DOI 10.4149/BLL_2024_80

Bratisl Med J 2024; 125 (8):

CLINICAL STUDY

Patients' perspectives on the use of artificial intelligence and robots in healthcare

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ABSTRACT

OBJECTIVE: We aimed to evaluate the opinions of individuals aged 18 and above in our country regarding the use of artificial intelligence (AI) and robots in the field of healthcare.

BACKGROUND: The growing population and patient load, coupled with increasing data, can expedite the diagnosis and treatment process for patients through faster, easier, and more accurate interpretation of information.

METHODS: The study encompasses voluntary participants aged 18 and above, who have either undergone surgery in a hospital or have accompanied a family member during a surgical procedure and possess internet access as well as the capability to participate in online surveys.

RESULTS: A total of 725 individuals participated in our study 61% (n=442) of respondents expressed trust in the operation of AI and robots in the hospital setting. 64.1% (n=465) of participants expressed trust in AI's contribution to disease diagnosis and laboratory tests. The confidence in AI's use in radiological examinations and its contribution reached 71.6% (n=519).

CONCLUSION: This study demonstrates that the use of AI and robots in healthcare services is accepted by our society and would be appropriate in our society *(Tab. 5, Fig. 1, Ref. 24)*. Text in PDF www.elis.sk

KEY WORDS: artificial intelligence, healthcare, diagnosis, surveys and questionnaires.

Introduction

The term artificial intelligence (AI) was first defined by John McCarthy in 1955 as "the science and engineering of making intelligent machines" (1). Robotic surgery is one of the applications of AI in healthcare. Robotic systems were first developed in 1997 and received FDA approval in 2000.

Computers used in the field of healthcare incorporate deep learning, machine learning, and other AI technologies. The use of AI and robots in healthcare is increasing, particularly in preventive healthcare, diagnosis, treatment, and decision-making processes (2). However, there is insufficient data on individuals' opinions regarding the use of AI in medicine.

In general, the applications of AI and robots play a crucial role in decision-making, early diagnosis and treatment, medical imaging, laboratory work, determining treatment options, and providing information to patients and their families about diseases (3). Additionally, the growing population and patient load, coupled with increasing data, can expedite the diagnosis and treatment process for patients through faster, easier, and more accurate interpretation of information (4).

Our objective is to evaluate the opinions of individuals aged 18 and above in our country regarding the use of AI and robots in the field of healthcare. In this context, we aim to explore their concerns and future perspectives.

Materials and methods

Ethical approval for this survey was obtained from the local ethics committee of the Health Sciences University, Izmir Tepecik Training and Research Hospital (Decision no: 2021/11–23).

The survey was designed by a team of five expert physicians from various departments of our hospital (General Surgery, Urology, Family Medicine, Pharmacology, Infectious Diseases). The survey form was created in electronic format. As a demonstration, it was initially applied to 30 individuals including patients, their families, and non-physician healthcare workers from our hospital in an interdisciplinary manner, and any shortcomings were addressed.

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The study included voluntary participants aged 18 and above, who had previously undergone surgery at the hospital and/or accompanied a family member who had undergone surgery, and had internet access and online survey availability, between May 26, 2021, and June 27, 2021.

In our survey, we used only AI terminology instead of complex terms such as algorithms, deep learning, and machine learning, in order to be easily understood by everyone. The survey investigated participants' demographic characteristics, their knowledge about the use of AI in healthcare, their confidence in AI for diagnosis, treatment, and monitoring of diseases, their trust in robotic surgery, and their concerns regarding these topics. Participants who did not fully complete the survey or were unable to complete it were excluded from the study. Voluntary participation was emphasized to the individuals prior to the survey, and it was explained that the data would be classified and evaluated afterwards.

Statistics: The scale consists of a total of 10 questions. One question is of a 3-point Likert scale (scoring from 0 to 2), while the others are of a 5-point Likert scale (scoring from 0 to 4). The scale allows for a maximum score of 38 and a minimum score of 0. The validity and reliability analyses of the scale are provided in the findings section. The cutoff value was not calculated.

Data Analysis: Descriptive statistics, presenting the number (n) and percentages (%), were used in tables to evaluate the data obtained from the research. Mean and standard deviation were calculated and used for descriptive analysis. Pearson's Chi-Square analysis was used for the analysis of categorical data. Cronbach's alpha was used for the analysis of internal consistency and reliability coefficients of the "AI and Robot Use in Healthcare" survey. Factor analysis (Extraction Method: Principal Component Analysis) was conducted for validity analysis, and the "Kaiser–Mayer–Olkin Measure of Sampling Adequacy (KMO) and Bartlett's test" were performed for the factor analysis. Independent t-tests were used for comparing the mean scores between gender groups.

One-way ANOVA analysis and post hoc analysis using the Holm–Sidak method were conducted for comparing age groups and educational backgrounds. The results were considered statistically significant if $p<0.05$. All statistical analyses were performed using IBM SPSS 26.0 and Confirmatory Factor Analysis was performed with AMOS 22.0 software.

Tab. 1. Characteristic of demographical variables.

Variables	Subgroups	Frequency (n)	Percentage (%)
Gender			
	Male	319	44.0
	Female	406	56.0
Age Groups			
	18–30	161	22.2
	31–40	216	29.8
	41–50	238	32.8
	51–60	87	12.0
	61–70	23	3.2
Graduate			
	Primary education	72	9.9
	Middle school	70	9.7
	High school	152	21.0
	Bachelor degree	305	42.1
	Master degree	82	11.3
	Doctorate	44	6.1

Results

In our study, a total of 725 individuals participated in the survey. Upon examining the demographic data, it was found that 319 (44%) participants were male, while 406 (56%) participants were female. The distribution of participants across different age groups and educational backgrounds is shown in Table 1.

Reliability: The reliability of the "AI and Robot Use in Health" survey was analyzed in terms of internal consistency using Cronbach's alpha. Cronbach's alpha was calculated at the scale level for the entire sample. In evaluating the internal consistency of the "AI and Robot Use in Health" survey, the overall Cronbach's alpha value was calculated as 0.826 (Tab. 2).

Tab. 2. Analysis of the reliability of the "AI and Robot Use in Health"; Item-Total Statistics.

Items	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Do you know about AI and its use in medicine?	21.95	43.517	0.176	0.840
How much do you trust the hospital run by AI and robots?	21.50	36.166	0.690	0.791
Do you trust AI in the diagnosis of your disease?	21.51	35.243	0.748	0.784
Do you trust AI in laboratory tests of your disease (blood tests, urinalysis…etc.)?	21.29	36.556	0.655	0.795
Do you trust AI and robots in radiological examinations (USG, CT, MRI etc.)?	21.15	37.033	0.660	0.795
Would it be sufficient for you to be informed by AI and robots about your disease?	21.68	35.823	0.671	0.793
Do you trust AI and robots in planning the treatment of your disease and in drug treatment (prescribing)?	21.63	35.981	0.677	0.792
Would you accept that AI and robots do your surgery?	22.73	43.056	0.329	0.826
Would you like AI and robots to follow up your disease?	21.63	35.783	0.679	0.792
Does the use of AI and robot in medicine scare you?	22.11	47.437	–0.121	0.869

AI – Artificial intelligence, USG – ultrasonography, CT – computerized tomography, MRI – magnetic resonance imaging

Validity: To assess the adequacy of the sample for factor analysis, a KMO (Kaiser–Mayer–Olkin) analysis and "Barlett's Test of Sphericity" analysis were conducted. The KMO value was found to be 0.894, and the "Barlett's Test of Sphericity" yielded a $p<0.0001$ ($df=45$, $\chi^2=2908.8$), indicating the suitability of the sample for factor analysis. According to the factor analysis, three components were identified, which accounted for 68.0% of the total variance (Fig. 1). Of these three components, component 1 (trust; questions 2–7 and 9) accounted for 46.0% of the variance, component 2 (patient consent; question 8) accounted for 11.5% and component 3 (level of knowledge; questions 1 and 10) accounted for 10.5%.

Table 3 presents the clarification and determination of the components by considering the survey questions together and revealing under which component they are grouped. The first component contained the highest number of items, followed by the third component. The first component measured the 'trust' in the use of AI in the healthcare domain. The second component included a question about the use of AI and robots for personal health monitoring and consent. The third component measured participants' knowledge level regarding the use of AI in healthcare. Thus, this questionnaire successfully measured trust, knowledge level, and consent in the context of AI and robot use in health.

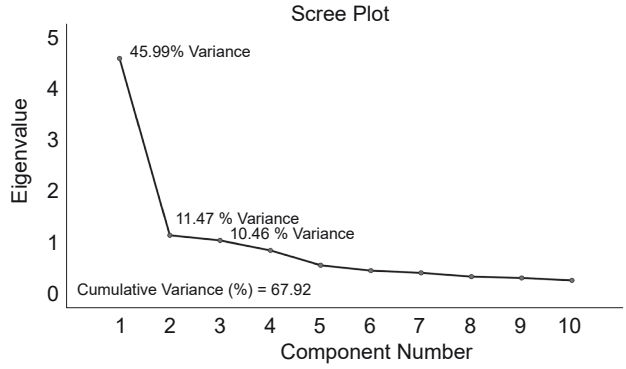

Fig. 1. Screeplot analysis to identify components.

Table 4 presents the distribution of responses to the survey questions. The response to the question 'Do you know about AI and its use in medicine?' indicates that 39.1% (n=284) of respondents had knowledge in this area. Regarding the question 'How much do you trust the hospital run by AI and robots?', 61%

Tab. 3. Rotated Component Matrix.

Items	Component		
	1	2	3
Do you know about AI and its use in medicine?	0.272	–0.136	**0.801**
How much do you trust the hospital run by AI and robots?	**0.810**	0.124	0.106
Do you trust AI in the diagnosis of your disease?	**0.844**	0.184	–0.001
Do you trust AI in laboratory tests of your disease (blood tests, urinalysis…etc.)?	**0.838**	0.021	–0.044
Do you trust AI and robots in radiological examinations USG, CT, MRI, etc.)?	**0.798**	0.101	0.004
Would it be sufficient for you to be informed by AI and robots about your disease?	**0.652**	0.485	–0.132
Do you trust AI and robots in planning the treatment of your disease and in drug treatment (prescribing)?	**0.626**	0.524	–0.076
Would you accept that AI and robots do your surgery?	0.070	**0.839**	0.086
Would you like AI and robots to follow up your disease?	**0.607**	0.526	0.035
Does the use of AI and robot in medicine scare you?	–0.281	0.217	**0.663**

Extraction Method – Principal Component Analysis. Rotation Method – Varimax with Kaiser Normalization.
AI – Artificial intelligence, USG – ultrasonography, CT – computerized tomography, MRI – magnetic resonance imaging

Tab. 4. Question-based Response Distribution of the Questionnaire.

Items	No idea	Not at all	Somewhat	Moderately	Very
			n (%)		
Do you know about AI and its use in medicine?	28(3.9)	166(22.9)	247(34.1)	220(30.3)	64(8.8)
How much do you trust the hospital run by AI and robots?	37(5.1)	90(12.4)	156(21.5)	258(35.6)	184(25.4)
Do you trust AI in the diagnosis of your disease?	43(5.9)	79(10.9)	164(22.6)	246(33.9)	193(26.6)
Do you trust AI in laboratory tests of your disease (blood tests, urinalysis…etc)?	13(1.8)	97(13.4)	150(20.7)	185(25.5)	280(38.6)
Do you trust AI and robots in radiological examinations (USG, CT, MRI, etc.)?	16(2.2)	65(9.0)	125(17.2)	225(31.0)	294(40.6)
Would it be sufficient for you to be informed by AI and robots about your disease?	41(5.7)	127(17.5)	182(25.1)	196(27.0)	179(24.7)
Do you trust AI and robots in planning the treatment of your disease and in drug treatment (prescribing)?	37(5.1)	113(15.6)	179(24.7)	219(30.2)	177(24.4)
Would you accept that AI and robots do your surgery? [a]	115(15.9)	206(28.4)	–	–	404(55.7)
Would you like AI and robots to follow up your disease?	42(5.8)	122(16.8)	154(21.2)	239(33.0)	168(23.2)
Does the use of AI and robot in medicine scare you?	49(6.8)	212(29.2)	230(31.7)	152(21.0)	82(11.3)

[a] 3-point Likert Scale Type
AI – Artificial intelligence, USG – ultrasonography, CT – computerized tomography, MRI – magnetic resonance imaging

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[a] 3-point Likert Scale Type

AI – Artificial intelligence, USG – ultrasonography, CT – computerized tomography, MRI – magnetic resonance imaging

(n=442) of respondents expressed trust in the operation of AI and robots in the hospital setting. 64.1% (n=465) of participants expressed trust in AI's contribution to disease diagnosis and laboratory tests. The confidence in AI's use in radiological examinations and its contribution reached 71.6% (n=519). Regarding the question 'Would it be sufficient for you to be informed by AI and robots about your disease?', 51.7% (n=375) of respondents expressed trust in AI and its functioning. In terms of the question 'Do you trust AI and robots in planning the treatment of your disease and in drug treatment (prescribing)?', 54.6% (n=396) of respondents generally expressed trust in AI's ability to make treatment plans and prescribe medications. The percentage of respondents who approved of AI and robots performing surgeries remained 55.7% (n=404). 56.2% (n=407) of respondents had a positive view of AI and robots being involved in disease monitoring. The percentage of individuals expressing concerns about the use of AI and robots in healthcare was found to be 63%. This indicates a similar result to those who did not want the use of AI and robots in surgical procedures.

Among the female participants (n=406), the overall mean survey score was found to be 24.2±6.7, while among the male participants (n=319), it was 24.3±7.1. When comparing the total survey scores between genders, no significant difference was found (p=0.846).

Regarding educational status, a statistically significant difference was observed only between participants with primary education and those with a high school education (p=0.022).

In the study of "Confirmatory Factor Analysis (CFA)" was used to reveal whether the scale was validated in the sample of patients, and the reliability of fit coefficients of the scale CMIN=343.79 df=35; χ^2/df=9.823; CFI=0.898; IFI=0.898; NFI=0.888; GFI= 0.903; RMSEA= 0.110) were determined.

When the reliability of fit coefficients of the scale was examined, it was found that they were within the range of acceptable values in the literature (5–9). Detailed data are given in Table 5.

Tab. 5. Threshold values of goodness of fit coefficient according to different sources and comparing.

Reference Comment	Critical Value	Research Finding Value	Comment
Kline, 2011	0.95≥GFI≥90	0.903	Good fit
Byrne and Campbell, 1999	CFI≥0.80	0.898	Acceptable
Hooper et al, 2008	0.80≥NFI≥0.90	0.888	Acceptable
Jöreskog and Sörborn, 1993	0.08≥RMSEA≥0.05	0.110	Above acceptable value

Discussion

According to this survey, the majority of participants expressed trust in AI and robot applications in healthcare and were willing to accept treatments provided by these technologies. In a previous survey conducted by Staj et al with 264 participants to better understand public perception and understanding of medical technologies such as AI and robotic surgery, it was found that most participants had more trust in AI than doctors when it came to diagnosing diseases (10). A review examining patient and general public attitudes towards clinical AI concluded that participants were generally willing to accept AI in their healthcare management (11). In contrast to our study, a national online survey was conducted in the Netherlands in March 2022, involving 1909 participants, to investigate the applications of AI in robotic surgery, radiology, and dermatology. That study found a higher level of skepticism towards AI in medicine (12). However, in a survey conducted in Germany with 229 patients, the majority preferred human clinicians over AI. They emphasized the need for supervision by a healthcare professional when AI was involved in a medical procedure. Additionally, it was concluded that AI could assist doctors in integrating the latest scientific evidence into medicine (13). In our study, moderate (n=257, 35.4%) and high (n=184, 25.4%) levels of trust were found in the hospital managed by AI, and moderate (n=244, 33.6%) and high (n=194, 26.8%) levels of trust were reported in the diagnosis of diseases. Our findings are believed to be consistent with the majority of the literature. It was observed that more than half of the population had high expectations of this technology. As a result of these developments, with the use of AI, doc-

tors can allocate more time to patients, leading to early diagnosis, treatment, and reaching a greater number of patients.

According to this study, the public finds the use of AI and robots reliable in the diagnosis of diseases through laboratory and imaging methods (biochemical, radiological, pathological). A survey conducted in Germany with 303 participating doctors in an online survey showed high expectations for the future improvement of patient care through the processing of large amounts of data in radiology and pathology imaging procedures (14). Currently, digital pathology testing such as ECOG 2197.64 based on stored samples from a completed clinical trial is used to predict the risk of cancer recurrence in breast cancer patients (95% confidence interval, 1.21–4.79) (15). AI has been gradually integrated into the diagnosis of breast cancer, which accounts for approximately 30% of malignancies in women, including imaging and pathology (16).

A study conducted in Chinese social media users revealed that AI was perceived to replace all doctors, particularly affecting pathologists, radiologists, and dermatologists (17). In our study, patients showed high trust in AI and robots in areas that go beyond the laboratory, such as radiology, pathology, and biochemistry. This is believed to be due to the already existing use of computer systems in these fields. The implementation of this technology can reduce the number of healthcare professionals required in these areas and streamline workflow.

Our study found that the public was ready to undergo surgery performed by AI and robots, had trust in AI for follow-up care, and did not fear AI. Our survey also indicates that most patients are ready for fully autonomous surgery, which demonstrates society's openness to innovation in the era of science and technology.

Among medical professionals, it was concluded that AI had some disadvantages such as high cost and lack of human touch. In our study, more than half of the individuals (n=404, 55.7%) accepted surgery performed by AI and robots, and answered that they were not scared at all when asked if AI and robots scared them (n=215, 29.6%). In a study evaluating the attitudes of patients and their families towards AI use in neurosurgery, most participants reported that they did not find fully autonomous surgery suitable or acceptable. However, most found partially autonomous surgery, where the neurosurgeon retains ultimate control, to be suitable and acceptable.(18). Surgeons generally have concerns about approaches that lack the sense of touch in surgical procedures. The study by Emiroglu and colleagues, which examined the thoughts, reservations, approaches, and perspectives of specialized physicians in breast health in our country regarding the future of AI, showed that the use of AI technology in the diagnosis and treatment of breast cancer is beneficial for both physicians and patients. However, it revealed that physicians have also concerns about potential medical errors and liability issues that AI may cause (19). Participants who expressed that they are not afraid of AI and robots have relegated such concerns to a secondary position and have not given them importance.

Limitations: This original study has some limitations. Firstly, it should be noted that the questions and answers are inherently subjective in nature. Secondly, our study is conducted online. There are existing studies that demonstrate the comparability of the validity and reliability of data obtained online with data obtained through traditional methods (20, 21). However, populations without access to the internet and digital information resources (e.g., the elderly or individuals with low socioeconomic status) are not adequately represented in our findings (22). Nevertheless, online data collection remains a method that enables researchers to efficiently and cost-effectively gather data from large and diverse populations. Despite its disadvantages, we opted for online survey, acknowledging these limitations (23, 24).

Conclusion

This study demonstrates that the use of AI and robots in healthcare services is accepted by our society and would be appropriate in our society. More than half of the participants have trust in these digital technologies. We believe that there is a significant portion of the population willing to embrace AI and robots in diagnostic and treatment approaches within hospitals, aligning with the era of science. There is a need for broader studies that involve wider participation and examine the perspectives of different segments of society in these matters.

Learning points

According to our study, most individuals express confidence in the implementation of artificial intelligence and robots in healthcare. Additionally, they are willing to embrace treatments delivered through medical technologies, including artificial intelligence and robotic surgery.

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Received November 16, 2023.
Accepted February 14, 2024.