

Digital transformation of the healthcare system in Serbia: attitudes of eZdravlje and HIS users

Digitalna transformacija zdravstvenog sistema u Srbiji: Stavovi korisnika eZdravlja i ZIS-a

Nikola Bošković^{a*} 

^a Academy of Applied Studies Belgrade, Belgrade, Serbia

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Abstract

The permanent development of information technologies and the global digitization trend have transformed many sectors, including medicine. Serbia's health information system (HIS) represents a key platform for centralized data collection and processing. At the same time, its integration with the digital service eZdravlje has the potential to improve communication between health workers and patients. eZdravlje and HIS based on empirical research conducted among citizens and health workers in Serbia from February to June 2024. The results were obtained through two surveys, one of which was conducted among citizens, while the other was conducted among doctors. Based on the analysis of these data, the paper provides a comparative overview of the use of the digital services eZdravlje and HIS in Serbia. In addition, deficiencies in HIS were identified that can serve as a basis for further creation of digitization strategies, as well as improvement and improvement of health services in Serbia, in accordance with modern technological achievements.

Keywords: eZdravlje, HIS (health information system), Serbia, empirical research

Sažetak

Permanentni razvoj informacionih tehnologija i globalni trend digitalizacije transformisali su mnoge sektore, uključujući i medicinu. Zdravstveni informacioni sistem (ZIS) u Srbiji predstavlja ključnu platformu za centralizovano prikupljanje i obradu podataka, dok njegova integracija sa digitalnom uslugom eZdravlje ima potencijal da unapredi komunikaciju između zdravstvenih radnika i pacijenata. Cilj ovog rada je da se na osnovu empiriskog istraživanja, sprovedenog među građanima i zdravstvenim radnicima u Srbiji u periodu od februara do juna 2024. godine, prikažu stavovi ispitanika o upotrebi digitalne usluge eZdravlje i ZIS-a. Rezultati su dobijeni kroz dve ankete od kojih je jedna sprovedena među građanima, dok je druga sprovedena među lekarima. Na osnovu analize ovih podataka, rad pruža komparativni pregled upotrebe digitalne usluge eZdravlje i ZIS-a u Srbiji. Pored toga, identifikovani su nedostaci u ZIS-u koji mogu poslužiti kao osnova za dalje kreiranje strategija digitalizacije, te unapređenje i poboljšanje zdravstvenih usluga u Srbiji, u skladu sa savremenim tehnološkim dostignućima.

Ključne reči: eZdravlje, ZIS (zdravstveni informacioni sistem), Srbija, empirijsko istraživanje

1. Introduction

In the 1990s, at the Military Medical Academy in Serbia, the development of the concept of telemedicine began, which at that time involved digitalization and the establishment of telepathological connections between Belgrade and other medical centers, which brought significant results in medical diagnostics (Reljin & Čučuz, 2007). Reljin and Gavrovska (2013) define telemedicine as "health care provided at a distance". As Avdić and Avdić state, *telemedicine* is also known as *eHealth* (i.e.,

electronic Health). The same authors state that it is a concept that arose at the end of the 20th century, uniting information and communication technologies (ICT) in health information system (HIS) to improve performance, mobility of health workers and patient access to health services (Avdić & Avdić, 2016). The introduction of digital tools into medical practice has become necessary in order to improve the efficiency of health systems, reduce congestion and waiting time, and improve the availability of health services. The eHealth service and HIS represent the key elements of the digital

*Corresponding author

E-mail address: nikola.boskovic@assb.edu.rs

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transformation of the healthcare system in the Republic of Serbia, providing medical professionals with centralized access to data and giving citizens an easier way to schedule examinations and access health records.

When it comes to the Republic of Serbia, a large percentage of the population uses a mobile phone every day. In a survey conducted at the beginning of 2024, which aimed to determine citizens' views regarding the *eUprava* portal (eGovernment) in Serbia, as many as 99.3% of the sample of 144 respondents used a mobile phone (Bošković & Marjanović, 2024). All services that exist on computers can also be used on mobile phones and are, therefore, almost always available to citizens. HIS is called *mZdravstvo* on a mobile phone (*mHealth*, i.e., *mobile Health*), and the constant progress of mobile technologies leads to the creation of an increasing number of applications for phone devices. Various applications are being developed for mobile phones. Milenković and colleagues point out a plan for developing a mobile application that would collect data on the patient's health status with the help of sensors, and then through the application, the data obtained would be forwarded to HIS, i.e. in the patient's medical record (Milenković et. al., 2014). The mobile application *mojDoktor*, which has been in use in the Republic of Serbia since 2015 (<https://www.mojdoktor.gov.rs/>), is integrated into the countries HIS. It serves as a central electronic system that stores and processes all medical and health-related patients' data, as well as informations about healthcare professionals and institutions. The integrated HIS of the Republic of Serbia enables efficient data management, enhances healthcare planning, and ensures transparency and better access to healthcare services (mojDoktor, 2025).

HIS functions as a central platform that enables medical professionals to access relevant patient data, which contributes to faster and safer service delivery. On the other hand, *eZdravlje* (*eHealth*), as part of the *eUprava* portal, enables citizens to schedule an appointment with their chosen doctor and view their health information, which reduces the need for physical visits to health facilities and shortens waiting time. Although these innovations bring obvious benefits, there is a need to examine how citizens and healthcare professionals perceive these systems and to what extent they use them. In the relevant research conducted at the beginning of 2024 (Bošković & Marjanović, 2024), it was determined that citizens are not sufficiently informed about the functionalities and benefits that the *eUprava* portal provides to the citizens of the Republic of Serbia, which means that more work must be done on the dissemination of information related to this electronic service.

Heliant Health is an HIS used by 280 health institutions and enables all forms of interaction between patients and the health institution, as well as within the institution itself and with the Republic Health Insurance Fund (<https://heliant.rs/resenja/heliant/>). Also, the ZipSoft company is active on the market with its HIS called *eKarton*TM. It is represented in 42 health institutions and enables the creation and management of electronic patient

records, recording visits and medical procedures, generating reports, scheduling appointments with synchronization with Google Calendar, sending SMS and e-mail messages, recording audio records of visits, integration of external medical documentation, as well as recording laboratory analyzes (<https://www.zipsoft.rs/>). *MEDIS.NET* is a HIS developed at the Faculty of Electronic Engineering at the University of Niš, within the Laboratory for Medical Informatics (Janković et al., 2010). This HIS is licensed by the Ministry of Health of the Republic of Serbia for use in primary healthcare nationwide, and its active implementation began in 2010, when it was introduced in 19 health centers and 6 other primary healthcare institutions (Milenković, 2021).

The primary goal of this paper is to analyze, through empirical research conducted among citizens and doctors of the Republic of Serbia, the attitudes and experiences of users regarding the use of *eZdravlje* and HIS. Also, the research aims to identify the key advantages and disadvantages of these systems, as well as to offer recommendations for their improvement. Based on the formulated hypotheses, it is expected that citizens and healthcare workers will have a positive attitude towards the use of these digital services and that a higher degree of digital literacy will contribute to more frequent use of the system.

This work is based on surveys conducted among 203 citizens and 43 doctors in the period from February to June 2024. The surveys are designed to examine key aspects of the use of digital health services, including frequency of use, user satisfaction, as well as the identification of problems and possible obstacles in their daily work. The obtained results will provide insight into the current state of digitization of the healthcare system in Serbia and help define future guidelines for improving these services.

2. Literature Review

Analyzing the available literature related to HIS in the Republic of Serbia, the largest number of authors encountered similar problems and challenges in previous research, bearing in mind the fact that the digital transformation of HIS in Serbia is very slow. Papers published in scientific and professional periodicals can be classified into three categories. The first category of works aimed to point out the importance of improving the existing HIS and new services. The second category of papers elaborates on the procedures used during the introduction of HIS in health institutions. In contrast, the third category of papers highlights the challenges that HIS faces, proposing solutions for its further promotion and improvement.

In his extensive study, Avdić (2021) investigates the role of smart healthcare as a key component of a smart city, with a particular focus on the integration of existing and new services, such as *eZdravlje*, as one of the many services of *eUprava*. The author proposes a software platform that enables the uniform integration of heterogeneous health services using data from different

sources (sensory, textual, as well as data obtained by crowdsourcing from relational and non-relational databases) since such a platform would enable more efficient implementation of services for information and disease prevention, epidemic control, a search of medical documents, monitoring of air pollution, labelling of medical texts and organization of screening programs (ibid.). Finally, the author emphasizes that the special contribution of this extensively conducted study is the development of methods based on artificial intelligence for marking medical text documents in the Serbian language, thus facilitating the automatic processing of medical data and documentation (ibid.). This study provides a good insight into the fact that not much has changed in the field of HIS in the last four years (i.e., from 2020 to the present).

As of 2020, there are few published works dealing with the analysis of the introduction of HIS. Milošević et al. (2020) analyze the advantages of introducing HIS in the Health Center in Niš. The software (MEDIS.NET) was developed in the Medical Informatics Laboratory of the Faculty of Electronics in Niš (Milošević, 2021), and the information system was gradually introduced from 2004 to 2019 (Milošević et al., 2020). Research has shown that the implementation of HIS led to significant improvements in the quality and efficiency of health service delivery, including better access to patient information, faster diagnostics and greater patient safety (ibid.). The results obtained by this study unequivocally show the meaning of the introduction of HIS in the health sector while emphasizing the importance of digitization of health institutions in the Republic of Serbia. The University of California, San Diego Health (UCSDH), in order to respond more efficiently to the COVID-19 pandemic, implemented several enhancements to its electronic health record (EHR), including multimodal screening, flexible triage protocols, video visits, and predefined laboratory tests for COVID-19 (Reeves et al., 2021). These functionalities demonstrate similarities with the features of the MEDIS.NET system. Terzić et al. (2020) investigate how the integration of Internet objects (IoT, i.e., *Internet of Things*), big data (Big Data) and 5G networks transforms the health sector, with a special focus on the role of new technology in collecting huge amounts of health data. Although the authors recognize the potential of these technologies to improve health services, they clearly warn of the challenges they have encountered, such as the lack of a structured approach to research in this area, the need for sophisticated tools for data analysis, as well as issues of privacy and data security (ibid.). A study on the evolution of Internet of Things (IoT) reality was conducted on a sample of 256 healthcare service users in Spain. A model was developed to describe the relationship between patients' ability to effectively use information and communication technologies and the success of IoT-based healthcare services (Martínez-Caro et al., 2018). Ahmadi et al. (2015) conducted a study in Malaysia based on data from the HIS of a public hospital. Through data analysis, they identified four key factors (human, technological, organizational, and environmental) that influence the adoption and improvement of HIS.

In a similar study, Milenković et al. (2012) look at the development and introduction of the electronic health system in Serbia, with an emphasis on how information technologies improved health care by increasing its efficiency, quality and availability. Also, the authors discuss the challenges in implementing this system, including the need for infrastructure modernization and better education of healthcare workers. [ibid.]. Vučetić et al. (2010) analyze strategies for designing and implementing HIS, which centralizes patient data in electronic health records. The authors state that the main goals include improving the quality of healthcare services, reducing administrative costs and facilitating communication between patients and healthcare institutions, and they put a special focus on data security, which is ensured through smart cards and cryptographic mechanisms, which additionally enables the secure exchange of sensitive information through Internet (ibid.). Kuhn and Giuse (2003) analyze the current state of HIS through historical trends and strategies for improvement, highlighting that implementation challenges are often related to the adoption of new technologies rather than technological limitations themselves. A study conducted to assess digital literacy and the attitudes of healthcare workers before the introduction of HIS (electronic health records) was carried out in a tertiary healthcare institution. The conclusions reached by Kuek and Hakkennes (2019) indicate that 70-80% of respondents are digitally literate and have a positive attitude toward the introduction of HIS. However, they believe that the healthcare institution must provide education and training for healthcare workers with low digital literacy and those who lack trust in digital technologies before implementing HIS.

Examination of the user experiences of healthcare workers in connection with HIS was also analyzed in foreign works. Kuo et al. (2018) analyzes the key factors for improving the quality of hospital information systems and increasing the satisfaction of doctors who use them, focusing on the quality of the system, information and services. The authors conducted empirical research in the southern part of Taiwan on a sample of 150 doctors, and the obtained results show that the level of satisfaction of doctors with the hospital information system is lower and that it is necessary to work especially on the education of young doctors (ibid.). A similar study on a sample of 325 nurses was conducted by Barzekar et al. (2019), whose research focused on the factors influencing the acceptance of the hospital information system. The authors investigated the effects of managerial support, usefulness, and ease of use of a hospital information system. The results show that managerial support and the expediency of the hospital information system are key factors that positively influence users' attitudes, intentions, and satisfaction, while ease of use has a smaller impact on these factors (ibid.). Another study that analyzed health information systems was conducted with 127 respondents from Osijek-Baranja County. Pešić and Pešić (2024) conducted a survey of user experiences of HIS, and the results showed that healthcare workers positively evaluate the use of the health information system, especially when it comes to a faster access to patient data. However, the authors point out that there are significant differences in

satisfaction among different groups of employees, with nurses and technicians being the least satisfied, which implies the need for permanent training of employees and better organization of work in order to maximize the benefits of HIS and reduce the administrative burden jobs, especially for the aforementioned group of workers (ibid.). A study involving 154 nurses was conducted at a hospital in South Africa. A mixed-methods approach, combining quantitative and qualitative analysis, was used to identify the key characteristics of the Hospital Information System (HIS) that most significantly impact user satisfaction (Cohen et al., 2014).

A qualitative study was conducted in the United Kingdom regarding the lower acceptance and non-use of technological innovations. Iyanna et al. (2022) analyzed data from healthcare workers (doctors, nurses, and other clinical staff) based on open-ended questions answered by the respondents. The authors found that various barriers were identified from the perspective of healthcare workers. The same authors propose a conceptual framework for resistance to eHealth innovations, which is grounded in Innovation Resistance Theory (ibid.). Between 2013 and 2019, Carini et al. (2021) analyzed 47 articles to assess user attitudes and satisfaction with healthcare portals, as well as healthcare outcomes. Their findings suggest that patient portals have the potential to improve interactions between users and healthcare professionals, raise awareness of patients' health conditions, and assist in regular medication adherence. However, it remains unclear whether these portals enhance healthcare quality and the overall use of this digital technology (ibid.). A similar study was conducted in Denmark, where the participants were patients (31 in total). Gybel Jensen and others (2024) interviewed and recorded the respondents' answers. Their findings indicate that there is no equality in digital literacy, which places a certain number of users at a disadvantage. Therefore, it is necessary to adapt and simplify the communication methods for these users.

By analyzing and interpreting previous works on the topic of HIS and *eZdravlje*, published in scientific periodicals of domestic and foreign publishers published in the country and abroad, it is concluded that the tests conducted are different, as well as the methods and models implemented in them. In most of the works, HIS is analyzed, and the author suggests ways in which this system can be improved and further modernized.

3. Empirical research

The research was conducted from February to June 2024 with two surveys. The first survey was intended for all citizens of the Republic of Serbia, and the second survey was for doctors working in all healthcare institutions (primary, secondary or tertiary) on the territory of the Republic of Serbia. A total of 203 respondents took part in the survey for citizens, while 43 participants completed the survey for doctors. The youngest respondent was 18 years old, while the oldest was more than 66 years old. The basic research task was to analysis the attitudes of the citizens of the Republic of Serbia regarding the use of the

eZdravlje service and the analysis of the attitudes of the doctors of the Republic of Serbia about HIS and the *eZdravlje* service in Serbia. This research focused on examining the attitudes of citizens and healthcare professionals towards the use of the digital eHealth service and the Health Information System (HIS), as well as their impact on the efficiency of healthcare services.

To achieve this, we formulated the following research questions:

- How do citizens and healthcare professionals perceive the use of the digital eHealth service and HIS?
- To what extent does the digital eHealth service contribute to reducing waiting times and improving the organization of healthcare institutions?
- What advantages of HIS are recognized by healthcare professionals in the Republic of Serbia?
- What challenges and limitations do healthcare professionals encounter when using HIS, and how do they affect their efficiency and daily work?
- Is there a correlation between the level of digital literacy of citizens and healthcare professionals and the frequency of use of eHealth and HIS?

These research questions align with the main objectives of the study, which include examining attitudes and the use of digital health systems, identifying their advantages and disadvantages, and analyzing their impact on the effectiveness of the healthcare system. The implemented method was a survey of citizens and doctors of the Republic of Serbia through two separate surveys. The survey for citizens consisted of a total of seven closed-ended questions, while the survey for doctors consisted of seven closed-ended questions and one open-ended question. For the purposes of the research, the instrument used was an anonymous questionnaire created on the Google Forms page, and the citizens were given a link to the survey via e-mail and a generated QR code of the survey, so they accessed the survey sheet by scanning it. The questions were created by the author of the paper.

4. Research results

The respondents who participated in the research were adult citizens of the Republic of Serbia, and a detailed presentation of the results obtained in both surveys can be found in Table 1. Looking at the percentages, we conclude that the most represented respondents are 26-35 years old (for both surveys) - 30% of the citizen respondents and 46.5% of the doctor respondents.

Table 1. Age of respondents

Age of respondents	Citizens		Doctors	
	N	%	N	%
From 18 to 25 years of life	25	12.3	0	0
From 26 to 35 years of life	61	30	20	46.5
From 36 to 45 years of life	39	19.2	6	14
From 46 to 55 years of life	45	22.2	16	37.2
From 56 to 65 years of life	28	13.8	1	2.3
Over 66+ years of life	5	2.5	0	0

Source: Author

Females made up the majority in both surveys - 69% and 65.1% respectively. A detailed presentation of the results can be found in Table 2.

Table 2. Gender of respondents

Gender	Citizens		Doctors	
	N	%	N	%
Male	63	31	15	34.9
Female	140	69	28	65.1

Source: Author

When it comes to citizens, 73.4% of respondents come from Belgrade and its surroundings, while the percentage of doctors is slightly lower and amounts to 65.1%. A detailed presentation of the results can be found in Table 3.

Table 3. Regions of Serbia from which respondents come

Region	Citizens		Doctors	
	N	%	N	%
Belgrade	149	73.4	28	65.1
Vojvodina	10	4.9	4	9.3
Šumadija and Western Serbia	33	16.3	8	18.6
Southern and Eastern Serbia	11	5.5	3	7

Source: Author

Mobile phones are used daily by both groups of respondents - 99% of citizen respondents and 97.7% of medical doctors in the sample. A detailed presentation of the results can be found in Table 4.

Table 4. Electronic devices that respondents use on a daily basis

Electronic devices	Citizens		Doctors	
	N	%	N	%
Computer/Laptop	169	83.3	34	79.1
Mobile phone	201	99	42	97.7
Tablet	23	11.3	5	11.6

Source: Author

Using a five-point Likert scale, research participants assessed their information literacy. When it comes to citizens, 35.5% of respondents rated their IT literacy with a grade of 5 (excellent), while 34.9% of respondents of doctor respondents rated their IT literacy with a grade of 4 (very good). A detailed presentation of the results can be found in Table 5.

Table 5. Self-assessment of information literacy of respondents

Information literacy	Citizens		Doctors	
	N	%	N	%
1 (unsatisfactory)	7	3.4	0	0
2 (enough)	15	7.4	5	11.6
3 (good)	47	23.2	14	32.6
4 (very good)	66	32.5	15	34.9
5 (excellent)	68	35.5	9	20.9

Source: Author

The citizen respondents stated the purposes for which they use the *eZdravlje* application. Out of the total number of respondents, 10.3% of them use *eZdravlje services*, while only 8.4% of surveyed citizens make an appointment with their chosen doctor using this application. Although

21.2% of those surveyed are familiar with the functionalities of the *eZdravlje application*, the largest number of respondents still make an appointment with their chosen doctor by phone call - as many as 29.4%. A detailed presentation of the results can be found in Table 6.

Table 6. Purpose of using the *eZdravlje* application

Statement	N	%
I use <i>eUprava</i> services related to <i>eZdravlje</i> .	21	10.3
I have the <i>eZdravlje</i> application installed on my mobile phone.	15	7.4
Using the <i>eZdravlje</i> application, I make an appointment with the selected doctor.	17	8.4
I schedule my doctor's appointments exclusively by phone call.	80	29.4
I always go to the doctor, so I wait in line for the chosen doctor to see me.	46	22.7
I am familiar with the functionalities of the <i>eZdravlje</i> application.	43	21.2
I like that the health information system has <i>eRecept</i> and that everything is interconnected.	53	26.1
I like that on the <i>eZdravlje</i> application I can see my history of medical examinations and medical reports (<i>eStatistika</i>).	21	10.3
I only go to private health centres, so I don't use <i>eZdravlje</i> .	55	27.1

Source: Author

When it comes to assessing the usefulness of the *eZdravlje* application, 60.1% of respondents pointed out that they do not use it at all. The remaining number of citizens surveyed (39.9%) rated the application using a five-point Likert scale. Slightly less than 5% of the respondents rated the performance of the *eZdravlje* application as unsatisfactory (1), 11.1% rated the application as sufficient (2), and 33.3% of the surveyed citizens rated it as good (3). A slightly smaller percentage of citizens, 28.4% of them, rated the application as very good (4), while 22.2% of those surveyed rated the *eZdravlje* application with the highest rating - excellent (5). A detailed presentation of the results can be found in Table 7.

Table 7. Evaluation of the *eZdravlje* application

<i>eZdravlje</i>	N	%
1 (unsatisfactory)	4	4.9
2 (enough)	9	11.1
3 (good)	27	33.3
4 (very good)	23	28.4
5 (excellent)	18	22.2
I do not use <i>eZdravlje</i> application.	122	60.1

Source: Author

Doctors' respondents also expressed their opinion about HIS. Of the total number of respondents, 65.1% of doctors pointed out that the introduction of the health information system made their work easier, while 72.1% of them believe that the optimization of the administrative part of their work would make their work easier and shorten the time they currently spend on this part of the work. A detailed presentation of the results can be found in Table 8.

When it comes to scheduling appointments for medical examinations, medical doctors also confirmed the views

expressed by the surveyed citizens. A little more than half of the surveyed doctors, 53.5% of them, state that the appointment with the chosen doctor is most often scheduled by phone, while the appointment via the application is minimal and amounts to only 2.3%. A detailed presentation of the results can be found in Table 9.

Table 8. Doctors' views on HIS

Statement	N	%
The introduction of the health information system made my job easier.	28	65.1
The administrative part of the job is not difficult for me.	12	27.9
Optimizing the administrative part would make my job much easier and reduce the time I spend on administration.	31	72.1
Electronic insight into the history of the health record (<i>eStatistika</i>) makes my job easier.	27	62.8
The introduction of the health information system made my job easier.	28	65.1

Source: Author

Table 9. Doctors' attitudes regarding *eZdravlje* and HIS

Statement	N	%
Patients use the <i>eZdravlje</i> system to a greater extent.	1	2.3
Patients generally schedule an appointment with their chosen doctor using the <i>eZdravlje</i> system.	1	2.3
Patients usually make an appointment with their chosen doctor by phone.	23	53.5
Patients generally come without an appointment with their chosen doctor and wait for their turn to be examined.	19	44.2
The functionality of the health information system <i>eRecept</i> makes my job easier.	16	37.2
The functionality of the health information system suits me completely.	3	7
I would not change anything in the health information system.	1	2.3

Source: Author

At the end of the survey, medical doctors had space to write their personal views on HIS, as well as what should be changed or added to it. Almost all respondents who answered this question had the same answer, ie. they pointed out that it is necessary to connect all primary, secondary and tertiary institutions in the Republic of Serbia. Also, the doctors emphasized that it is extremely important to provide them with access to the patient's medical record, regardless of the program used by the health institution.

5. Discussion

Looking at both surveys, all respondents were citizens of legal age. When it comes to the age group of 18 - 25 years, there were respondents in the survey for citizens, while there were no doctors of medicine in this age group. This result is expected, given that doctors start their employment only after completing their studies, which is around the age of 25, and most often even later. As previously mentioned, the majority of respondents are between 26 and 35 years of age. An expected result was also found in the 66+ age group, where no doctors were

present, as doctors typically retire by that age. Among the surveyed citizens, there were only a few respondents in this age group. This finding is unsurprising, given that older populations use digital technology far less than younger generations, who are more familiar with and surrounded by it daily. Similar findings were reported by Gybel Jensen et al. (2024), who highlighted technological barriers faced by older respondents. The majority of respondents are female, and the Belgrade region is predominant among both groups. As for electronic devices used daily by the respondents, mobile phones are, as expected, the most frequently used, followed closely by computers and laptops.

Among citizens, there is a small percentage who rate their information literacy as unsatisfactory. Among doctors, however, no respondents gave themselves the lowest rating, indicating a generally higher level of information literacy. Most respondents in both groups consider their information literacy to be very good or excellent, with citizens more frequently choosing the highest rating (5). Doctors tend to assess their information literacy somewhat more critically, and the percentage of doctors who rate their skills as 5 (excellent) is lower compared to citizen respondents (the share of ratings 3 (good) and 4 (very good)). Based on the average self-assessment of digital literacy, the scores are comparable for both citizens and doctors. Gybel Jensen et al. (2024) also pointed out that lower digital literacy places certain users at a disadvantage, emphasizing the need for adapting digital services to be more accessible.

Based on the analysis of responses from citizen participants, a small number use *eUprava* services related to *eZdravlje*. The percentage obtained indicates a relatively low number of respondents who use *eZdravlje* services through eGovernment, which could be due to a lack of awareness or a preference for traditional methods of scheduling appointments and communicating with healthcare providers. Nearly a third of respondents exclusively use phone calls to schedule appointments, suggesting that this method remains the most popular among citizen respondents. This may be interpreted as a habit or an established way of communicating with healthcare facilities, with a desire for more direct contact with medical staff. A similar observation was made in Denmark by Gybel Jensen et al. (2024), where disparities in digital literacy affected technology adoption. An even smaller percentage of citizen respondents have the *eZdravlje* app installed on their mobile phones. This further suggests a lack of awareness, potential technical barriers, or simply a lack of interest in the benefits offered by modern information technology. Additionally, a significant number of citizens go directly to the doctor without scheduling an appointment beforehand, which can lead to overcrowding and longer waiting times. This may also indicate a lack of familiarity with modern appointment-scheduling methods or a lack of trust in them. In other countries, such as Taiwan, Kuo et al. (2018) also found that digital health services had low adoption rates among certain demographics, primarily due to habits and trust issues in new technologies. In addition to the *eZdravlje* portal, citizens of the Republic of Serbia also

have access to the *mojDoktor* application for scheduling appointments with their chosen doctor.

Almost a fifth of those surveyed are familiar with the capabilities offered by the *eZdravlje* application, underscoring the importance of broader promotion of information technologies and user education regarding available digital healthcare services. A quarter of respondents hold a positive view of the health system's connection and the *eRecept* feature, indicating that this functionality is seen as beneficial. Carini et al. (2021) highlighted that the digital prescription service has a positive impact on service users, but there is a need for further improvements. Interest in accessing personal medical history (*eStatistika*) through the application, however, remains relatively low. A significant portion of respondents rely solely on private healthcare services and, therefore, do not use *eZdravlje*. Currently, it is not possible to schedule appointments with doctors in private healthcare institutions through the application, nor can patients access *eStatistika* within it. This lack of integration occurs because private healthcare institutions are not connected to the national health information system across the Republic of Serbia. These findings highlight the need to integrate the private sector into digital health systems, facilitating a more comprehensive and connected healthcare network. Studies in Malaysia have also emphasized the importance of system-wide integration to ensure seamless data exchange across all healthcare providers (Ahmadi et al., 2015).

When it comes to the views of doctors, almost two-thirds of those surveyed pointed out that the introduction of the health information system in health institutions made their work easier. Such a high percentage indicates that medical doctors believe that new technologies have had a positive effect on their efficiency and productivity. This result is consistent with Pešić and Pešić (2024), who also reported positive effects of digitalization on medical professionals' efficiency. The majority of those surveyed point out that the administrative part of their work is difficult for them, while the same percentage states that the optimization of the administrative part would make their work much easier, which would shorten the time they spend on administration. Similar concerns were raised in studies conducted in South Africa by Cohen et al. (2014), where excessive administrative tasks hindered healthcare workers' productivity, despite the advantages of digitalization. A high percentage of the need to optimize administrative tasks clearly shows that respondents recognize room for improvement in administrative processes, and the need for optimization may suggest that the current system does not cover all aspects of administration or that there are redundant steps in the procedures and that system improvement or automation of the certain process.

Almost two-thirds of the respondents underlined that electronic insight into the history of the health record (*eStatistika*) makes the work of doctors much easier since electronic insight unequivocally contributes to more efficient work. The ability to quickly access data can significantly reduce the time spent searching for

information, thereby enabling better patient service. This aligns with findings by Carini et al. (2021), who noted that digital health records enhance workflow efficiency. The surveyed doctors also confirmed a relatively large number of patients who schedule an appointment with their chosen doctor by phone call. Equally significant is the percentage of patients who chose to wait in line at their chosen doctor in order to be examined. Scheduling an appointment with a doctor by phone is still the dominant method, which may indicate patient habits, lack of information about the *eZdravlje* application or insufficient development of digital services. This was also observed by Kuo et al. (2018), who suggested that targeted education campaigns could improve the adoption of digital healthcare tools.

More than a third of the surveyed doctors believe that the functionality of the health information system *eRecept* makes their work easier. This indicates a positive aspect of digitization in relation to medicines and prescriptions, but also the need for further improvement of IT tools. Although they emphasized certain positive attitudes regarding HIS, an extremely large number of respondents from the ranks of medical doctors pointed out that the functionality of the health information system did not suit them. The high percentage indicates that most of the respondents have a critical attitude towards the current system and believe that there is room for improvement and adaptation. Similar concerns have been raised in studies by Kuhn and Giuse (2003), who pointed out that digital health transformations require both technological advancements and policy development to ensure data protection. Finally, a negligible number of respondents stated that they would not change anything in the health information system, stressing that there is no need for any changes. Finally, the largest number of respondents who answered the last question underlined the necessity of connecting all primary, secondary and tertiary institutions in the Republic of Serbia, as well as private health institutions, so that doctors can access the health records of patients throughout the country. This certainly represents a big challenge, especially taking into account the protection of personal data, because, with such a single system, all health data on patients would be available to all health workers in the Republic of Serbia.

While HIS in Serbia has brought significant benefits, its full potential has yet to be realized. Comparing these findings with similar international studies confirms that issues such as digital literacy, integration, and administrative burdens are common worldwide. Future improvements should focus on system-wide integration, better promotion of digital services, and enhanced education for both healthcare workers and patients to maximize HIS efficiency and accessibility.

6. Conclusion

Based on the analysis of data collected on the basis of two conducted surveys, several key conclusions can be drawn about the *eZdravlja* application in the Republic of Serbia, and its use both among citizens and medical doctors. The age structure of respondents shows that most participants in both groups fall between 25 and 65 years old. A

predominance of female respondents and a concentration in the Belgrade region provide additional demographic insights about the survey participants. Analyzing the level of IT and digital literacy, the conducted research indicates that doctors tend to self-assess the aforementioned competencies more strictly, while citizens rate their level of digital literacy with the highest marks.

Regarding the use of *eZdravlje* and *eUprava* services among citizens, the data indicates that traditional methods for scheduling appointments are still preferred. This preference may stem from limited awareness of the benefits of digitalization or from certain technical obstacles that reduce application usage. The results obtained from the statistical analysis additionally indicate that the need for more comprehensive education and promotion of digital tools such as *eZdravlje* among the general public is extremely important. Our initial hypothesis was not fully confirmed because healthcare professionals generally have a positive attitude towards the use of the *eZdravlje* digital service, but the citizens surveyed do not share the same attitudes, given that they are not sufficiently informed about all the digital services that exist and are available to them.

The use of private health services without integration with *eZdravlje* further complicates access to all digital functionalities provided by modern technologies, which emphasizes the need to incorporate the private sector into the health information system. Responses from medical doctors suggest that while digitalization and the introduction of information systems facilitate their work, there is also a clear need for additional system improvements. Specific functionalities, such as *eRecept*, *eStatistika*, and electronic access to patient history, are seen as improving efficiency and performance, although doctors emphasize the need for further optimization of administrative procedures.

Finally, the need for integration across all levels of healthcare, including both public and private institutions, is increasingly evident to ensure a comprehensive and functional health information system. This integration would facilitate easier access to patient health data and significantly enhance service quality, though it also presents challenges-especially concerning personal data protection. The survey results point to a clear need for further education and promotion of the *eZdravlje* application, as well as the importance of connecting all segments of the health system in Serbia to maximize the advantages of digitalization and improve the user experience.

The limited sample of surveyed doctors presents a significant challenge to the internal validity of the above research. Low motivation among doctors to participate, combined with administrative barriers and the requirement to obtain approval from healthcare institutions, hindered the distribution of the survey and resulted in a smaller number of respondents. This limits the analysis of the results to the broader population of doctors, thereby affecting the external validity of the study. Therefore, the findings should be interpreted with

caution, taking into account the potential impact of these statistical limitations.

References

- Ahmadi, H., Nilashi, M., & Ibrahim, O. (2015). Organizational decision to adopt hospital information system: An empirical investigation in the case of Malaysian public hospitals. *International Journal of Medical Informatics*, 84(3), 166-188. <https://doi.org/10.1016/j.ijmedinf.2014.12.004>
- Avdić, D., & Avdić, A. (2016). Medis questionnaire - application of mobile computing in medicine *YU INFO 2016: Zbornik radova 21th Conference and exhibition*, Kopaonik, pp. 321-324
- Avdić, A. (2021). Realizacija servisa pametnog zdravstva i njihova integracija u koncept pametnih gradova. (Unpublished doctoral dissertation or master's thesis) University of Niš, Faculty of Electronics Engineering, Niš.
- Barzekar, H., Ebrahimi F., Luo J., Karami M., Robati Z., & Goodarzi P. (2019). Adoption of Hospital Information System Among Nurses: a Technology Acceptance Model Approach. *Acta Informatica Medica*, 27(5), 305-310. <https://doi.org/10.5455/aim.2019.27.305-310>
- Bošković, N., & Marjanović, M. (2024). Citizens' Attitudes Towards the Use of the eGOVERNMENT Portal (eUPRAVA) in the Republic of Serbia. *Sinteza 2024 - International Scientific Conference on Information Technology, Computer Science, and Data Science*, Belgrade, pp. 112-118. Singidunum University. <https://doi.org/10.15308/Sinteza-2024-112-118>
- Carini, E., Villani, L., Pezzullo, A. M., Gentili, A., Barbara, A., Ricciardi, W., & Boccia, S. (2021). The impact of digital patient portals on health outcomes, system efficiency, and patient attitudes: updated systematic literature review. *Journal of Medical Internet Research*, 23(9), e26189. <https://doi.org/10.2196/26189>
- Cohen, J., Coleman, E., & Kangethe, M. J. (2016). An importance-performance analysis of hospital information system attributes: A nurses' perspective. *International journal of medical informatics*, 86, 82-90. <https://doi.org/10.1016/j.ijmedinf.2015.10.010>
- Iyanna, S., Kaur, P., Ractham, P., Talwar, S., & Islam, A. N. (2022). Digital transformation of healthcare sector. What is impeding adoption and continued usage of technology-driven innovations by end-users?. *Journal of Business Research*, 153, 150-161. <https://doi.org/10.1016/j.jbusres.2022.08.007>
- Gybel Jensen, C., Gybel Jensen, F., & Loft, M. I. (2024). Patients' experiences with digitalization in the health care system: qualitative interview study. *Journal of Medical Internet Research*, 26, e47278. <https://doi.org/10.2196/47278>
- Giuse, D., & Kuhn, K. (2003). Health information systems challenges: The Heidelberg conference and the future. *International Journal of Medical Informatics*, 69(2-3), 105-114. [https://doi.org/10.1016/S1386-5056\(02\)00182-X](https://doi.org/10.1016/S1386-5056(02)00182-X)
- Janković, D., Milenković, A., Rajković, P., Stanković, T., Marković, I., Cvetković, S., Vučković, D., & Pešić, S. (2010). *Medicinski informacioni sistem MEDIS.NET*. Elektronski fakultet Niš - Laboratorija za medicinsku informatiku.
- Heliant (2024). Zdravstveni informacioni sistem. <https://heliant.rs/resenja/heliant/>
- Kuek A, & Hakkennes S. (2019). Healthcare staff digital literacy levels and their attitudes towards information systems.

- Health Informatics Journal*, 26(1), 592-612. <https://doi.org/10.1177/1460458219839613>
- Kuo, K.-M., Liu, C.-F., Talley, P. C., Pan, S.-Y. (2018). Strategic improvement for quality and satisfaction of hospital information systems. *Journal of Healthcare Engineering*. <https://doi.org/10.1155/2018/3689618>
- Martínez-Caro, E., Cegarra-Navarro, J. G., García-Pérez, A., & Fait, M. (2018). Healthcare service evolution towards the Internet of Things: An end-user perspective. *Technological Forecasting and Social Change*, 136, 268-276. <https://doi.org/10.1016/j.techfore.2018.03.025>
- Milenković, A. (2021). *Unapređenje koncepta medicinskih informacionih sistema u cilju smanjenja efekata i posledica epidemija i pandemija* (Unpublished doctoral dissertation or master's thesis). University of Niš, Faculty of Electronics Engineering, Niš.
- Milenković, A., Janković, D., Stojković, M., Veljanovski, A., & Rajković, P. (2014). Collaboration of mobile sensor applications and medical information system. *INFOTEH-JAHORINA*, 13, pp. 879-884.
- Milenković, D., Milenković, M. J., Vujin, V., Aleksić, A., & Radojičić, Z. (2012). Electronic health system – development and implementation into the health system of the Republic of Serbia. *Vojnosanitetski Pregled*, 69(10), 880-890. <https://doi.org/10.2298/VSP101125021M>
- Milošević, Z., Jerkan, M., Stojanović, M., Premović, N., Milošević, S., Ignjatović, A., Andjelković & Apostolović, M. (2020). Application of the health information system in the Health Center Niš. *Medicinska reč*, 1(1), 23-28. <https://doi.org/10.5937/medrec2001023M>
- mojDoktor (2025). Integrisani zdravstveni informacioni sistem Republike Srbije. <https://www.mojdoktor.gov.rs/>
- Pešić, S., & Pešić, M. (2024). User satisfaction, advantages, and disadvantages of health information systems in the Osijek-Baranja County: survey of users in the public healthcare system. *Bilten Hrvatskog društva za medicinsku informatiku*, 30(1), 5-14. <https://doi.org/10.69827/bhdmi-31850>
- Reljin, B., & Čučuz, V. (2007). Project telepathology network. *XXV Simpozijum o novim tehnologijama u poštanskom i telekomunikacionom saobraćaju PosTel 2007*, Belgrade, pp. 101-108.
- Reljin, I., & Gavrovska, A. (2013). Telemedicine. *Akademski misao*, Beograd.
- Reeves, J., Hollandsworth, H., Torriani, F., Taplitz, R., Abeles, S., Tai-Seale, M., Millen, M., Clay, B., & Longhurst, C. (2020). Rapid response to COVID-19: health informatics support for outbreak management in an academic health system, *Journal of the American Medical Informatics Association*, 27(6), 853–859. <https://doi.org/10.1093/jamia/ocaa037>
- Terzić, R., Pantović, V., & Milovanović, D. (2020). Mogućnosti i izazovi zdravstva 4.0 5G-IoT Big Data prediktivna analitika. *YU INFO 2020: Zbornik radova 26th Conference and exhibition*, Kopaonik, pp. 162-166.
- Vučetić, M., Uzelac, A., Gligorić, N., & Laketa, V. (2010). Transformation e-health model in Serbia. *Info M*, 36, 28-31.
- ZipSoft. (2024). Informacioni sistem za zdravstvene ustanove. <https://www.zipsoft.rs/>

