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Exploring the potential for introducing crowdsourced e-health services

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Abstract

The study had two primary goals: (1) to propose a methodological approach for introducing crowdsourced e-health services within healthcare institutions, and (2) to evaluate the readiness of citizens to adopt the proposed services. The proposed methodological approach addresses the essential infrastructural elements required for introducing crowdsourced e-health services, including their integration into institutional web portals and alignment with broader national digital health systems. By enabling structured citizen participation and facilitating dynamic data exchange among key stakeholders, the approach supports the modernization of healthcare service delivery. This research examined young citizens' readiness to use crowdsourced e-health services to assess the potential for adopting the proposed method. The findings indicate that perceived value is positively influenced by trust, while both perceived value and perceived behavioral control have a significant impact on the intention to contribute. This research introduces an original methodological approach tailored to support the implementation of crowdsourced e-health services within healthcare institutions. The proposed model stands out for its adaptability, as it combines communication, collaboration, crowdsourcing, and payment services within a unified structure. Its flexibility allows integration across different institutional levels, promoting citizen participation and enabling more transparent, efficient, and needs-driven healthcare delivery.

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e-health services, crowdsourcing, value-based adoption model, health institution

Introduction

Developing countries face significant economic imbalances, which are directly reflected in the quality and accessibility of their healthcare services.[1–4] Although significant technological progress has been made in healthcare, developing countries continue to face persistent challenges, particularly unequal access to health services among different population groups.[5] Many patients who are from low-income households or uninsured may receive inferior medical care, and consequently, they often contract chronic diseases.[6] Although numerous studies have pointed to the advantages of the actions of health institutions with the patient in focus, there are still a lot of problems in practice with the information flow between the patients and employees of health institutions.[7–10] This situation is, to some extent, a consequence of the lack of medical personnel, and the trends are worrisome because there is a great shortage of health workers in many countries.[11,12] In this regard, the efforts of the UN are present in the form of their sustainable development goals (SDGs), where universal health coverage is sought, including protection from financial risks. By 2030, a significant solution to the problem of the lack of medical personnel is predicted.[13]

Although most of the mentioned problems need to be addressed through government-led system solutions, many initiatives can contribute to reducing the level of the health divide and improving information availability. One of the possibilities is crowdsourcing, which has great potential to improve the quality and availability of health information and services and increase user satisfaction.[14] Crowdsourcing is a term that implies the use of the collective intelligence of people in solving certain problems or working together to complete a task.[15] Organizations interested in crowdsourcing apply it through their web portals, or available web and mobile applications[16] and services.[17] Crowdsourcing has been researched in many domains, and its application in healthcare is attractive because it can often solve problems involving the unavailability of adequate healthcare services. Furthermore, crowdsourcing campaigns in healthcare can be implemented quickly with lower costs.

Our contribution to this field is the proposition of a methodological approach that can be utilized to improve the provision of innovative crowdsourced e-health services by health institutions. Considering the needs and critical points in a healthcare setting, as well as the gap that exists in the provision of healthcare services,[18] the motivation for this work was to examine the willingness and intention of citizens to use crowdsourced e-health services and contribute to introducing the proposed innovations. This study is focused on Generation Z (aged 18–25) as a relevant target group expected to be early adopters of crowdsourced e-health services, but this age-specific sample also represents a key limitation, as the findings may not be generalizable to older populations with potentially different levels of readiness and expectations. Due to the limited availability of real-world crowdsourcing in healthcare, most respondents lacked prior experience with such services, and the study measured contribution intention rather than actual behavior. Challenges related to implementing the proposed methodological approach include integration with centralized health information systems, lack of interoperability, insufficient data exchange standards, and the need for user training. Additionally, the success of such services depends on building a culture of participation among citizens, professionals, and institutions.

The paper consists of six sections. It begins with an overview of crowdsourcing models in healthcare and examines their potential to enhance e-health service delivery. This is followed by a detailed presentation of the proposed methodological approach for introducing crowdsourced e-health services within healthcare institutions. The fourth section focuses on citizens' readiness to adopt these services by evaluating their intention to engage with the proposed system. Research findings are discussed in the fifth section, highlighting that perceived value—shaped by trust—and perceived behavioral control significantly influence contribution intention, while also addressing the research's limitations. The final section summarizes the main conclusions, outlines theoretical and practical implications, and proposes directions for future research, positioning the model as a comprehensive and adaptable solution within the digital healthcare ecosystem.

Theoretical background

This section presents the theoretical background and selected literature related to crowdsourcing in healthcare, with a focus on its conceptual foundations and practical implementations in e-health services.

Crowdsourcing models in healthcare

The application of crowdsourcing in e-health is reflected in the ability to gather more information, ideas, and experience, and potentially provide answers or solutions to a particular problem. The use of crowdsourcing in the e-health area, in most cases, is based on the model of collective intelligence, "wise crowds",[19] or "wisdom of the crowd".[20] The crowd wisdom model in healthcare can be defined through the active participation of citizens in sharing knowledge, ideas, information, and attitudes through various crowdsourcing platforms.[21–24] It has even found a place in plastic and reconstructive surgery.[25] The interpretation of medical images is often critical, so one of the possible solutions could be a crowd wisdom system, as suggested by the authors of[26] and.[27] Aside from healthcare practice, crowd wisdom can also be applied through virtual workshops and the training of healthcare workers.[28] The "wisdom of the crowd" phenomenon has proven to be an excellent way of forecasting and involving the individual expertise of public health experts.[20,29,30]

Crowdsourcing can take the form of crowdfunding, a model used to raise financial resources for specific purposes through collective public contributions. Crowdfunding can be used to set up laboratories for exercises and lectures that will be socially useful,[31] for example, to research diseases such as cancer[32] or rare diseases.[33–36]

When there is a shortage of experts in a specific field or a need for a greater diversity of ideas, the crowdsourcing model known as "crowd creation" is applied.[19] It represents an open call to the "crowd" for new and useful solutions.[37–39]

Mass voting or crowd voting can be used to vote on proposed solutions related to healthcare service improvement initiatives.[40] In this way, citizens, patients, healthcare professionals, and other relevant stakeholders are enabled to actively participate in decision-making processes that contribute to the healthcare system improvement.[41]

People often search for health information on the Internet, regardless of the poor quality of health information on various websites.[42] In 43, the authors showed that users do not trust Internet-crowdsourced health information. It may take some time to improve the quality of information on professionally edited websites and restore confidence in such sources of health information. Crowdsourcing through web applications, for example, web-based crowdsourcing has gained extensive attention in the healthcare field.[44–46]

In public health, crowdsourcing can be used to reduce the cost of healthcare and make it more efficient.[47] A significant contribution to traditional infectious disease surveillance efforts can be made using crowd forecasts. Crowdsourcing is increasingly used and has great potential in health and medical research.[48,49]

The review[48] summarizes crowdsourcing applications in healthcare, highlighting the use of web and mobile platforms for health promotion, surveillance, and intervention design. Key success factors include digital accessibility, clear communication, and participant motivation. While readiness was not directly measured, the need for assessment in future research was emphasized.

With the market penetration of mobile and Internet of Things (IoT) technologies, crowdsensing has become more prevalent.[50] It refers to the collection of various data by citizens from the environment and the sharing of such data for public use.[51–53] In healthcare, the process of collecting health-related data through mobile devices or wearable IoT sensors—such as smartwatches and fitness trackers—is known as mobile crowdsensing. This model enables real-time health monitoring and supports applications such as telerehabilitation and remote healthcare services, where continuous patient tracking is essential for therapy personalization and timely professional feedback.[54,55]

Possibilities for improving e-health services with crowdsourcing

The successful implementation of any crowdsourcing model in healthcare largely depends on participants' willingness to engage with crowdsourced e-health services. Active involvement of participants in crowdsourcing campaigns can enhance strategic decision-making and operational effectiveness within healthcare institutions, while also contributing to improved treatment outcomes through a deeper understanding of users' needs and perspectives.[56]

Implementing crowdsourcing in e-health services brings multiple benefits by fostering active engagement from citizens and stakeholders and promoting shared responsibility in addressing healthcare challenges. The inclusion of diverse perspectives enables the creation of more relevant, innovative, and user-centred health solutions, while collective input and real-time feedback accelerate the development and testing of new ideas. Additionally, crowdsourcing supports scalable and adaptable service models, improves the efficiency of health data collection for public health monitoring, and enhances collaboration among patients, healthcare providers, and researchers, leading to more integrated and personalised care.

In the study,[57] the authors presented a structured initiative for improving electronic health records (EHR) by collecting feedback from healthcare professionals through internal communication channels. Submissions were made via the built-in HelpDesk function within the EHR system, service desk tickets, and direct email. In the most recent phase, feedback was gathered exclusively through the HelpDesk feature, enabling real-time reporting with automatic screenshot capture. Although a dedicated crowdsourcing portal was not used, the approach followed a crowdsourcing logic by actively involving end users in identifying issues and suggesting system improvements.

In a digital platform for individuals with depression and anxiety, crowdsourcing was implemented through peer contribution and user feedback.[58] The system enabled interaction and shared experiences via web and mobile interfaces. Readiness was evaluated indirectly through engagement metrics and user feedback, both suggesting a high level of acceptance.

In the study by Stewart et al.,[59] a web-based crowdsourcing approach was used to engage clinicians in proposing and selecting strategies for implementing evidence-based practices in community mental health services. This participatory design method demonstrated the potential of clinician-driven crowdsourcing to generate practical, user-informed solutions for improving service delivery.

Previous studies[57–59] have predominantly focused on isolated attempts to apply crowdsourcing within e-health services, often limited to pilot projects or specific use cases. A review of the existing literature reveals a lack of comprehensive methodological frameworks for implementing crowdsourcing-based e-health services as an integral component of institutional web portals and ensuring their integration with central health information systems.

Methodological approach for introducing crowdsourced e-health services

This study proposes a methodological approach for introducing crowdsourced e-health services within healthcare institutions, aimed at enhancing communication, collaboration, and citizen engagement across all levels of care (Figure 1). The approach introduces a structured framework that supports the integration of crowdsourcing functionalities, such as service feedback, problem reporting, and collaborative participation, into existing e-health systems. By promoting interoperability and standardization, the method enables healthcare institutions to adopt a shared infrastructure that can be connected with the state's central health information system. Its applicability across primary, secondary, and tertiary levels of care makes it a valuable foundation for developing a cohesive and participatory digital healthcare ecosystem.

The steps of the developed methodological approach are as follows:

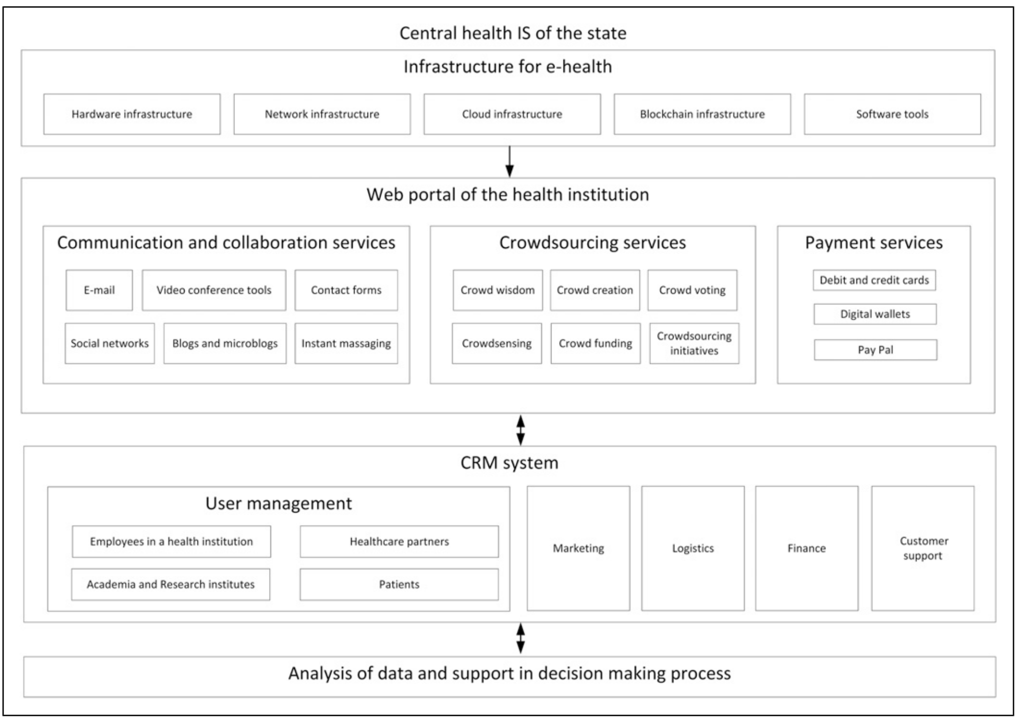

Figure 1. Methodological approach for introducing crowdsourced e-health services.

Development of an infrastructure for e-health

For the effective delivery of e-health services, healthcare institutions must operate within a well-established, state-level infrastructure that supports the integration of various digital technologies. This infrastructure should encompass hardware, network, cloud, blockchain components, along with specialized software tools for managing e-health services. Through such a unified environment, healthcare institutions can host their web platforms and implement a range of digital services adapted to their specific needs. Cloud computing plays a crucial role by enabling scalable, flexible, and cost-effective access to digital healthcare tools and data storage. Additionally, blockchain technology introduces a decentralized and secure framework for recording healthcare-related transactions involving all key actors—healthcare institutions, the pharmaceutical sector, laboratories, academia, research institutes, and patients—ensuring traceability and integrity across the entire healthcare value chain.[60] The application of smart contracts within this context can further enhance operational transparency, reduce administrative errors, prevent fraud, and guarantee the immutability of recorded transactions.[61]

Integration of the infrastructure for e-health with the central information system of the state

Depending on a country's legal and regulatory framework, the central health information system should enable integration with the digital systems used by healthcare institutions. It should provide secure and standardized access to patient data, treatment outcomes, and research findings, while also facilitating the exchange and distribution of health information necessary for informed decision-making across all levels of the healthcare system.

Development of the web portal of the health institution

For the delivery of e-health services, each health institution should have a web portal, through which it would provide all users with general information about the health institution, the provision of health services, the availability of medical equipment for diagnoses and treatments, and the availability of doctors, specialists, and other medical personnel.

Implementation of communication and collaboration services within the health institution's web portal

The web portal of the health institution should integrate services for communication and collaboration (email, social networks, blogs, microblogs, tools for video calls, contact forms, and instant messages) to better communicate, exchange data, facilitate the process of providing medical services, and raise awareness about diseases, prevention, diagnoses, and treatments. Social media services such as social networks, blogs, and microblogs as well as content creation communities should enable real-time information sharing. In this way, awareness of existing health issues can be raised, contributing to more effective disease prevention and treatment. Furthermore, social media, especially social networks, can be used to manage relationships with patients, clients, and other healthcare facilities and organizations. In addition to social media, healthcare institutions use other services for communication and collaboration, such as email, instant messages, and platforms for communication and collaboration.

Implementation of crowdsourcing services within the health institution's web portal

Crowdsourcing services (crowd wisdom, crowd creation, crowdfunding, crowd voting, crowdsensing, and crowd initiatives) should enable the exchange of opinions and knowledge among doctors, specialists, pharmacists, the academic community, patients, and others, thus solving existing problems in the health sector related to the provision of medical services, diagnoses, treatment methods, costs, and waiting times for examinations and treatments, either by proposing constructive solutions to solve identified problems or by donating material and non-material means to solve problems. Crowdsourcing services can enable patients and other stakeholders to develop initiatives and vote to select the best solutions for identified problems. Furthermore, crowdsourcing enables the collection of data on the health status of patients and, thus, allows patients who are unable to visit a doctor to receive advice remotely (telemedicine).

Implementation of a payment service within the health institution's web portal

Within the healthcare institution's web portal, it is necessary to have e-payment services enabled for debit and credit cards, digital wallets, or PayPal. In this way, it would be possible to pay for a health institution's medical services and enable the payment of donations related to crowdfunded services.

Integration of the health institution's web portal with the customer relationship management system

By applying customer relationship management (hereinafter: CRM) services, healthcare institutions can improve customer services, adapt services to customer needs, provide consulting services, increase patient and client loyalty, and improve how they conduct business. The CRM system can manage different roles of users, such as employees in the health institution, business partners, members of the academic community and institute, and patients. Within the CRM system, it is possible to create, conduct, and monitor the marketing campaigns of the health institution. Campaigns can refer to the promotion of healthcare, new health services within the health institution, discounts for loyal users, and others. Furthermore, within the CRM system are available functionalities related to the monitoring of finances, logistics, and customer support.

Data analysis and support in the decision-making process

A range of analytical tools can be used to monitor and analyse data related to the utilisation of healthcare infrastructure, web portal traffic, usage patterns of e-health services, payment transactions, social media activity, CRM interactions, and other relevant metrics. Advanced analytics techniques such as big data processing platforms and artificial intelligence (AI) tools can be applied to gain deeper insights and support data-driven decision-making. These technologies enable the detection of patterns, the prediction of user behavior, the identification of system bottlenecks, and the continuous optimization of healthcare service delivery.

The proposed methodological approach is applicable and adaptable for health institutions at any level. The infrastructure can be simpler than the one proposed or expanded by the application of other advanced technologies, such as mobile technologies, the Internet of Things, Big Data, Artificial Intelligence, Augmented Reality, etc. It may or may not be integrated with the health information system of the state, depending on the state regulations, laws, and business policies of the health institutions. Web portal development can be enabled by choosing different web technologies or by using ready-made content management systems, such as WordPress. The functionalities of the CRM system can be adapted according to the needs of the healthcare institution, and the integration of the web portal with this system is optional.

Examination of citizens' readiness to use crowdsourced e-health services

Defining the research model and hypotheses

This research adopts a quantitative, survey-based, correlational research design grounded in a deductive, empirical approach. Based on the developed methodological approach for introducing crowdsourced e-health services in health institutions, a survey examining citizens' readiness to use these services was conducted. For this research, we used the Value-based Adoption Model (hereinafter: VAM),[62] with specific constructs related to the benefits. Data were collected through a structured questionnaire and analysed using Partial Least Squares Structural Equation Modelling (hereinafter: PLS-SEM) in SmartPLS 4, to test hypotheses, explaining behavioural intention, and identifying predictive factors relevant to crowdsourced e-health service adoption.

The perceived benefits included enjoyment and utility in the material sense, which are features of intrinsic and emotional benefits.[62] Perceived benefits are defined as the degree to which a person believes that using a new technology will improve their performance.[63] Perceived benefits include both intrinsic and extrinsic motivators, such as learning and acquiring skills, task autonomy, reputation, financial compensation, and others. Perceived value is a key determinant of an individual's intention to adopt a technology. It is based on the perception of what is given and received.[64]

The research model based on the VAM[64] is shown in Figure 2.

This study focused on the perceived benefit and effort factors with direct effects on the perceived value. Based on the proposed research model, ten hypotheses were defined:

H1. Perceived enjoyment has a positive effect on citizens' perceived value of crowdsourced e-health services. Perceived enjoyment refers to the extent to which the activity of using technology is perceived as enjoyable in itself.[63,64] High perceived enjoyment has been identified as an incentive for innovation adoption.[65] Previous research has shown that, in crowdsourcing services, perceived

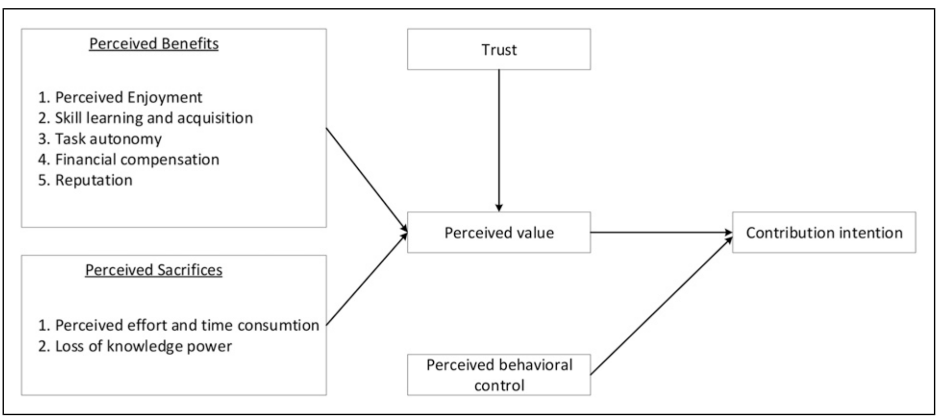

Figure 2. Research model[64].

enjoyment has a considerably favorable effect on contribution.[64,66] Users will find technology beneficial if they enjoy using it and find it interesting.

H2. Skill learning and acquisition positively influence citizens' perceived value of crowdsourced e-health services. The possibility of exhibiting and developing new skills that are linked to problem solutions motivates involvement in crowdsourcing services.[67,68] Users are usually encouraged to master new skills and develop creative methods to achieve tasks.[69]

H3. Task autonomy is positively associated with citizens' perceived value of crowdsourced e-health services. Task autonomy refers to the extent to which the requester gives users freedom and discretion over how the work should be completed.[70] Previous research has found that task autonomy increases solver engagement in crowdsourcing environments.[71–73]

H4. Financial compensation positively affects the citizens' perceived value of crowdsourced e-health services. Financial compensation is a major factor in a user's perception of value. The larger the monetary incentive, the higher the influence and the more diversified the audience it attracts.[74] Financial compensation has always been an essential motivation for encouraging crowdsourcing contributions.[75]

H5. Reputation positively contributes to citizens' perceived value of crowdsourced e-health services. Plenty of research shows that reputation is a significant value associated with contributing to solutions in the context of crowdsourcing.[76] Reputation relates to an individual's perception of earning respect, increasing status, or improving their image by contributing to solutions using crowdsourcing services.[77,78]

H6. Perceived effort and time consumption negatively affect citizens' perceived value of crowdsourced e-health services. According to related studies on crowdsourcing and online collaboration, the perceived effort, time consumption, and loss of knowledge power were identified as the primary effort components.[79] The perceived effort and time consumption indicate an individual's perception of the time and effort put into addressing a problem on a crowdsourcing website.

H7. Perceived loss of knowledge power negatively influences citizens' perceived value of crowdsourced e-health services. In crowdsourcing, solvers may fear losing their prestige, power, or value if others learn, duplicate, transfer, or replicate their distinctive knowledge and exclusive skills for providing a solution.[43,80] The notion of losing knowledge and distinctive value can lower the perceived value of offering solutions in an environment of crowdsourcing.

H8. Trust in system operators positively affects the perceived value of crowdsourced e-health services. A website with crowdsourcing services can be regarded as an intermediary in knowledge transactions and exchange.[43] In the context of crowdsourcing, a potential user with a low perception of trust may believe that others may inappropriately use their expertise, and hence, decline to offer their knowledge. Users who believe that a crowdsourcing website can protect their knowledge contributions and secure their interests will increase their contributions.[81,82]

H9. Perceived behavioral control positively influences behavioral intention to use crowdsourced e-health services. The perceived behavioral control is a reliable predictor of an individual's adoption intention and behavior.[83] It relates to a person's perception of the abilities, skills, and sense of control required by the action. The perceived behavioral control should increase the contribution intention by reducing potential users' fear of failure and incompetence anxiety.

H10. Perceived value has a positive effect on behavioral intention to use crowdsourced e-health services. A high perceived value has been empirically found as an inducement for innovation adoption.[84] When an individual sees the value in providing solutions on a crowdsourcing website, he is more likely to participate and contribute.

Instruments and data collection

The survey method was used to collect data. The data were collected using an anonymous questionnaire. The questionnaire contained five demographic questions and 32 questions to measure the citizens' readiness to use the crowdsourced e-health services. The questionnaire began with an explanation of the crowdsourced e-health services referenced in the questions.

Table 1 presents the numerical indicators used to assess citizens' readiness to utilize crowdsourced e-health services, with the complete list of indicators available in the Online Appendix.

The values given in Table 1 suggest a reduced degree of deviation from the normal distribution for the respective indicators. All the indicators were considered for further analysis.

Sample description

A total of 1153 respondents participated in the research on citizens' readiness to use crowdsourced e-health services. All participants belonged to the age group of 18 to 25 years, corresponding to Generation Z—digital natives generally characterized by a high level of technological fluency and openness to innovative solutions. The study did not involve the use of medical data or biological material, nor were any interventions or experimental methods applied. Instead, respondents were invited to share their opinions on potential collaboration with healthcare institutions and their willingness to participate in a crowdsourcing campaign, as indicated through a structured questionnaire. The demographic data are presented in Table 2.

Next, the survey addressed the gender of the respondents. It was found that females made up a significantly higher proportion of the sample, accounting for 62.8%, while 37.2% of the participants were male. This indicates a greater representation of young women in the study, which may reflect higher engagement in health-related topics or greater openness toward digital healthcare innovations among female respondents.

Regarding the educational background, most of the respondents (61.0%) had completed high school. A substantial portion (34.9%) reported pursuing or having completed undergraduate studies, while 3.4% had vocational education. Only 0.7% of the respondents had completed graduate-level education. The educational structure of the sample shows that a large majority of participants had either secondary or tertiary education, which is consistent with the expected educational profile of individuals aged 18 to 25 and supports the study's aim to assess digital health readiness among younger, educated citizens.

In terms of employment status, most respondents (77.5%) identified as dependent, likely indicating they were full-time students without permanent employment. Part-time or freelance work was reported by 17.4%, while a small percentage had permanent (2.8%) or temporary employment (2.3%). Given the educational and occupational diversity of the sample, it is also important to emphasize that while many respondents consider e-health services primarily from a user or patient perspective, a portion of them—particularly those pursuing health-related fields of study—may also approach these services from the standpoint of future healthcare professionals. This dual perspective

Table 1. Indicators for examining citizens' readiness to use crowdsourcing healthcare services.

Indicator	Mean	Std. Dev	Excess kurtosis	Skewness
Perceived enjoyment (EN)				
EN1	3.336	1.182	−0.568	−0.308
EN2	3.997	1.094	0.164	−0.915
Skill learning and acquisition (SL)				
SL1	3.831	0.970	0.322	−0.797
SL2	4.172	0.957	1.384	−1.265
Task autonomy (TA)				
TA1	4.230	0.945	1.025	−1.213
TA2	4.539	0.826	3.553	−1.947
TA5	4.101	1.019	0.605	−1.086
Financial compensation (FC)				
FC1	3.789	1.146	−0.128	−0.775
FC2	4.021	1.102	0.245	−1.014
FC3	3.646	1.125	−0.467	−0.573
Reputation (RE)				
RE1	3.256	1.064	−0.369	−0.173
RE2	3.197	1.120	−0.603	−0.185
RE3	3.453	1.097	−0.400	−0.428
Perceived effort and time consumption (PE)				
PE1	2.529	1.211	−0.749	0.532
PE2	2.456	1.189	−0.706	0.542
Loss of knowledge power (LK)				
LK1	2.114	1.136	−0.277	0.765
LK2	2.053	1.134	−0.209	0.839
LK3	2.194	1.203	−0.540	0.693
Trust (TR)				
TR1	3.718	0.933	0.136	−0.584
TR2	3.648	1.144	−0.372	−0.603
TR3	3.654	1.142	−0.449	−0.606
Perceived value (PV)				
PV1	4.319	0.883	1.292	−1.287
PV2	4.224	0.896	0.723	−1.062
PV3	4.194	0.913	0.467	−1.001
PV4	4.179	0.854	0.015	−0.777
PV5	4.001	0.992	0.024	−0.770

(continued)

Table 1. (continued)

Indicator	Mean	Std. Dev	Excess kurtosis	Skewness
Perceived behavioral control (PBC)				
PBC1	2.870	1.303	−1.081	0.119
PBC2	2.999	1.260	−1.026	−0.066
Contribution intention (CI)				
CI1	3.028	1.155	−0.722	−0.037
CI2	3.049	1.141	−0.684	−0.086
CI3	3.218	1.168	−0.758	−0.223
CI4	3.003	1.160	−0.724	−0.037

provides a more nuanced understanding of user roles, expectations, and readiness for engaging with crowdsourced digital healthcare platforms.

These demographic characteristics portray a population of young, digitally literate individuals with a relatively high level of education and limited labour market involvement. This makes them an appropriate target group for evaluating the potential of crowdsourced e-health services, which rely on digital participation and collaborative engagement within the healthcare ecosystem.

Results

Data analysis

The partial least-squares structural equation modelling method (PLS-SEM) was used to conduct a detailed examination of the cause-and-effect relationships between the variables that measure the readiness to use crowdsourced e-health services. The SmartPLS 4.1.0.0 software tool[85] was used for the analysis. The hypotheses were tested using path coefficients in the PLS structural model. The application results of the PLS algorithms are shown in Figure 3 and described in Tables 3 and 6.

Table 2. Demographic data of respondents.

Variable	Values	Frequency	%
General Demographically data			
Gender	Male	429	37.2%
	Female	724	62.8%
Level of education	High school	703	61.0%
	Vocational studies	39	3.4%
	Undergraduate studies	403	34.9%
	Graduate studies	8	0.7%
Employment Status	Permanent employment (indefinite-term employment)	32	2.8%
	Temporary employment (fixed-term employment)	27	2.3%
	Dependent	894	77.5%
	Part-time jobs/freelance	200	17.4%

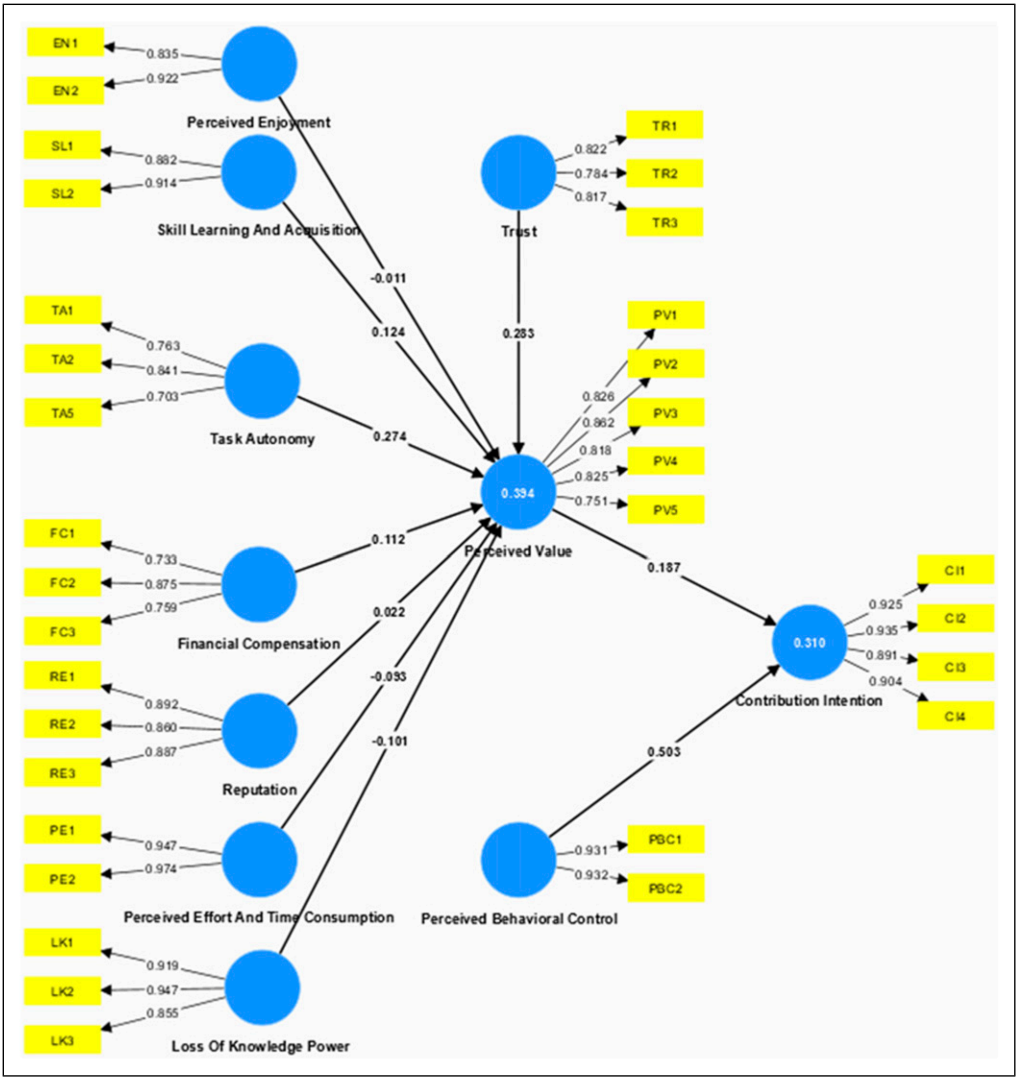

Figure 3. Results of application of PLS algorithms.

The structural model's path coefficients were used to evaluate the relationships between the variables under consideration. According to the results, the variable that positively affected the perceived value the most was trust. Additionally, all the other variables had path coefficients close to zero, indicating very little impact, whereas task autonomy, skill learning and acquisition, financial compensation, and reputation had a positive impact on the perceived value.

Measurement model

Table 3 shows the validity assessment of the measurement model. In structural modelling, the AVE index is calculated using the average explained variance of individual indicators, with a value greater

Table 3. Validity assessment of the measurement model.

Variable	Indicator	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	AVE
Contribution intention	CI1, CI2, CI3, CI4	0.934	0.937	0.953	0.835
Financial compensation	FC1, FC2, FC3	0.704	0.745	0.833	0.626
Loss of knowledge power	LK1, LK2, LK3	0.893	0.915	0.934	0.824
Perceived behavioral control	PBC1, PBC2	0.848	0.848	0.930	0.868
Perceived effort and time consumption	PE1, PE2	0.918	0.920	0.960	0.922
Perceived enjoyment	EN1, EN2	0.715	0.776	0.872	0.773
Perceived value	PV1, PV2, PV3, PV4, PV5	0.875	0.877	0.909	0.668
Reputation	RE1, RE2, RE3	0.858	0.895	0.911	0.774
Skill learning and acquisition	SL1, SL2	0.761	0.773	0.893	0.806
Task autonomy	TA1, TA2, TA5	0.658	0.673	0.814	0.595
Trust	TR1, TR2, TR3	0.736	0.745	0.849	0.652

than 0.5 indicating convergent validity of the model.[86] Reliability was assessed by calculating Cronbach alpha coefficient and composite reliability where a value greater than or equal to 0.7[87] was taken to indicate a high degree of internal consistency. All presented values indicated a high reliability of the measurement model.

Table 4. Assessment of model validity—Fornell–Larcker criterion.

	CI	FC	Lk	BHC	Pe	EN	PV	Re	SL	Ta	TR
Contribution intention	0.914										
Financial Compensation	0.184	0.792									
Loss of knowledge power	0.110	0.040	0.908								
Perceived Behavioral control	0.525	0.107	0.178	0.932							
Perceived effort and time consumption	0.134	0.137	0.419	0.161	0.960						
Perceived Enjoyment	0.343	0.208	−0.035	0.180	0.042	0.879					
Perceived value	0.246	0.309	−0.209	0.117	−0.133	0.287	0.817				
Reputation	0.460	0.302	0.129	0.309	0.195	0.373	0.233	0.880			
Skill learning and acquisition	0.287	0.329	−0.068	0.147	0.002	0.451	0.424	0.376	0.898		
Task autonomy	0.267	0.305	−0.204	0.124	−0.118	0.420	0.506	0.273	0.504	0.771	
Trust	0.346	0.299	−0.044	0.235	0.053	0.341	0.469	0.322	0.408	0.364	0.808

Additionally, we examined the validity of the Fornell–Larcker model, which compares AVE values with the correlation of factors. According to the correlation matrix in Table 4, each variable's validity was achieved.[88]

Structural model

Using the VIF (Variance Inflation Factor), the degree of collinearity was evaluated. Since all the values were less than five, there was no collinearity between the variables.[89] The VIF values are presented in Table 5.

The coefficient of determination (R^2) was utilized to assess the predicted correctness of the suggested model. For the perceived value and behavioral intention, the values of the R^2 coefficients of determination were moderate, at 0.394 and 0.310, respectively. The results of the hypothesis testing using the bootstrapping method are presented in Table 6. The results show that trust had a statistically significant impact on the perceived value ($\beta = 0.283$, $T > 1.96$), while both the perceived value ($\beta = 0.187$, $T > 1.96$) and the perceived behavioral control ($\beta = 0.503$, $T > 1.96$) had a statistically significant impact on the contribution intention. According to the results in Table 6, two relations did not pass the significance test: perceived enjoyment -> perceived value and reputation -> perceived value. These relations reflect, respectively, hypotheses H1 and H5, which can be rejected. All the other hypotheses were accepted in our model since the remaining coefficients all exhibited positive relations.

Discussion

The research results indicate that the variables perceived value and perceived behavioral control play key roles in shaping citizens' willingness to participate in crowdsourcing-based healthcare services. Perceived value reflects an individual's evaluation of the benefits associated with engagement, while perceived behavioral control was introduced as an additional variable, extending the original Value-based Adoption Model (VAM). Findings show that this variable had a considerable positive impact on citizens' intention to contribute, thereby increasing the explanatory power of the model. Taken together, these two variables significantly influence the intention to engage in the development and implementation of such services. In general, when people have self-confidence, they perceive themselves as having the competence and knowledge to perform some actions and they have a

Table 5. VIF values.

	Behavioral intention	Perceived value
Skill learning and acquisition		1.639
Loss of knowledge power		1.268
Perceived behavioral control	1.014	
Perceived effort and time consumption		1.275
Perceived enjoyment		1.434
Perceived value	1.014	
Reputation		1.373
Financial compensation		1.243
Task autonomy		1.589
Trust		1.337

Table 6. Testing the hypotheses.

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T Statistics (|O/ STDEV|)	P Values
Financial compensation -> perceived value	0.112	0.113	0.027	4.224	0.000
Loss of knowledge power -> perceived value	−0.101	−0.101	0.026	3.912	0.000
Perceived behavioral control -> contribution intention	0.503	0.503	0.024	20.832	0.000
Perceived effort and time consumption -> Perceived value	−0.093	−0.094	0.025	3.658	0.000
Perceived enjoyment -> Perceived value	−0.011	−0.010	0.029	0.398	0.691
Perceived value -> Contribution intention	0.187	0.187	0.024	7.706	0.000
Reputation -> Perceived value	0.022	0.022	0.029	0.769	0.442
Skill learning and acquisition -> perceived value	0.124	0.123	0.032	3.838	0.000
Task autonomy -> Perceived value	0.274	0.274	0.033	8.211	0.000
Trust -> perceived value	0.283	0.284	0.029	9.839	0.000

positive attitude towards contributing to the realization of a certain activity. The attitude towards crowdsourcing services in healthcare can be explained similarly. Citizens who have the knowledge, abilities, and resources to provide certain solutions or ideas will contribute more to the development of e-health services based on crowdsourcing.

It was found that trust, task autonomy, financial compensation and loss of knowledge power, skill learning and acquisition, perceived effort, and time consumption were the important factors that determined the perceived value. Trust had the greatest impact on the perceived value. Therefore, if there is trust in e-health services based on crowdsourcing, users will consider them necessary and probably use them.[43]

Although the perceived enjoyment and reputation factors have been confirmed in other studies as factors that have an impact on the perceived value,[90] this was not shown in our case. Perceived enjoyment as a factor had no significance on the perceived value, most likely because the respondents had no experience with using the crowdsourcing platform in healthcare. Therefore, they could not manifest a certain degree of satisfaction with its use. The situation is much the same as with reputation. Crowdsourcing has not been implemented in healthcare where respondents receive services. Therefore, they can only guess what kind of reputation they would have if they participated in crowdsourcing.

The proposed methodological approach enhances the functioning of healthcare institutions by supporting more efficient operations, particularly through the integration of e-health services that facilitate improved communication, collaboration, and customer relationship management. By combining crowdsourcing, payment, and interaction functionalities into a unified system, the method enables a more coordinated and responsive healthcare delivery process.

Limitations

The implementation of crowdsourced e-health services in developing countries presents several structural and operational challenges that complicate the validation of the proposed method. One of the core limitations lies in the complexity of integrating newly developed e-health functionalities into existing national health information systems. These central systems are often under state control and vary significantly in terms of digital maturity, standardization, and openness to third-party integrations.

Another key limitation is the need for interoperability across a fragmented healthcare infrastructure. For the proposed method to function effectively, seamless data exchange must be enabled between national health platforms and the diverse web portals of individual healthcare institutions. This requires not only technical alignment but also regulatory frameworks and standardized protocols for secure and ethical data sharing that remains underdeveloped in many low- and middle-income settings.

In addition, successful implementation depends on the digital literacy of both citizens and healthcare professionals. The introduction of collaborative and participatory e-health services will require systematic training and support for all stakeholders. Without this, there is a significant risk that the platforms may be underutilized or misapplied, reducing their potential impact on healthcare delivery.

For the crowdsourced approach to achieve its full potential, there must be a strong culture of engagement and shared responsibility among all actors—citizens, institutions, and authorities alike. This implies not only technical readiness but also social willingness to actively participate in identifying and resolving issues within the healthcare system.

This research is based on a sample of respondents aged 18 to 25, representing Generation Z, who are considered digital natives and likely early adopters of crowdsourced e-health services. However, further research is needed to examine the readiness of older population groups to engage with such services.

While conceptual validation through simulations, surveys, and stakeholder interviews may offer valuable preliminary insights, these methods cannot fully replicate the challenges of real-world integration and sustained usage. Therefore, future validation efforts should include broader stakeholder involvement-including healthcare providers, system developers, government actors, and end users to assess both technical feasibility and long-term adoption potential in diverse healthcare contexts.

Conclusion

This paper presents a methodological approach for introducing crowdsourced e-health services within healthcare institutions, emphasizing the integration of communication, collaboration, crowdsourcing, and payment functionalities into healthcare institutional web portals. The proposed method is designed to function within a shared digital infrastructure and allows for interoperability with the central health information system. It enables healthcare institutions at all levels to introduce innovative services based on citizen engagement, supporting more inclusive and responsive healthcare delivery. Unlike previous research, which has largely focused on isolated use cases or pilot initiatives,[57–59] this study offers a scalable and system-oriented solution for embedding crowdsourcing mechanisms into the existing e-health landscape.

Theoretical and practical implications of the research

The study contributes to the theoretical understanding of technology adoption in healthcare by extending the Value-based Adoption Model (VAM) with additional variables and confirming the key role of perceived value and behavioral control in shaping citizens' intention to engage with crowdsourced e-health services. It also highlights the importance of balancing motivational drivers with limiting factors such as effort, time investment, and perceived loss of knowledge power.

From a practical perspective, the proposed methodological approach provides healthcare institutions with a structured framework for implementing crowdsourced e-health services within existing digital infrastructures. It supports direct citizen participation through components such as problem reporting, feedback, and collaboration, while offering guidance for designing user-friendly and secure web interfaces. The method also serves as a foundation for policymakers and IT planners in developing scalable, interoperable systems aligned with national health strategies, and can be applied across institutions of various levels to support a more integrated and responsive healthcare ecosystem.

Future work

Future research will focus on expanding the proposed method by including broader and more diverse user groups, particularly individuals from older age cohorts who were not represented in the current research. This will allow for a more comprehensive understanding of the population's readiness to adopt crowdsourced e-health services and help identify generational differences in perceived value, trust, and behavioral intention. Future research will assess the readiness of key stakeholders—including healthcare professionals, administrators, and decision-makers—to adopt and support the implementation of crowdsourcing-based services within institutional settings.

As part of the next development phase, a prototype web platform will be designed based on the proposed methodological approach. This platform will integrate a full set of crowdsourced e-health functionalities, including communication tools, collaborative health features, data submission options, and secure payment systems. The prototype will be conceptually validated through structured interviews, focus groups, and feasibility assessments involving representatives from healthcare institutions, regulatory bodies, and IT infrastructure providers.

The planned technical development will include the design of integration modules that connect the institutional web platforms with the central health information system, ensuring compliance with national interoperability standards and enabling secure data exchange across the broader healthcare ecosystem. These activities aim to validate the practical feasibility of the proposed solution while refining its architecture to meet the operational and regulatory demands of real-world healthcare environments.

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Consent to participate

Written informed consent was obtained from all subjects involved in the study. Informed consent was obtained prior to participation via an online questionnaire.

Author contributions

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Aleksandra Labus: Investigation, Conceptualization, Methodology, Writing - review & editing, Supervision.
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The authors confirm that the data supporting the findings of this study are available within the article and its supplementary materials are available on request.

Supplemental Material

Supplemental material for this article is available online.

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