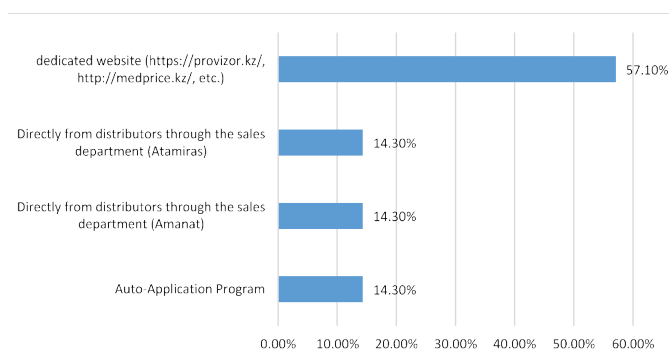


Figure 10. Use of operational programs by respondents

The sale of medicines and medical devices is carried out in 100% of cases through the pharmacy network, and insurance prescriptions - 42.9%. However, currently, there is a sale of medicines through the delivery service Wolt - 28.6%, online pharmacies - 28.6%, and Kaspi marketplace - 14.3% (Figure11).

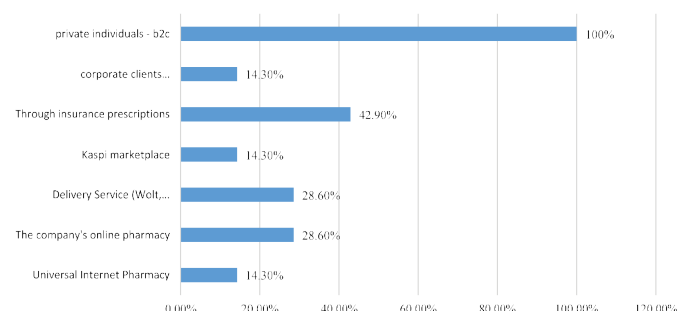


Figure 11. Sales of drugs and MI by pharmacies through various services

We have used the Salesforce system to solve the problem. This program is designed to achieve these goals, especially in accounting processes, including accounting for the receipt of goods in the warehouses, accounting for prices, markups and discounts for sold goods. The system also allows you to automatically generate analytical tables and charts for management analysis and monitor company resources.

The technology of the Salesforce system is based on the principles of architecture focused on providing access to software components and data through "Force.com", which is provided to subscribers for the self-development of applications and extensions for cash register software.¹⁴⁻¹⁶

The system also allows users to work with it through a web browser on the Internet with two-way data encryption.¹⁷⁻¹⁹

To protect the system's data, there is an access protection system (password authentication or user biometrics), monitoring of user actions and the ability to roll back illegal actions. Access to the system is prohibited for unauthorized users.

The system supports several data options for export/import into the system, such as:

1. XLS file is a Microsoft Excel file format.
2. A CSV (Comma Separated Values) file is a text file whose format allows you to save data in a structured table.
3. BigQuery is a Google Cloud service designed to work with Big Data.

This system is designed for end users, considering the specific requirements of the subject area, and provides opportunities for the effective use of technical infrastructure.

The Salesforce system modified by us was created according to the principles of cross-platform architecture and consists of the following subsystems:

- 1) The base of employees - is an access point of authorized persons to the functionality and data of the system;

- 2) Database management system (DBMS);
- 3) System for generating analytical reports.
- 4) Panel for managers

Below, in Table 3, the immediate capabilities of the available subsystems are presented.

Table 3. Modified Salesforce system for a pharmacy organization			
Functionality of subsystems			
Employee database	Database management system	Analytical reporting system	Panel for managers
Access to the information database of the company's employees.	Search for information about pharmaceutical products.	Calculation of staff sales figures.	Tracking all events occurring in all pharmacies in real time.
Storage of personnel personal data (full name, photo, etc. for employees);	Storage of data on goods and prices.	Uploading analysis results in Excel (CSV) format.	Monitoring of the movement of drugs and medical devices.
Sales personnel rating.	Storage of data on counterparties and deliveries.	Formation of diagrams of various types. Analytical reporting system.	Personnel control in a pharmacy.
Input-output of information about contractors, goods, deliveries.	Storage of sales and write-off data.		View Pharmacy Financial Statements

The information support of the system is based on the information-logical model of the subject area of all levels of data presentation. The system interface is minimally sufficient and does not allow ambiguity when performing each technological operation. The system interface and messages intended for end users are implemented in Russian. It is allowed to use interfaces with the English language for administrative consoles of system software.

The employee base created using the free tool "Force.com" includes the following functional components:

1. The employee registration component is designed to create questionnaires and data about the career of employees in the company. It ensures that the structure of the questionnaires meets the information needs of managers, as well as the compliance of employee positions with the accepted regulatory framework.
2. The counterparty registration component is designed to create data on manufacturers and suppliers of goods.
3. The administration component is for the general-purpose directories maintenance (products, promotions, product groups, families, dosage forms, countries, etc.).
4. The sales control component is designed to automate and control sales and write-offs. It provides a quick search for products by specified characteristics. The component connects the sale with the logged in employee. The

component records and stores in the database the facts of sales and write-off of goods.

Access to the system is provided by PIN code or employee biometrics. To do this, you need to click on the Login by fingerprint button or select a PIN code on the authorization form. A fingerprint authorization form will open with the instruction "Put your finger". The pharmacist will need to apply the finger for which the fingerprint was registered to the fingerprint scanner (hereinafter referred to as the Scanner). If the fingerprint is found in the database, then authorization will be successful and the cash register will be unlocked. If the fingerprint is not found, then the fingerprint authorization form will reopen until it is closed with the "Close" button, and the cash register will not be unlocked.

The entire personnel record of the working hours of a pharmacy employee is counted through the entrance using fingerprints. That is, the beginning of the shift is associated with the entrance to the cash register software.

To mark the time of your departure and end your work shift, the pharmacist just needs to open his profile and click on the "End shift" button.

Thanks to the modification of the system, a pharmacy employee can accept payments through:

1. Cash
2. Non-cash funds (Bank cards)
3. Non-cash funds (Kaspi QR)
4. Non-cash funds for legal entities
5. According to insurance prescriptions.

On figure 12 shows the control panel interface for managers.

In this part, you can view real-time information on all active points (pharmacies) of the pharmacy network:

1. Pharmacy Income and Expenses in packages and money.
2. Expansion of the network in the Republic of Kazakhstan.
3. The movement of goods in comparison with the last year.
4. Detailed information for each network pharmacy.

All reports can be downloaded in XLS or CSV files for viewing in Microsoft Excel.

Thus, the system provides control tools for detecting failures and errors, as well as the possibility of organizing continuous monitoring of the state of the complex without a significant impact on its load. The system modified by us is designed to automate business processes and analyze the work of a pharmaceutical company.

Further, we have developed an instruction and an algorithm for using cash register software and additional software in the structure of the system, which is set out in the form of guidelines and implemented in the practice of the Europharma network.

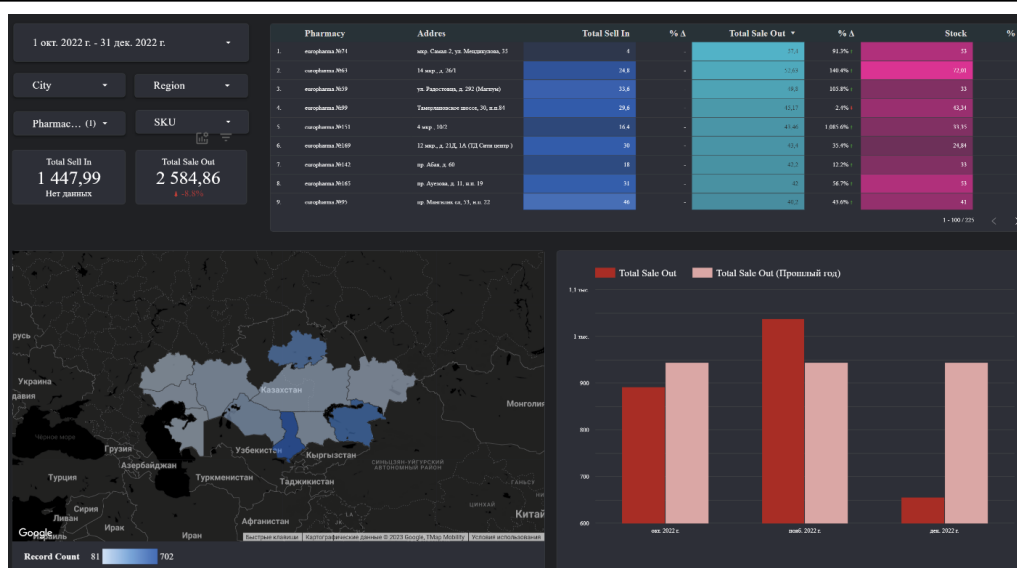


Figure 12. Control panel interface for managers

CONCLUSIONS

To conclude, the main directions of using information technologies in pharmacy are determined: automation of workflow; communications, technology management of pharmaceutical production, automation of accounting and planning, development of decision-making systems, automation of banking operations, and creation of automated workplaces. The automated system “Salesforce” was substantiated and developed to optimize business processes and analyze the work of a pharmaceutical company.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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AUTHOR CONTRIBUTIONS

Conceptualization: Clara D. Shertaeva, Gulnara I. Utegenova; Methodology: Olga V. Blinova, Rabiga M. Anarbaeva; Software: Aigul Zh. Serikbaeva, Sholpan L. Akhelova; Validation: Gulnara I. Utegenova; Formal analysis: Olga V. Blinova; Investigation: Ayat U. Agabek and Aidana D. Orynbayeva; Writing—original draft preparation: Sayora K. Jabarkulova and Bayan I. Tursubekova; Writing—review and editing: Clara D. Shertaeva and Gulnara I. Utegenova; Visualization: Sayora K. Jabarkulova and Bayan I. Tursubekova; Supervision: Clara D. Shertaeva, Gulnara I. Utegenova.

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