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The Website Development for Blood Donation in Kazakhstan

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Abstract

The subject of blood donation was examined using differentiated techniques in many of countries being primarily founded on analysis of population perception. This research aims to investigate the current state of blood donation procedure in Kazakhstan for proposal of a digital solution as a web application to anticipate an improvement of existing system for medical institutions and blood donors. The objective of the study dedicated to analysis of existing framework required for successful adoption of the website. The study based upon primary data arose from an interview with the Blood Center executive of Astana followed with anonymized digital survey and the website development analysis. The results suggest that a digital platform dedicated to transfusion medicine have potential to be efficient environment for Blood Centers for such strategies as collection of donors and promotion of a matter as blood donation. The research extends the literature on digitalization in the context of web development for healthcare facilities.

Key words: Blood donation, Transfusion medicine, Blood donors, Blood Center, Website.

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1. INTRODUCTION

Blood transfusion is an essential fraction of the healthcare system worldwide. The current paper considers Kazakhstan, located in Central Asia with a population of 20 million (Bureau of National Statistics, 2024), where the number of blood donors is 15 donations per 1,000 population, whereas in terms of bone marrow donation the number equivalent to 1 per 10,000 (Research and Production Center of Transfusiology, 2021). As a result, the larger the number of donors, the higher the probability of saving a greater number of patients. One of the proposed solutions to increase the number of blood sharing volunteers via digitalization as the world-practicing development of web platforms for healthcare organizations. Respectively, the purpose of the study to investigate the current state of blood donation procedure in Kazakhstan for implementation of solution as a website to anticipate an improvement in existing system for medical institutions and blood donors. The objective of the study to analyze existing framework required for successful adoption of the web application. The results extend the literature on digitalization via illumination of potential benefits of the web platform for healthcare facilities in Kazakhstan as an extensional communication approach for propagation of a matter and encouragement of individuals for blood donation. The research is relevant to healthcare providers and parties involved in digitalization.

1.1. Problem Statement

The comparison of existing and proposed system for transfusion medicine of Astana presented in Table 1. Specifically, the existing digital platform as a website of the Blood Center represent a need for blood types via table chart (i.e., arrangement of data via rows and columns) in a static manner (i.e., non-interactive, unchangeable and read-only content). The proposed system considers provision of information regarding blood sufficiency in dynamic format (i.e., changeable content) via dependence on data and user behaviour. As a result, encouragement of

voluntary donations, education of population and empowerment of Blood Center operations proposed via current system will cover following aspects:

1. The system presents secure storage of data via centralized database.

2. The system presents a new approach to Blood Centers for donor collection.

3. The system presents visitors unified interaction with Blood Centers across the country.

Existing System	Proposed System
1. Blood Bank represent a need for blood types via usage of a table chart in representation of a static content.	1. The system presents modified approach to represent a need for blood types of Blood Centers via dynamic content.
2. Potential donors does not have an availability to accept an initiative for donation via platform.	2. The system allows potential donors to accept an initiative for donation via platform.
3. The system does not provide high efficiency.	3. The system will provide greater engagement due to modified user experience that possible to result in high efficiency.

Table 1. Comparison of existing and proposed system.

The review of worldwide platforms dedicated to transfusion medicine represented in Table 2 via mention of organizations which obtain a distinct feature as publication of each blood type sufficiency in measurement of days on a nationwide scale via single system on non-commercial basis. Specifically, the brightest example could be represented by functioning in Russia "DonorSearch" website, which ranked first in the "Society" category in 2021 based upon the

Leaders of Sustainable Development (Strategy Partners, 2021). Supportively, the "Carter BloodCare" enable supply of over 440,000 units of blood products on annual basis to cover the needs of over 200 hospitals across Texas (Carter BloodCare, 2021).

№	Organization	Country
1	DonorSearch	Russian Federation
2	Carter BloodCare	Texas, The United States of America
3	Irish Blood Transfusion Service	Ireland
4	Scottish National Blood Transfusion Service	Scotland

Table 2. Benchmark Organizations.

1.2. Research Hypotheses

The hypotheses for the study to identify the impact of website development for transfusion medicine in Kazakhstan are as follows:

H1: Website development will positively affect medical institutions and potential donors via advancement of the interaction process due to development of operational convenience.

H2: Website elaboration will have a beneficial impact on the current blood donation system in Kazakhstan via an increase in metrics as the number of blood sharing volunteers.

2. LITERATURE REVIEW

According to the New York Blood Center (2023) blood that is produced in the bone marrow, collected as whole blood and separated into components such as platelets, red cells, and plasma.

Concretely, surgical interventions and treatment for leukaemia need platelets, stop of bleeding require plasma and red blood cells dedicated for blood loss (American Red Cross, n.d.). As a result, blood transfusion has saved millions in emergencies since its establishment in 1818 based upon Association for the Advancement of Blood & Biotherapies (AABB, n.d.), when human blood was successfully transfused for the first time with postpartum bleeding case. Still, the absence of a substitute for blood develops a constant demand for donors worldwide, as majority of medical interventions depend on adequate blood supplies. Accordingly, constant increase of donor pool is the fundamental basis of the transfusion medicine lifecycle. Subsequently, understanding of volunteer's attitude based upon incentives and barriers is highly significant for development of the current structure of blood donation system. Concretely, obstacles as lack of knowledge (Garrido et al., 2021) and fear of infection (Tripathi et al., 2021; Stock & Möckel, 2021) tend to hinder donation and considered to be barriers, whereas solidarity (Garrido et al., 2021), empathy (Mohammed & Essel, 2018) and willingness to alleviate shortages (Veld et al., 2019) considered to be motivational factors. However, the correlation between barriers and incentives explained to be negative, since the prevalence of barriers leads to decision as not to donate, and vice versa (Romero-Domínguez et al., 2021). Supportively, the prevalence of barriers leads to expectation of a greater payment to become a donor (France et al., 2022). Respectively, in Kazakhstan more than 200 thousand individuals share blood and 18 thousand considered to be frequent donors on a gratuitous basis (Ministry of Health of the Republic of Kazakhstan, 2021). Resultatively, donors who have reached 40 donations are awarded with badges and letters of gratitude from local executives, whereas donors with a smaller number are encouraged by certificates. Nonetheless, personal incentives (e.g., willingness to help people in need, intention to eliminate shortages) are considered a stronger determinant over the possession of certain inducements (Veld et al., 2019). As a result, development of donor acquisition strategies should not be fundamental on extrinsic motivation, but focused on public education

regarding the nature of blood as a scarcity for encouragement of donors (Mohammed & Essel, 2018). Subsequently, existing literature articulates considerable attention to be dedicated to the aspect of knowledge due to lack of awareness regarding the blood donation procedure. Concretely, majority identified to be not aware of the minimum age for blood donation (Mohammed & Essel, 2018), duration of the donation procedure and possessed blood type (Zucoloto & Martinez, 2018). Resultatively, donors obtain greater knowledge on blood donation compared to non-donors (Zucoloto & Martinez, 2018; Stock & Möckel, 2021). Supportively, lack of knowledge perceived as a main hindrance to donation for both, donors and non-donors (Baidoo et al., 2024). Equivalently, increase in the likelihood of voluntary donations possible to occur via addressing knowledge gap as a determinant aspect of decision to become a donor (Atherley et al., 2016). Specifically, television and the internet determined to be the most efficient instruments for increase of awareness on blood donation (Ou-Yang et al., 2017; Stock & Möckel, 2021). Supportively, digital product dedicated to transfusion medicine as encompasses an idea of blood bank executives might include pre and post donation educational materials with consideration of aspects as confidentiality and privacy (Batis & Albarrak, 2021). Concretely, privacy as a primary requirement for digitalization refers to exchange of personal or medical data (Niklas et al., 2023), whereas obligation for healthcare providers as prohibition on disclosure of personal data of patients refers to principle of confidentiality implied via medical ethics as Hippocratic Oath (Chandrashekar, 2023). Resultatively, protection of users and responsibility for data receivers within digital interaction essential to be concerned as in the privacy and security law of European Union entitled General Data Protection Regulation (GDPR) that imposes legal and technical requirements for secure collection of personal data (e.g. name, address, health records, etc.) based upon voluntarily consent of the user (Wolford, 2023; Chandrashekar, 2023). Otherwise, breach of confidentiality leads to negative consequences as decrease of voluntary donations for transfusion medicine (Chandrashekar, 2023). Supportively,

digital products of healthcare industries tend to collect data build on MySQL database due to beneficial qualities as reliability, stability, efficiency and scalability for secure interaction with a web system (GeeksforGeeks, 2024). Additionally, MySQL support CRUD operations (i.e., Create, Read, Update, Delete) for associated user roles in a framework of obtained functionalities within a system (Ayadi et al., 2024; Ohyver et al., 2019). Equivalently, web platform developed on Node.js and MySQL database will benefit medical applications (Zhang, 2019). Subsequently, digitalization provides advantageous environment for donors and blood banks via change of donor pool and maintenance of donor management (Niklas et al., 2023).

3. METHODOLOGY

The study obtains an exploratory sequential mixed design, where qualitative analysis based upon primary data arose from an interview with the Blood Center executive of Astana, whereas quantitative analysis based upon an anonymized digital survey via Google Forms with a record of responses in a Google Sheet followed with analysis of the website development. The software development (i.e., code for the web application) written in Visual Studio Code platform based upon a composition of structure basis elaboration via Hypertext Markup Language (HTML), inclusion of design via Cascading Style Sheets (CSS), implementation of functionality via JavaScript programming language developed by Brendan Eich in 1995 (Theisen, 2019) followed with development of Relational Database Management System (RDBMS) as MySQL via Structured Query Language (SQL) queries (Soewito et al., 2018).

3.1. Ethical Considerations

The collection of data essential to follow ethical clearance for interview and survey both based upon mixed methods of the study. Subsequently, informed about the study participants were agreed adult individuals (≥18 years) as only exclusion criteria, since participants aged under 18

are not allowed to donate blood. Supportively, elimination of the language barrier provided via translation of the questionnaire into Russian to ensure a high-level understanding of the respondents, since data validity issues might occur as not all participants may possess English.

3.2. Survey Questionnaire

The structured, anonymized, and self-administered questionnaire consisted of 19 closed questions translated into Russian (see Appendix 1). The questionnaire was divided into the following sections: Socio-demographic characteristics as age, gender, and education (3 question), blood donation experience (2 question), attitude towards blood donation as analysis of incentives and barriers (2 question), knowledge on blood donation procedure (4 question), perception of blood donation procedure using 5-point Likert scale where 1 indicates "Extremely Unlikely" and 5 indicates "Extremely Likely" (3 question), perception of a digital platform dedicated to transfusion medicine with analysis of convenience level using 10-point rating scale (5 question). Additionally, choosing more than one answer among listed options in some questions was allowed same as an opportunity to elaborate thoughts under the choice "other" (i.e., extra text field). As a result, the questionnaire collected via Google Form was accessed to participants via survey link and QR Code.

3.3. Interview Questionnaire

The semi-structured interview consisted of 15 open-ended questions as represented in Table 3 was prepared. The interview consisted of the following units:

Unit	Questions

To learn about a person, and his / her position	1. Name 2. Position in the Blood Center
To discover about the Blood Center and its objectives	1. What is the current working structure of the Blood Center? 2. What objectives does the Blood Center follow?
To explore current state of blood donation system	1. What is the current need of the blood? 2. What are the requirements for becoming a donor? 3. What is the process of blood donation? 4. What are the statistics of regular donations? 5. How does donor collection occur at the current time? 6. What incentives for donors exist at the current time? 7. What can be considered a barrier to increase the number of donors? 8. Were there any differences in the operation of the Blood Center during COVID-19? 9. Did the Blood Center face any difficulties during COVID-19?
To determine strategies of the Blood Center	1. What strategies to improve the current blood donation system you would like to implement? 2. What are the current communication channels with donors?

Table 3. The interview questions.

3.4. Data Collection

The quantitative research collected a total of 140 voluntary responses via self-administered Google Form questionnaire from middle of March to April (see Appendix 2). The survey consisted of multiple-choice closed questions aimed to analyze the perception of participants on the subject of blood donation based upon socio-demographic characteristics, individual experience and internal reasonings. The study was entirely anonymous as once response has been submitted, it cannot be identified and deleted.

4. ANALYSIS AND RESULTS

4.1. Quantitative Data

Socio-demographic characteristics as gender, age and education

The survey collected a total of 140 responses as 23.6% (N = 33) of males and 75% (N = 105) of females where major proportion of participants were aged between 18 to 23 years old (80.7%), as a great number of invited individuals of other age groups refused to participate, developing a lower proportion as 9.3% aged 24 to 30 and 8.6% aged 31 to 45. The most of the respondents (N = 84; 60%) obtained Higher Education, 6.4% acquired Vocational Education (e.g., College, Technician School) whereas 32.9% are Secondary School graduates.

Blood donation experience

Totally, regarding blood donation experience, 10.7% (N = 15) reported of donating blood once (10%, occasional donors) and more (0.7%, frequent donors), whereas majority of 89.3% (N =

125) have never donated blood (Appendix 2, Figure 1a). Concretely, 8.6% donate blood once per year, whereas 1.4% donate blood with a frequency as 2 (0.7%) and 3 (0.7%) times per year.

Attitude towards blood donation

The perception of incentive for the majority of 63.6% (N = 89) determined to be the desire to help people in need, whereas 20% willing to help only known individuals (e.g., relatives, friends). Concurrently, the minority of 5% (N = 7) preferred extrinsic rewards (e.g., monetary compensation, the title of "Honorary Donor"). Still, 27.9% (N = 39) reported the absence of any stimulus for donation of blood (Appendix 2, Figure 2a). Conversely, medical contraindications (e.g., low weight, anemia, etc.) represented as a primary barrier to become a donor for 55% (N = 77), followed by fear of procedure (i.e., fear of needles) for 29.3% and lack of awareness (e.g., location of donation centers, requirements) for 27.8%. Respectively, the remaining barriers in descending order with approximately similar values are lack of time (N = 34; 24,3%), lack of safety (e.g., fear of infection, physical consequences; N = 34; 24,3%) and lack of stimulus to become a donor (N = 31; 22,1%).

Knowledge on blood donation

The pie chart demonstrates even fractions, where 50.7% (N = 71) of participants represent awareness of age restrictions for blood donation and almost half as 49.3% of unaware participants in contrast, based upon a variety of incorrect answers (Appendix 2, Figure 3a). Respectively, 55.7% of participants (N = 78) tend to be not aware of the blood donation procedure, since the majority answered "I do not know" to the question as "Does donated blood have to be utilized within 24 hours, otherwise it is no longer unusable?" where 27.1% answered correctly (Appendix 2, Figure 3b). Nevertheless, greater number of participants as 67.9% (N = 95) determined to be aware of possessed blood type. Correspondingly, 87.1% (N = 122) of

respondents are aware that not every volunteer eligible for blood donation procedure (Appendix 2, Figure 3d).

Perception of blood donation procedure

Almost all participants of the study (N = 137; 97.9%) recognized the necessity of blood donation (Appendix 2, Figure 4a). However, in terms of perception for being a donor, data varies based upon a 5-point Likert scale. Concretely, recognition of the necessity to be a donor via the question as "How important it is to be a donor?" was considered as "Important" by 44.3% and "Very Important" by 25.7%, whereas 29.3% of respondents are neutral and 0.7% (N = 1) answered as "Not Important". Still, no one neglect necessity of being a donor via answering as "Not Very Important" (Appendix 2, Figure 4b). Furthermore, the readiness of respondents to become a donor in the future summarized as "Very Likely" by 25% and "Likely" by 37.1%, whereas 26.4% are neutral, 10% are "Unlikely" and 1.4% are "Very Unlikely" (Appendix 2, Figure 4c).

Perception of a digital platform

The preferred communication channel with the Blood Center for over a half of the respondents (N = 81; 57.9%) are direct text messages (i.e., SMS). However, 26.4% prefer to be contacted by email and 19.3% via direct calls, whereas 20.7% (N = 29) do not prefer any type of communication. The analysis of a website content dedicated to transfusion medicine determined the majority of participants indicated desire to obtain features as "Availability and Demand of Blood Types" by 82.1% (N = 115) for observation of blood sufficiency, reasons for donation by 52.9% (N = 74), location of a blood banks by 47.9% (N = 67), articles (e.g., cases of people in need, requirements and instructions for donation) by 46.4% (N = 65) and 40% (N= 56) would prefer to be aware of events dedicated to transfusion medicine (Appendix 2, Figure 5b). As a

result, majority of 88.6% (N=124) believe that the website dedicated to blood donation will obtain a positive impact, whereas neutral was chosen by 10.7% (N=15) and negative by 0.7% (N=1; Appendix 2, Figure 5c). Subsequently, the convenience of digital interaction and likelihood of a website usage to accept an idea of becoming a donor through the mentioned above features was determined via 10-point rating scale, where 1 is "Very Unlikely" and 10 is "Very Likely". Thereby, represented Figure 1 summarizes the likelihood of a website usage, where rating as 10 (i.e., "Very Likely") was chosen by 34.3% (N = 48), whereas 8.6% are "Neutral" (N = 12) and 2.9% (N = 4) answered as 1 or "Very Unlikely".
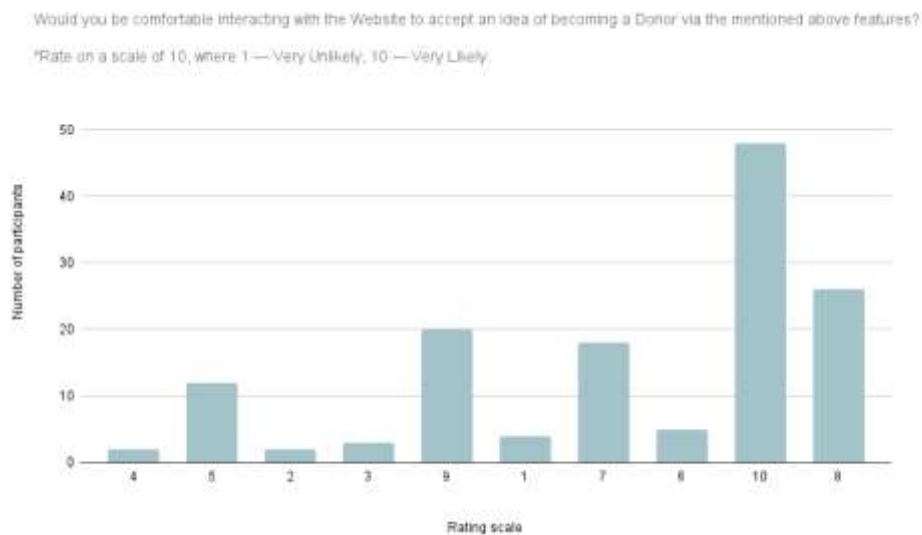
Figure 1. Likelihood of using a website dedicated to blood donation.

Supportively, as the last question the respondents were asked to select potential benefits of the website. As a result, increase in the number of donors was chosen by 75% (N = 105), raise of population awareness by 64.3% (N = 90), improvement of the healthcare system by 34.3% (N = 48), expansion of opportunities for donors and Blood Centers by 32.9% (N = 46) and development of a unified interaction between donors and Blood Centers by 31.4% (N = 44).

4.2. Qualitative Data

The Head of Donor Recruitment Department of the Scientific and Production Center of Transfusiology of Astana under the Ministry of Health of the Republic of Kazakhstan, physician, therapist and transfusiologist, Sagambayeva Aigerim Kabdyvakhitovna was face-to-face interviewed on 28 of March, where a total of 15 open-ended questions were asked. The semi-structured interview was transcribed handwritten. The purpose of the interview was to define if the website development dedicated to transfusion medicine is relevant for the Blood Center. Supportively, the following themes and subthemes were emerged:

Theme 1: Workflow and objectives of the Blood Center

The respondent was asked about standard workflow of the Blood Center. As a result, the working structure is based upon on-site sessions to cover the daily requests of 23 clinics that are supplied by the Blood Center. Consequently, the primary purpose of the Blood Center — supply of blood, since surgical interventions, blood loss, therapeutic treatment for leukaemia and multitude of other cases require blood that does not obtain any substitute. Supportively:

"Our objectives are firstly, to cover blood deficiencies, follow development of blood and its components along with improvement of scientific researches as we are "Scientific and Production Center of Transfusiology.""

Theme 2: Current statistics

The need of blood for 2023 equivalent to 39,000 donations or 120-150 donors for Astana only. The statistics of regular donations based upon a measurement of regular donors, the number of which equals to 3,000. However:

"Every new constructed medical facility signifies that the need of blood is only growing."

Theme 3: Donation procedure

The donation procedure begins with the completion of a donor questionnaire. Subsequently, the laboratory determines eligibility of individual for donation based upon medical indications (e.g., Rh, hemoglobin level). Afterwards, therapist conducts an assessment of donor's health suitability via analysis of previously or currently obtained diseases, and determines as if the ineligibility for donation is temporary or permanent. As a result, passed all required steps individual become eligible donor, drinks tea and makes a donation of blood or its components, when the procedure is completed, the donor is instructed to rest for minimum of 10 minutes.

Theme 4: Donor profile

Requirements: The requirements to become a donor implies 3 criteria as weight ($\geq$ 50 pounds), age ($\geq$ 18 years old) and absence of medical contraindications for anyone willing:

"Anyone willing under Ordinance No. 102 of the Ministry of Health of the Republic of Kazakhstan allowed to become a donor."

Acquisition: Collection of donors at the current time occur via call invitations, offsite events as visits to universities and public places, media channels as TV and newspapers, advertisements as banners and social networks as Twitter, Facebook, Instagram and TikTok. However, the most efficient communication channel determined to be direct calling:

"73% of donors are frequent donors who asked to donate via direct calling, since no other channel is as much efficient."

Incentives: The major intrinsic incentive for donors determined to be altruism (i.e., desire to help people in need). Concurrently, material rewards for donors — 0.25 MCI (932 tenge), medical certificate for 2 days of vacation and the title of "Honorary Donor" for 40 donations.

Still, the extra incentive includes health prevention as enhancement of an immune system, renewal of cells and prevention of cardiovascular diseases. Supportively, essential to highlight:

"Red blood cell lives in an organism only for 120 days, after this period dies; or it could be given to another person via possibilities of medicine and a good lifestyle of a sharing individual."

Barriers: The primary barrier to increase the number of donors rooted in fear of the population. Concretely, majority feel fear of being infected followed with a fear of needles (i.e., tend to be slightly larger). Still, vital to mention:

"People tend to think that there is no need to share common blood types due to the conviction that common blood types are frequent blood types. However, it only indicates that common blood types are equivalently the most needed. Remarkably, a human sharing blood does not lose anything."

Theme 5: COVID-19

The difference in operation of the Blood Center during COVID-19 in relation to the current state determined to be not a complication of movement, but acquisition of donors as people were in fear of getting infected during pandemic, whereas the demand of blood remained unchangeable:

"The need of blood is constant due to the absence of substitutes."

Theme 6: Strategies

The strategies for improvement of the current blood donation system focused on reduction of paid donations. Concretely, 92% of current donations are non-remunerated. However,

continuous increase of unpaid donations is essential as WHO suggest 100% of voluntary donations. Moreover, the Blood Center of Astana desire to obtain digital environment as a DonorSearch platform or mobile application with a possibility for publication of demand for blood, inclusion of a donor profile with a history of donations and provision of results based upon medical analysis:

"The most essential purpose to increase the number of donors via advocation that there is no alternative of blood."

4.3. Website Development

4.3.1. System Architecture

The system architecture is a visual representation of relationships between hardware and software components within a system dedicated to clarification of structure, functionality and interactions. Supportively, the proposed system allows the exchange of data and provision of interfaces in dependence on role of the user via Hypertext Transfer Protocol (HTTP). Concretely, the client-server structure of the HTTP protocol based upon transfer of request-response messages, where the web browser referred as a client and response messages provided via server as represented in Figure 2. As a result, connected to the Internet web server via interaction with a centralized database able to manage data and render interfaces due to role of the user on a real-time basis.
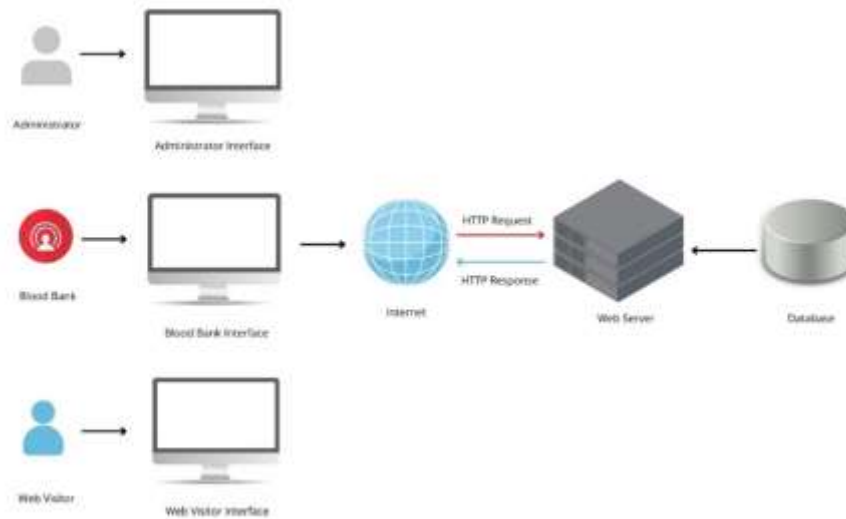
Figure 2. System Architecture of a digital platform.

Subsequently, the interaction with the web application begins via display of a primary page (i.e., Main Page). The Main Page introduces the content of a website to the user with a possibility of authorization (i.e., permission to access specific features of the platform) based upon Registration or Login to the system as represented in Figure 3 via a flowchart diagram to visualize the sequence of required decisions for execution of processes which allow interaction with a platform in accordance with CRUD operations:
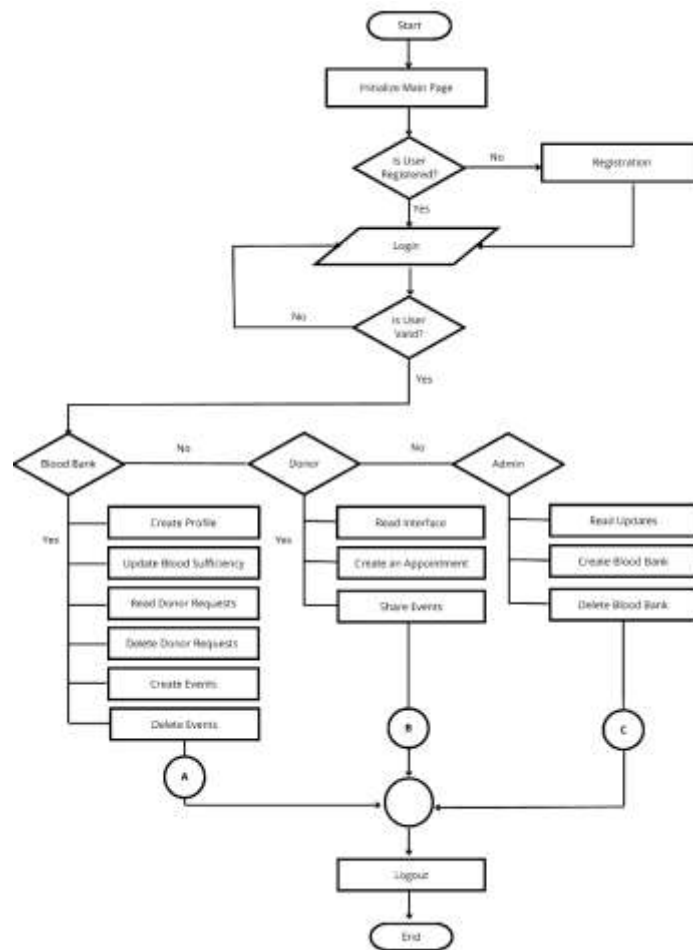
Figure 3. Flowchart Diagram of a system.

Specifically, the process of authorization represented via a sequence diagram in Figure 4 as a visual model for observation of system behavior based upon exchange of messages in sequential order. Concreatly, the interaction of synchronous and return messages founded on await of reply unless execution of the message will occur for continuation of cooperation. Supportively, the authorization process of the system via interaction with the centralized database possible to be explained in the following manner:

1. If a user of a platform decides to make an authorization and does not have an existing account, registration will occur via entrance of credentials as Blood Center name, city name, email, password and confirmation of a password. Respectively, display of

appropriate page with extra features of the system as management of blood sufficiency,

donors and events become available.

2. If a user of a platform decides to make an authorization and has an existing account, login

   will occur via entrance of credentials as Blood Bank email and password for successful

   authentication (i.e., assurance of identity to access specific features of a system) followed

   with a display of the appropriate page.
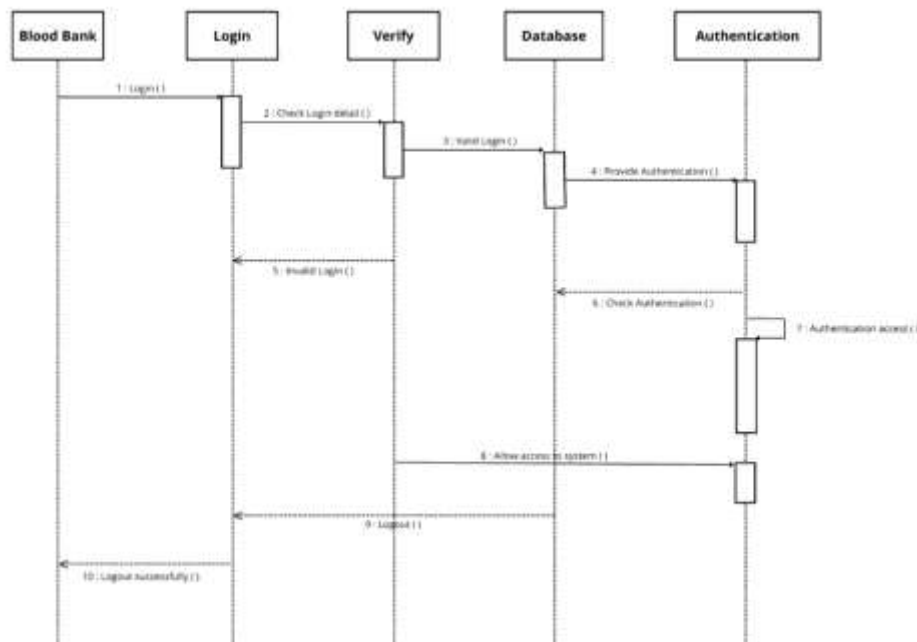
Figure 4. Sequence Diagram for authentication process of a system.

Equivalently, the system security based upon verification of identity to access the editorial

content of the platform in accordance with MySQL. Respectively, the system enables Blood

Banks to publish, store and modify data via centralized database. Concretely, Blood Centers able

to function within a system via the processes represented in Figure 5.
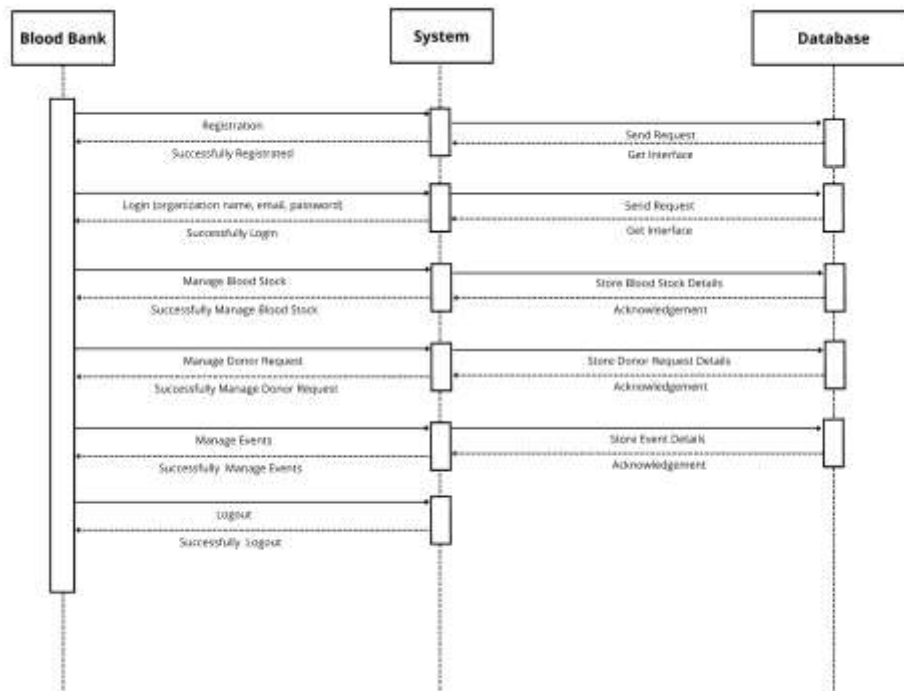
Figure 5. Sequence Diagram of a system dedicated to transfusion medicine.

4.3.2. Implementation

The content of the web application focuses on such aspects as publication of blood sufficiency

and events, inclusion of pre and post donation educational material as instruction for procedure

along with requirements. Supportively, provision of location for Blood Centers across the

country was developed via Google Map slider. The history of a concept as blood donation,

introduction with qualities and nature of blood was included. The website enables a gallery of

cases based upon a content of a book (Team & WHO, 2006) dedicated to stories of blood needed

individuals around the world for raise of population awareness. As a result, introduced with a

content of the website individual able to represent an intention for becoming a donor via filling

of a form at the Main Page. However, as the form require entrance of personal data, voluntary

consent of individual as acceptance of terms will be required for secure collection of data.

Supportively, the agreed individual's data will be received in accordance with preferred Blood

Bank. Respectively, independent Blood Centers after verification of identity will be able to obtain CRUD operations as publication and update of required data and materials as sufficiency of blood and events followed with observation of received requests as a dynamic content of the web application (see Appendix 3). Respectively, the interfaces of the system represented below:
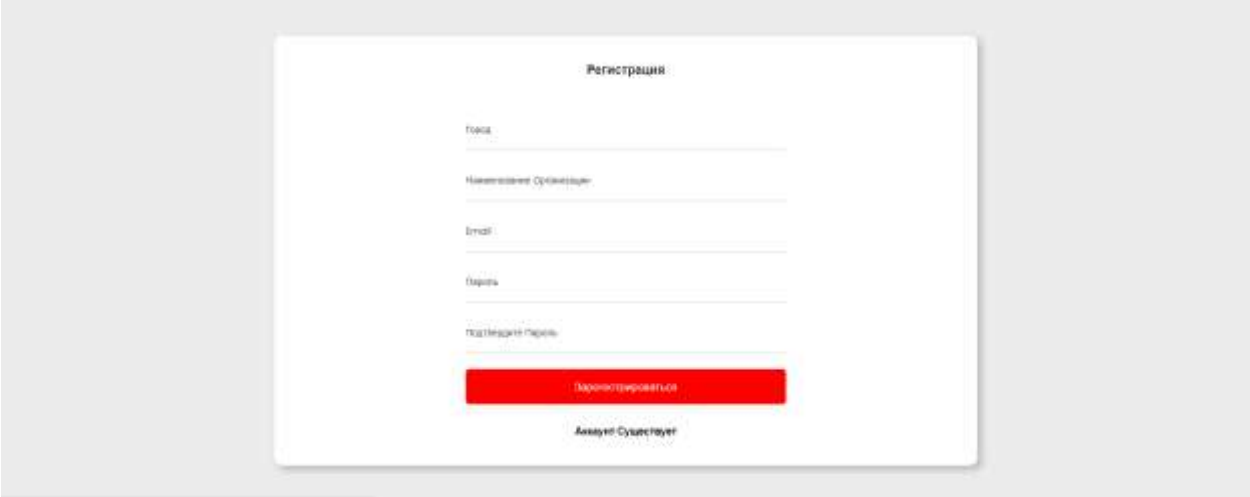
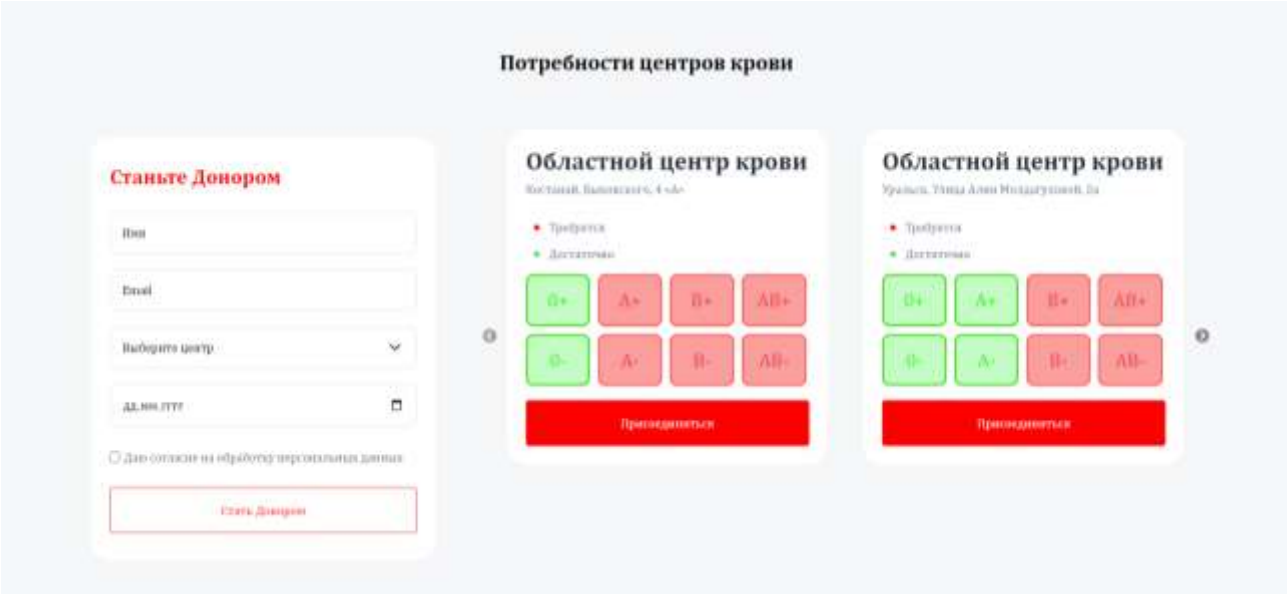Figure 6. Blood Center Registration Page for entrance to the sytem.

Figure 7. Blood sufficiency and proposal for donation of the system at the Main Page.
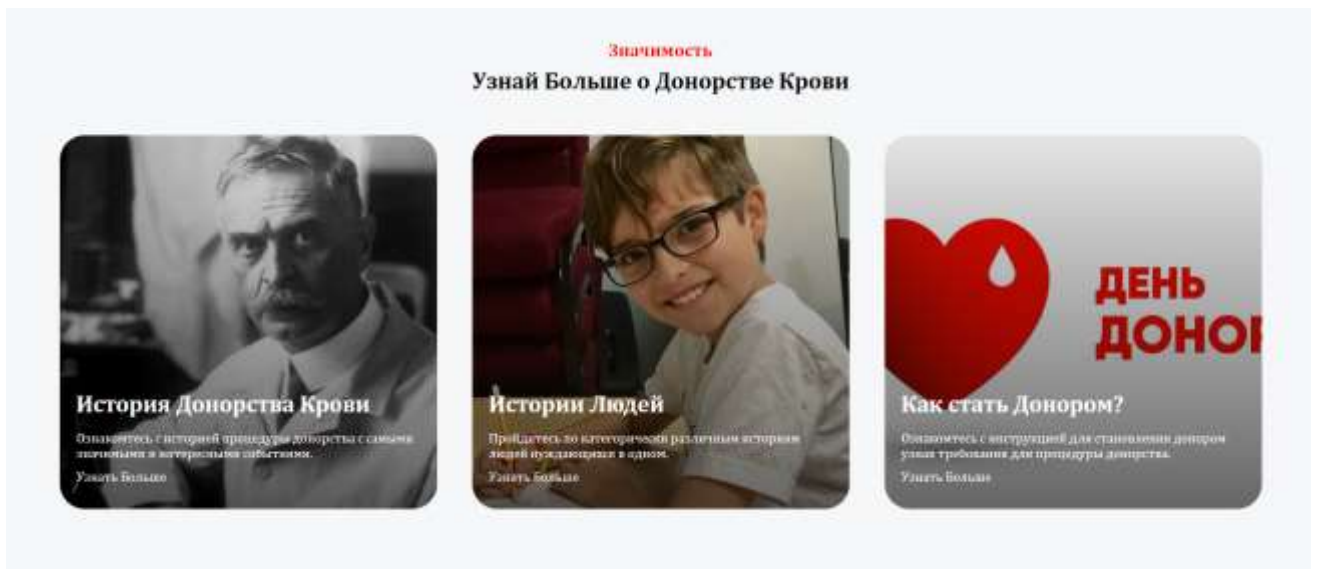
Figure 8. Articles dedicated for donation procedure of a digital platform at the Main Page.
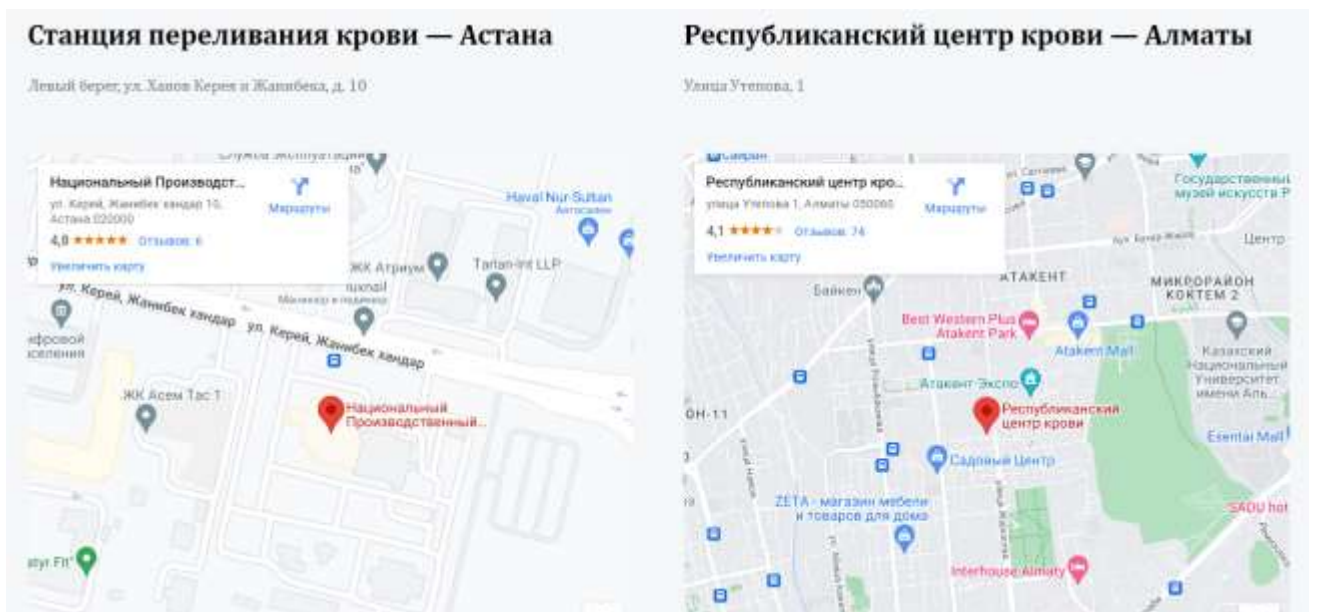
Figure 9. Location of Blood Centers of the digital platform.
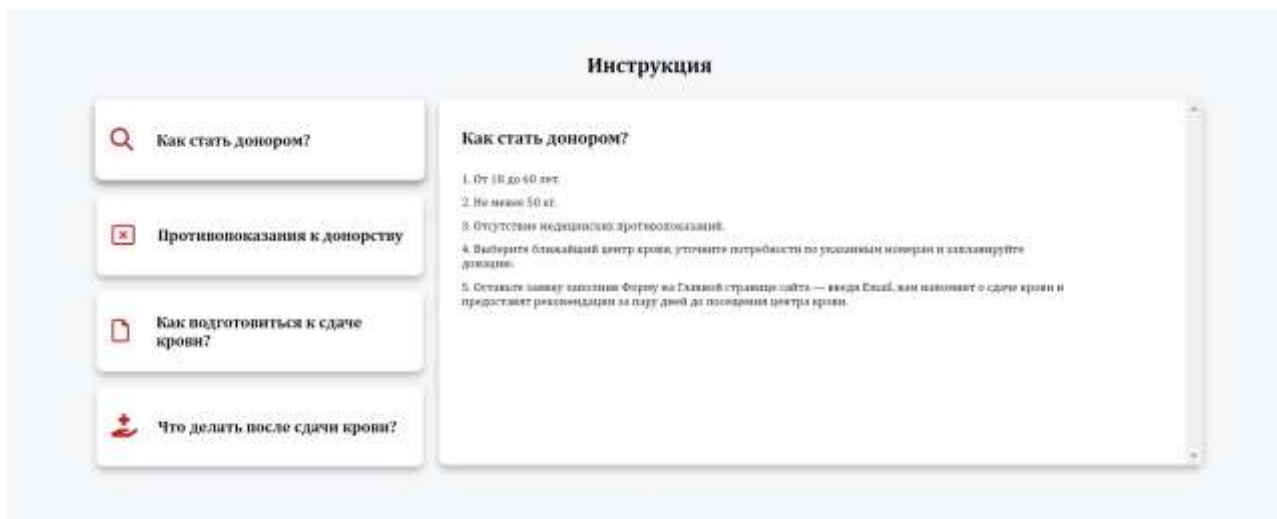
Figure 10. Instructions for donation procedure of the digital platform.

Figure 11. Introduction with nature of blood and its qualities via digital platform.

5. CONCLUSION

To conclude, the current paper investigated an analysis of the proposed solution as the website development for transfusion medicine in Kazakhstan. The research demonstrated a positive response of the Blood Center and high engagement of potential users of the platform. One of the

main limitations of the study is the prevalence of young participants aged between 18 to 23 covering primarily 81% of the population towards significantly small dataset of other age groups. The findings emphasize knowledge regarding blood donation procedure as a prior aspect for becoming a donor. The study highlights significance of intrinsic incentives for increase in the number of donors via emphasis for development of awareness regarding the subject as blood donation among population. The study suggest that a digital platform dedicated to transfusion medicine have potential to be efficient environment for Blood Centers for strategies as collection of donors and promotion of a matter as blood donation theoretically. The study is relevant to healthcare institutions and policymakers for development of strategies dedicated to transfusion medicine via implementation of digital solution as the website for promotion and development of blood donation in the country.

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APPENDICES

Appendix 1. The survey questions.

Question	Answer Options
1. What is your age?	☐ 18-23 ☐ 24-30 ☐ 31-45 ☐ 46-60
2. What is your gender?	☐ Male ☐ Female ☐ Prefer not to answer
3. What is your education?	☐ Basic General Education (9 years) ☐ Secondary General Education (11-12 years) ☐ Professional and Vocational Education (Technician School, College) ☐ Higher Education (Bachelor's Degree, Master's Degree, Doctoral Degree)
4. What is your donor status?	☐ Non-donor ☐ Infrequent donor ☐ Frequent donor
5. What is your donation frequency (number of donations per year)?	☐ 0 / year ☐ 1 / year ☐ 2 / year ☐ 3 / year ☐ 4 / year

6. What do you consider as an incentive for blood donation?	☐ Family / Friends in need ☐ Desire to help people in need ☐ To try a new experience ☐ Material rewards (cash remuneration, the title of "Honorary Donor") ☐ No Incentives
7. What do you consider as a barrier to blood donation?	☐ Fear of procedure ☐ Medical contraindications (low weight, anemia, other) ☐ Lack of Awareness (location of donation facilities, requirements to become a donor) ☐ Absence of Time ☐ Absence of Desire ☐ Lack of Safety (physical consequences) ☐ Other… (Text Input)
8. What are the age restrictions for blood donation?	☐ 14-70 ☐ 16-55 ☐ **18-60 (correct answer)** ☐ 21-65
9. Does donated blood need to be utilized within 24 hours, otherwise it is no longer usable?	☐ **No (correct answer)** ☐ Yes ☐ I do Not Know
10. Do you know your blood type?	☐ Yes ☐ No

11.Is everyone eligible for the donation procedure?	☐ Yes ☐ **No (correct answer)** ☐ I do Not Know
12. Do you consider blood donation essential?	☐ Yes ☐ No
13. How important it is to be a donor?	☐ Very important ☐ Important ☐ Neutral ☐ Not important ☐ Not very important
14. How likely are you to consider the idea of becoming a donor in the future?	☐ Very likely ☐ Likely ☐ Neutral ☐ Unlikely ☐ Very unlikely
15. What communication channel with the Blood Center you would prefer?	☐ Email ☐ Phone Call ☐ Text Message (SMS) ☐ Prefer not to communicate
16. What features would you like to see on a website dedicated to Blood Donation?	☐ Location of donation facilities ☐ Availability and demand of blood types ☐ Reasons for blood donation ☐ Events dedicated to blood donation

	□ Articles (cases of people being in need, instructions and requirements for donation)
17. What impact a blood donation website might have?	□ Positive impact □ Neutral impact □ Negative impact
18. What are the potential benefits of developing a website dedicated to blood donation?	□ Increase in the number of donors □ Increase of population awareness □ Improvement of interaction between Donors and the Blood Center □ Improvement of conditions for healthcare system □ Expansion of opportunities for Donors and Blood Centers
19. Would you be comfortable interacting with the Website to accept an idea of becoming a Donor via the mentioned above features? *Rate on a scale of 10, where 1 — very unlikely, 10 — very likely.	□ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 □ 8 □ 9 □ 10

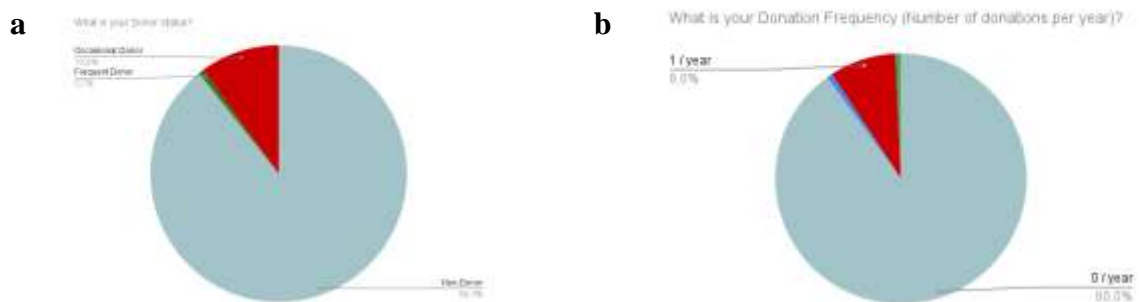**Appendix 2.** The survey results.

Figure 1. Blood donation experience of participants as status of a donor (a) and frequency of donations per year (b).
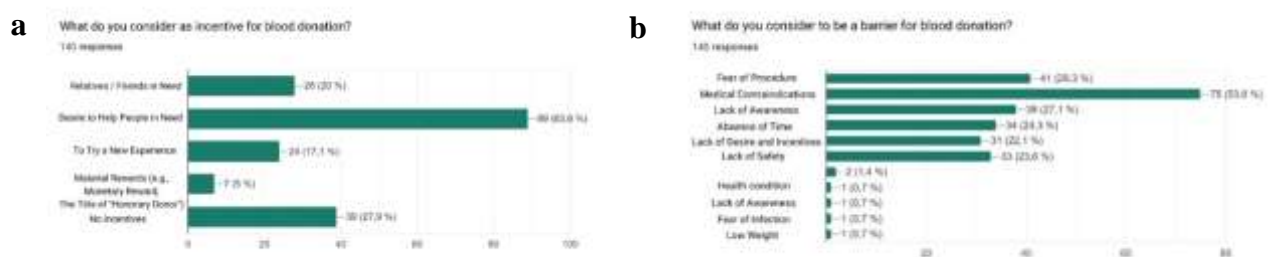

Figure 2. Attitude towards blood donation of participants as perception of incentives (a) and barriers (b).
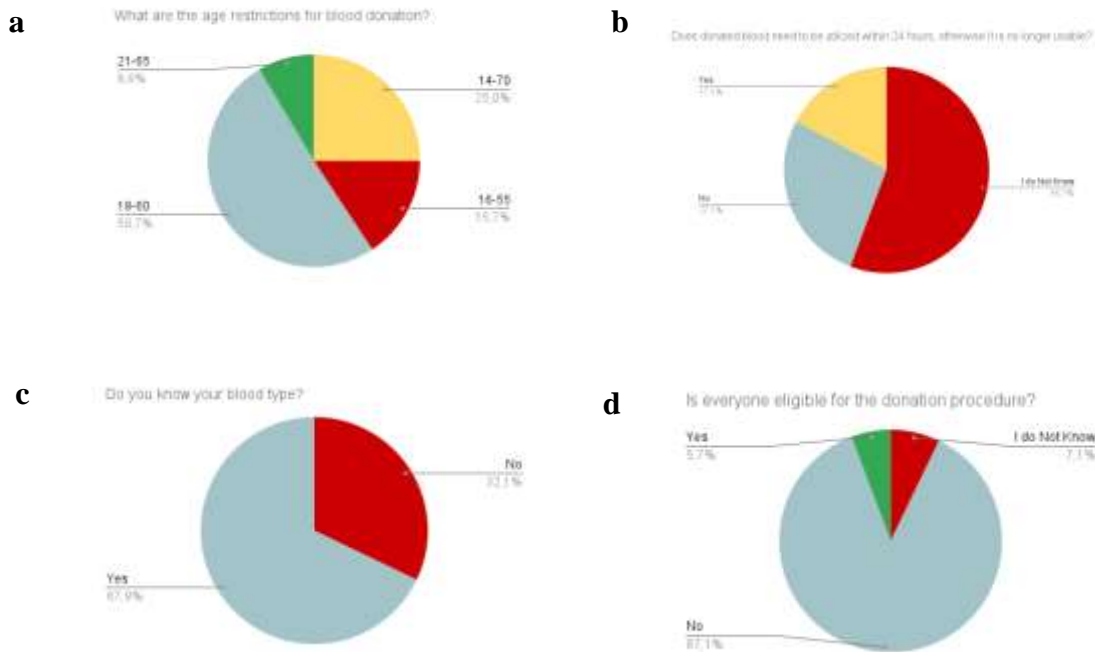
a What are the age restrictions for blood donation?

b Does donated blood need to be about within 24 hours, otherwise it is no longer usable?

c Do you know your blood type?

d Is everyone eligible for the donation procedure?

Figure 3. Results of knowledge on blood donation as valuation of awareness on age restrictions

(a), procedure (b), possessed blood type (c), and eligibility (d) for blood donation.

a Do you consider Blood Donation Essential?

b How important it is to Be a Donor?

c How likely are you to consider the idea of becoming a donor in the future?
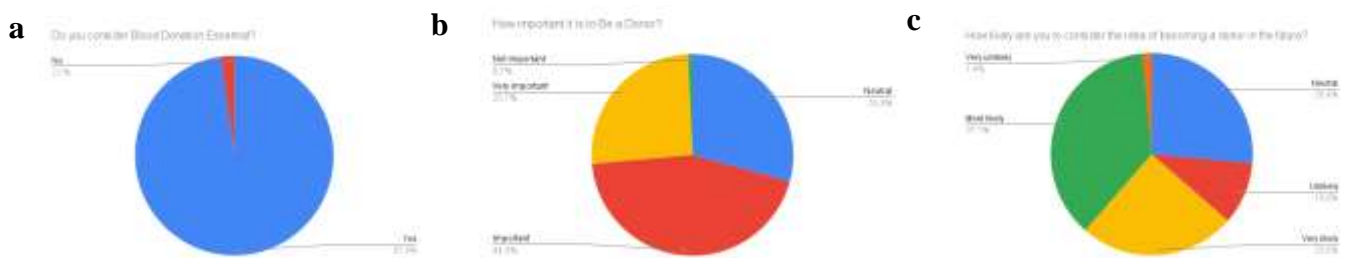
Figure 4. Results of perception on blood donation as recognition of necessity of blood donation

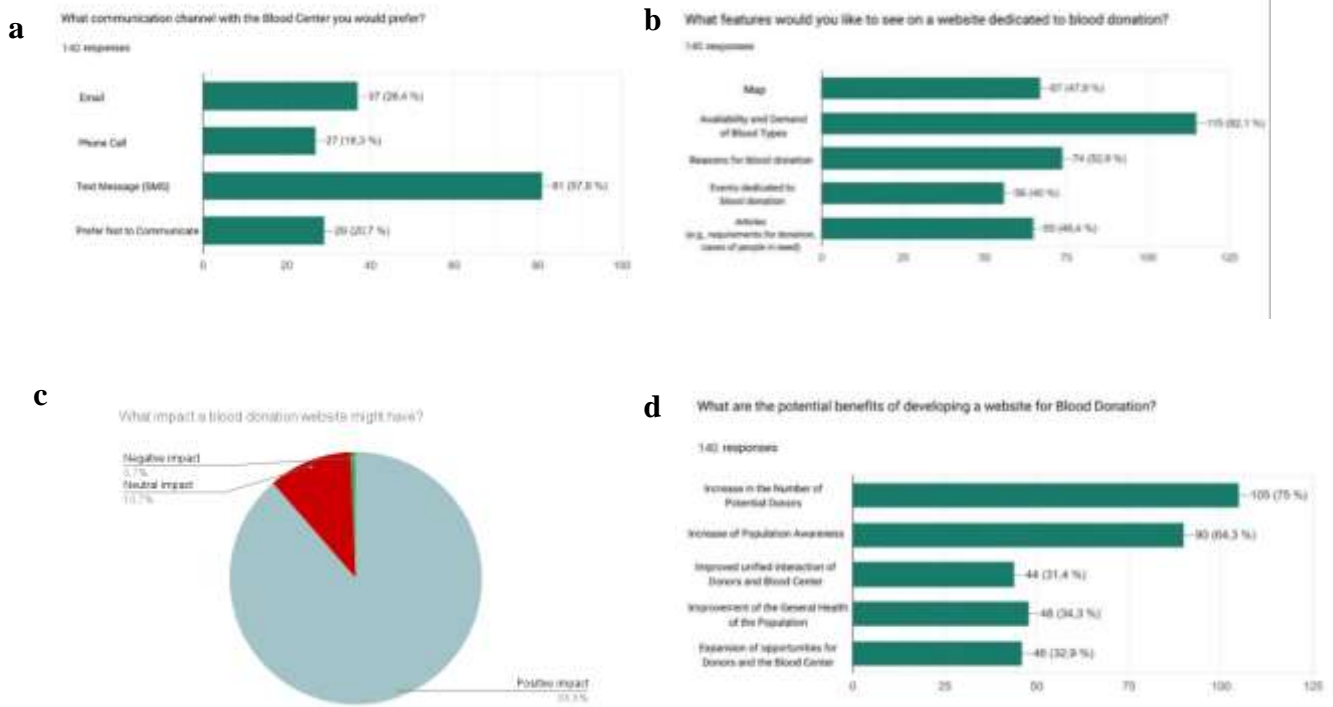(a), valuation of importance to be a donor (b), and consideration for becoming a donor (c).

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Figure 5. Results of perception on a digital platform dedicated to blood donation as preferred communication channel (a), preferred features for a website (b), valuation of perception on digitalization (c), and anticipated benefits of a website (d).
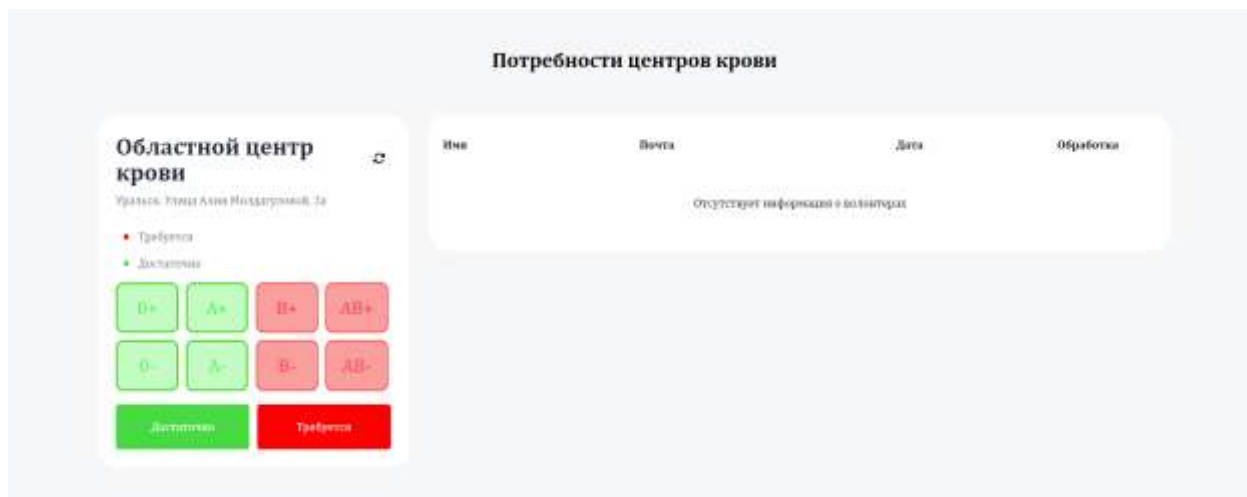
Appendix 3. The interfaces of the system.

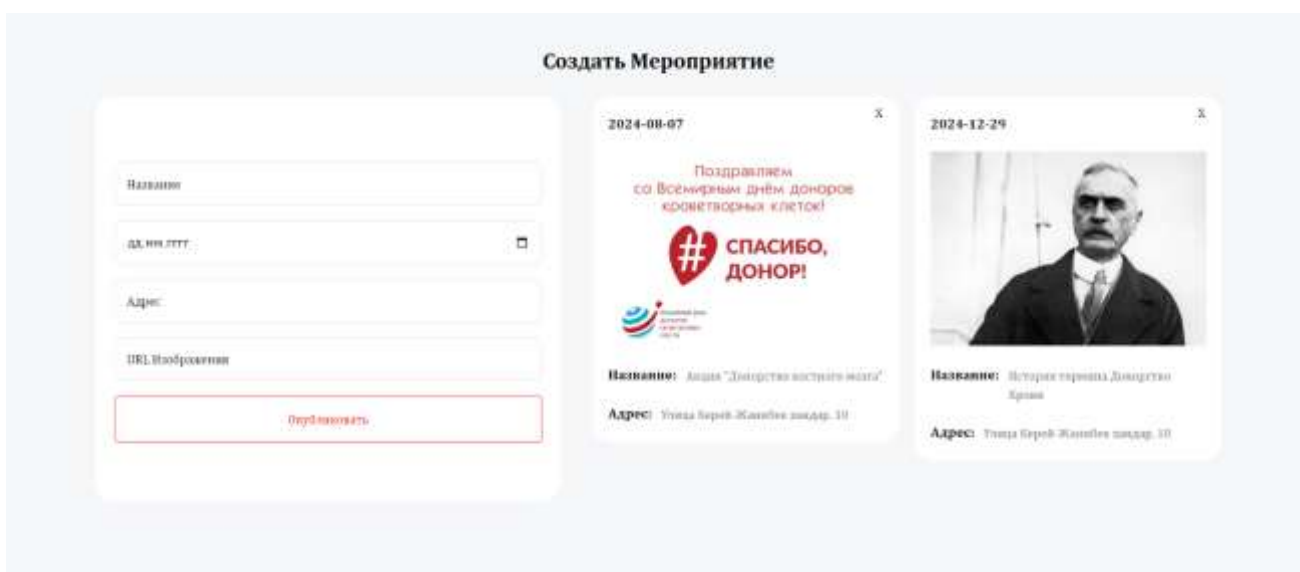Figure 1. Blood Center Profile for publication of blood sufficiency and observation of donor requests.

Figure 2. Blood Center Profile for management of events.