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Acceptance of Chatbot in government services: An analysis of responses from 1,00,000 actual users of chatbot during covid vaccination drive in West Bengal

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Abstract
The objective of this research is to identify key factors influencing the use of chatbot for healthcare services by its actual users. This research uses the relative advantage, ease of use, perceived usefulness, perceived risk and time to understand user intention to use chatbots for healthcare services. The puzzle of using AI based chatbots for healthcare services needs to be addressed as there are many issues of delivering healthcare services. Many of the difficulties faced are people's lack of knowledge on using a technology for availing healthcare services, literacy, intention to use, awareness, reach etc. This study has focused on the key factors influencing users behavior derived from innovation diffusion theory (IDT) and some factors from technology acceptance model (TAM) as they focus on key usage intentions. This study looks at the user perspective of using a technology driven service such as a Chatbot. A survey method was used to get the responses of the people in using Chatbot. A questionnaire was derived from the user acceptance theory and related theories and modified to suit the need of this research. A total of 100,000 responses were collected on various aspects of using chatbot service for vaccination during Covid-19. More than 1,00,000 people actual users responded. So, their responses can be taken into consideration for designing such future technology driven healthcare administration. This research has come up with the factors that has highly impacted covid vaccination drive during the time when everything was uncertain and health administration was also under extreme pressure to handle such pandemic situations.

Introduction

Government across the world is now using latest user friendly technologies to reach its people in delivering various services. Latest is the use of ChatBot for answering the queries of people at the technology end itself and providing hassle free services. There are many research related to the use of Chatbot in government services but hardly is known about the mass usage and impact of such services and the actual result of using such service. This study analyzed around 100,000 Covid vaccination actual Chatbot user responses.

Chatbot was launched as an emergency need by the government to administer covid vaccination drive and manage such a large population in need of covid vaccination. At the peak of the Covid pandemic, the Covid Chatbot was launched without the government or public being prepared for such a large-scale implementation. The purpose of the data collection was to understand the user's behavior when utilizing new technologies like Chatbot during Covid-19 and its

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effectiveness in vaccination drive. **At** the **height** of Covid vaccination demand**, the chatbot** was **launched with the intention of providing** vaccination information to citizens, reduce overcrowding, save their time during vaccination and inform people about the accurate place of the vaccination. The reduction of large crowds at the vaccination center and helped prevent the spread of Covid 19 and also saved people's time.

Below is a diagram depicting various role of AI in healthcare system.

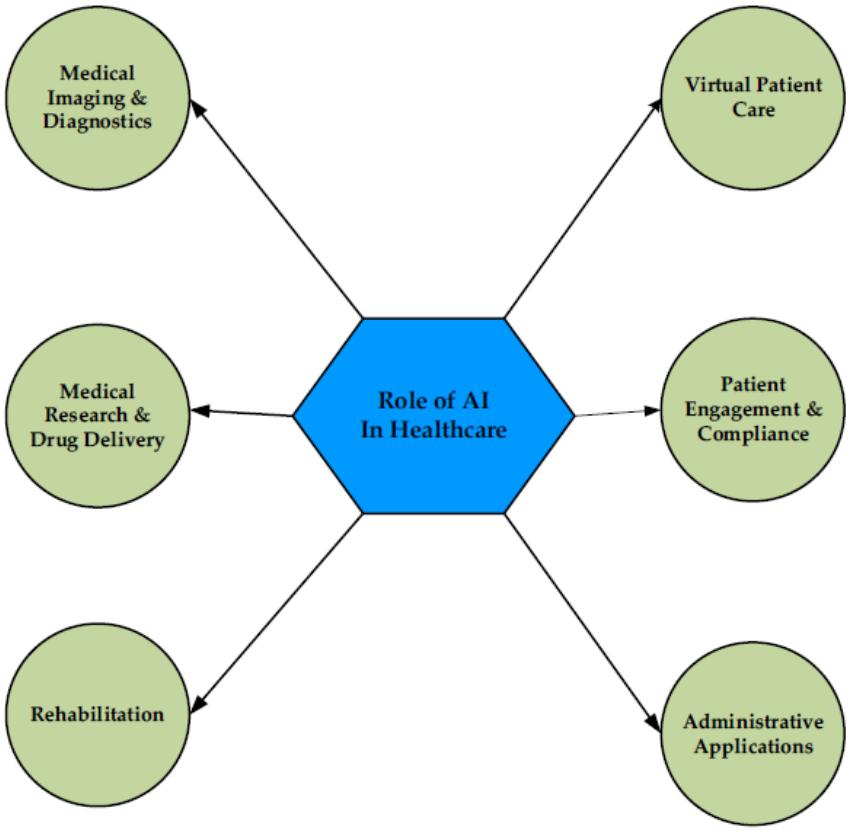

Figure 1. Application of AI in various aspects of healthcare.

(Source: A Review of the Role of Artificial Intelligence in Healthcare. J. Pers. Med. 2023, 13, 951)
The application of chatbot, chatgpt, and other AI models in the healthcare industry has advanced greatly both before and during the COVID-19 pandemic. Below is a summary of the ways in which these technologies were employed in the healthcare services.

Before COVID-19
Prior to the outbreak of the pandemic, healthcare was starting to incorporate AI models such as ChatGPT for diverse uses, mainly centered on aiding and engaging patients, providing a symptom-checking tool for patients, facilitating appointment scheduling, and sending medication reminders.
Systems checkers, AI-powered chatbots helped patients in evaluating their symptoms and offered guidance on the appropriate next steps (Bickmore, whether it be scheduling a doctor's appointment or utilizing over-the-counter remedies.

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Appointment Scheduling chatbots helped with the process of booking, rescheduling, and managing appointments.
Medication Reminders chatbots: Chatbots reminded patients to take their medications, which assisted in enhancing their adherence to treatment plans.
Chatbots were used in disseminating **medical Information and education**. Questions about illnesses, treatments, and best practices were answered while it also provided patients and medical professionals with up-to-date medical information. It was also used in training **and education of medical students** by providing instructional materials and simulating interactions.

During COVID-19
COVID-19 brought about faster adoption and expansion of AI applications in healthcare services due to the urgent need aggravated by the pandemic. Key areas that were impacted are:
COVID-19 Screening: AI-driven chatbots were used to screen individuals for COVID-19 symptoms and evaluate their risk based on self-reported data, this helped in managing patient flow and prioritizing care.
Remote Consultation and Telehealth: AI-powered tools made remote health consultations possible, which helped minimize the need for face-to-face appointments, especially during lockdowns and times when social distancing was essential.
Information Dissemination: AI was employed to distribute accurate COVID-19 information, combat false details, and offer updates on protocols and safety precautions to the public. AI assisted in educating the public about the virus, giving preventive measures, and providing vaccination information.
Research and Data Analysis: data was analyzed by AI models to forecast the virus's spread, pinpoint hotspots, and guide public health strategies.
Pandemic Modeling and Predictions: AI models analyzed data to predict the spread of the virus, identify hotspots, and inform public health strategies.
Drug Discovery and Vaccine Development: The analysis of large datasets and prediction of molecular interactions, facilitated by AI, played a crucial role in expediting the research and development of treatments and vaccines.
Resource Management: Managing healthcare resources like ICU beds, ventilators, and personal protective equipment (PPE) was assisted by AI chatbots, ensuring their allocation was optimized according to demand.
Workflow Optimization: Tools powered by AI improved the efficiency of processes in medical facilities during the pandemic, assisting in handling the added workload and operational difficulties.
The COVID-19 pandemic led to a notable increase in the use of AI models such as ChatGPT within the healthcare sector, meeting the urgent requirements for remote care, spreading information, and effectively handling resources. These progressions not only played a role in lessening the influence of the pandemic but also established the foundation for ongoing development and implementation of AI in healthcare post the COVID-19 era.

Literature review
Chatbot is a program that can comprehend and create responses using a text-grounded interface (Nadarzynski, T. et al. (2019), (Sallam, M., 2023), (Hassani, H. and Silva, E.S. (2023), (Chen, T.-J,

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2023). Xu et al. (2021) described the application of chatbots in healthcare, comprising patient support; monitoring and administration; and tumor diagnostics, screening, and management.
ChatGPT (Chat Generative Pretrained Transformer) is an AI-based conversational agent that utilizes natural language processing (NLP) and machine learning algorithms to simulate human-like conversations. Its critical applications in healthcare, including practice, education, and research, could be auspicious if the accompanying valid concerns are proactively inspected and tackled. It functions as a chatbot, a program that can comprehend and create responses using a text-grounded interface (Nadarzynski, T. et al. (2019), (Sallam, M., 2023), (Hassani, H. and Silva, E.S. (2023), Chen, T.-J, (2023). Xu et al. (2021) described the application of chatbots in healthcare, comprising patient support; monitoring and administration; and tumor diagnostics, screening, and management.

Literature Review on Chatbot Usage in Healthcare

Chatbot can be used for disseminating information, providing healthcare education and communication for the delivery of healthcare services. It can make easy to learn medical terms and understand the meaning of more complex medical terminologies and get better healthcare education (Sallam, M. 2023, Hossein, M et al., 2023). Many researches believe that Chatgpt can be used in early diagnosis of many diseases thereby reducing cost for users as well as administrators (Huh, Sun. 2023).
But the limitations of AI based chatbot is that it is based on certain algorithms which may be selective and biased, due to this it cannot replace actual practitioners expert advice as there are millions of patients with different conditions and everyone needs to be understood as per their medical need. Due to ethical concerns role of AI will still be limited in delivering medical advice (Busch, F. et al. 2023; Friederichs, H. et al. 2023; Mohammed, O. et al. 2023).
There is a combination of tight finances, elderly inhabitants, rising chronic diseases, and the strain on healthcare systems that previously struggled to cope with increased demand for service accessibility and availability. In addition, the COVID-19 pandemic led to health system failure in some countries, e.g., India, Brazil, and Indonesia (Williams, O.D., 2020).
The research framework combines some of the constructs of Technology Acceptance Model (TAM) and Innovation diffusion theory (IDT) along with time and perceived risk responsible for chatbot usage for healthcare services.

Research questions:

- RQ1: Will whatsapp chatbot based technology be significantly accepted by users for future government healthcare services?
- RQ2: To understand the effectiveness of chatbot usage in healthcare services such as vaccine administration during covid19 2021.
- RQ3: Does Technology acceptance model along with perceived risk and time, provide a statistically significant framework for the analysis of Chabot acceptance for healthcare management?

Research Objectives

- 1.To identify key factors impacting usage of chatbot services in healthcare services:

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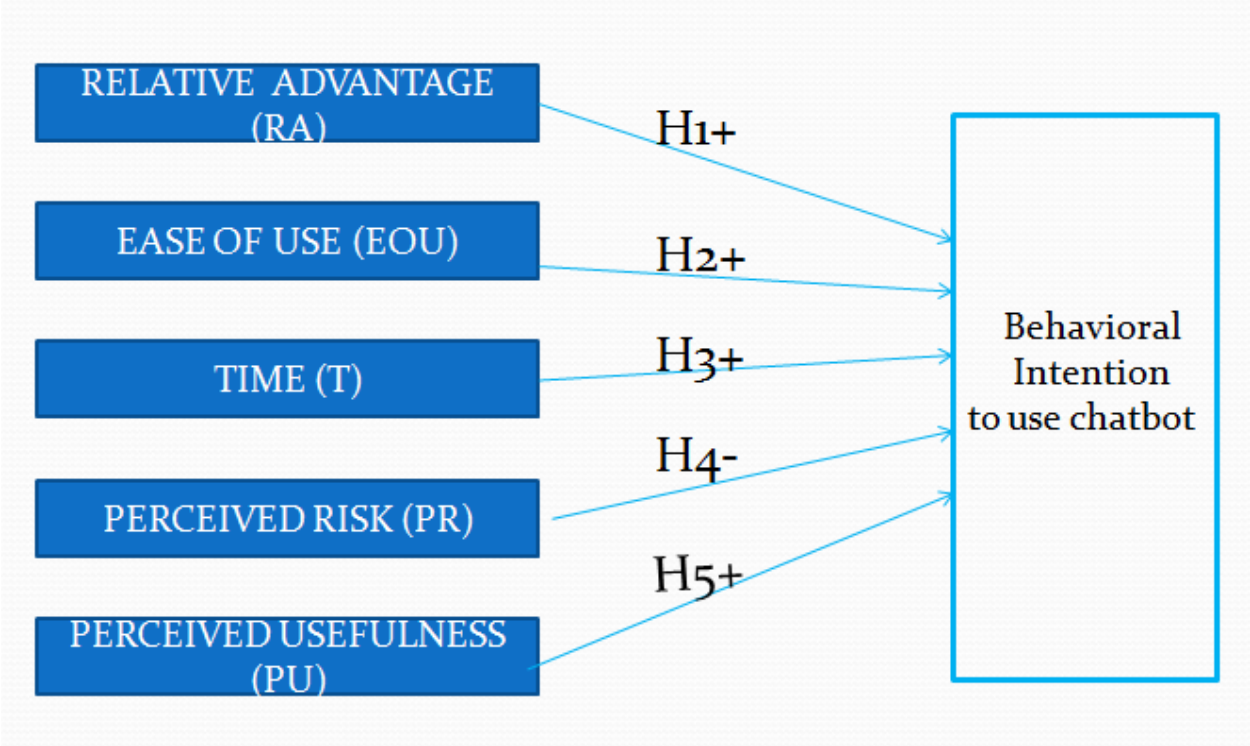
- 2. Do an analysis of chatbot services acceptance during Covid-19 vaccination drive in West Bengal.
- 3.To identify the most important factor impacting chabot usage in healthcare services.

Research Framework



H1: The relative advantage of chatbots positively influences behavioral intention toward their use in healthcare services.
H2: Ease of use (EOU) of chatbots positively influences behavioral intention toward their use in healthcare services.
H3: Time savings (T) due to chatbots positively influences behavioral intention toward their use in healthcare services.
H4: Risks involved (RI) negatively influences behavioral intention toward their use in healthcare services.
H5: Perceived usefulness (PU) positively influences behavioral intention toward their use in healthcare services.

A structured questionnaire was answered by 100,000 respondents.
Questionnaire:
string question1 = "Thanks a lot for the vaccination using this WhatsApp bot .\n Please rate this method of vaccination in your area on a scale of 1 to 5.\n\n 1 = Poor;\n 2 = Fair;\n 3 = Good;\n 4 = Very Good;\n 5 = Excellent\n";

1. string question A = "A. The innovative method of Whatsapp bot based vaccination is better than the conventional token based / cowin based vaccination drive prevalent in the country. And there are advantages of using it ";
2. string question B = "B. This WhatsApp bot based vaccination is easy to use.";

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3. string question C = "C. This WhatsApp bot based booking saves time over the conventional method.";
4. string question D = "D. There is no risk in using this WhatsApp bot based vaccination.";
5. string question E = "E. This method is useful, and you will like to have more government services like this on whatsappbot.";
   String options = "\n\n Strongly agree=5.\n Agree=4.\n Neutral=3.\n Disagree=2.\n Strongly disagree=1";

1. Relative advantage (RA)
2. Ease of use (EOU)
3. Time (T)
4. Perceived Risk (PR)
5. Perceived usefulness (PU)

Variables used in the study	**Variables refers to**
Relative advantage (RA)	"Relative advantage is the degree to which an innovation is perceived as being better than the idea it supersedes. The degree of relative advantage is often expressed as economic profitability, social prestige, or other benefits" (Rogers, 1995, p. 212).
Ease of use (EOU)	"Perceived ease of use was defined as the degree to which a person believes that using a particular system is free of effort" (Davis, 1989). Moore and Benbasat (1991), defined "ease of use as the degree to which using an innovation is perceived as being difficult to use". "This construct derived from the self-efficacy concept, which refers to a situation-specific belief about how well someone can execute actions for the prospective task" (Davis, 1989; Bandura, 1982). It was suggested that "self-efficacy had a predictive role in decision-making about technology use" (Hill, Smith & Mann, 1987). Also, perceived ease of use shared a similarity with the complexity factor theorized in the innovation diffusion literature as a barrier to innovation adoption. It was defined as "the degree to which individuals find the innovation difficult to understand and use" (Mahajan, 2010).
Time (T)	Reduced time is added to extend the understanding of user acceptance of chatbots. (Davis1989, Davis et al. 1989). Outcome expectations was used by (Compeau & Higgins,1995; Compeau et al., 1999). "This kind of risk refers to the consumer's worry about time consumption when purchasing a new product. The consumer here worries about how much of his time as well as the effort the new product would consumer.
Perceived Risk (PR)	Perceived Risk refers to the degree to which risks are perceived as associated with the innovation".

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	Perceived risk refers to the uncertainty a consumer feels when purchasing goods or using a services. The economic cost is not the only element of perceived risk. The uncertainty of the purchasing process can also produce psychological risks.
Perceived usefulness (PU)	It is "the degree to which a person believes that using a particular system would enhance his/her job performance" (Davis, 1989). "Perceived usefulness was defined as the individual's perception of the extent to which the use of a given technology improves performance". The conceptualization of this construct stemmed from Bandura's concept of "outcome judgement, which refers to an individual's expectation of a positive outcome triggering behaviour" (Bandura, 1982). "Perceived usefulness was operationalised based on evidence confirming the effect of system performance expectancy on system usage" (Robey, 1979).

string thanks = "Thanks for your valuable feedback. ";

- Furthermore, the majority of the literature reviewed, which is used to formulate our hypotheses, focused in some cases primarily on explaining behavioral intention rather than current usage.
- This research used actual users data to get to the key factors.
- Structured survey is suitable for collecting opinions, attitudes and feelings from large samples (Barnes & Jacobsen, 2013).

Methodology

- Sources of data collection:
  - Data was collected through a survey questionnaire
  - Random sampling was done. Data from randomly selected sample were used. Individuals who got vaccinated through the chatbot were contacted.
  - Likert scale was used for data collection where 5 was strongly agree and 1 was strongly disagree. All other values are quantifying levels in between these two numbers.
  - In May, 2021 people who already got vaccinated through Chabot were contacted randomly for the survey. Respondents were people from the state of West Bengal.
  - Sample size: 1,49, 339 responded fully.
  - Unit of analysis: first time chatbot users of the government covid19 vaccination drive.

Factor analysis and structural equation modeling were used to analyze the data. Data collected through sample survey was tested through Cronbach's alpha. The data adequacy was tested through Kaiser-Meyer-Olkin measure of sampling adequacy (KMO). Hypotheses testing was done through structural equation modeling (SEM), for the analysis. Analysis was done in IBM SPSS statistics, AMOS24.

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KMO is a test conducted to examine the strength of the partial correlation (how the factors explain each other) between the variables. KMO values closer to 1.0 are consider ideal while values less than 0.5 are unacceptable. Recently, most scholars argue that a KMO of at least 0.80 are good enough for factor analysis to commence.

The Bartlett's test of Sphericity is used to test the null hypothesis that the correlation matrix is an identity matrix. An identity correlation matrix means your variables are unrelated and not ideal for factor analysis. A significant statistical test (usually less than 0.05) shows that the correlation matrix is indeed not an identity matrix (rejection of the null hypothesis) as represented in the table below.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.853
Bartlett's Test of Sphericity	Approx. Chi-Square	7413.928
	df	153
	Sig.	.000

4. The main aim of SEM is finding the factor loadings, co-variances and variances of the factors and residual errors variances in the observed variables. Secondly it analyses the fit of the model" (Hox &Bechger, 1999).
5. **"Chi squared ($\chi 2$**) statistic is used to test the model-data fit, for a minimal fit function. Small differences between the two co-variance matrices implies that the model-data fit is good while the large difference rejects the model-data fit" (Fan & Sivo, 2007). "There was dissatisfaction with the Chi-squared statistic to use model-data fit, which led to other goodness of fit indices like; CFI, TLI, SRMR, RMSEA. Using SEM one can modify the model and get a better model-data fit" (Fan & Sivo, 2007).
6. Principal component analysis is a dimensionality reduction technique, factor analysis was used. Factor analysis technique is used for data reduction and finding out a few dimensions out of several observed variables (Grice, 2001).
7. There are several rotations that can be done in factor analysis to identify factors., The several rotations available are namely Direct Oblimin, Equamax, Promax, Quartimax and Varimax.. These rotations are done to find out unobserved factors from the observed variables.

Results and Data Analysis

Factor analysis and structural equation modeling were used to analyze the data.

- Cronbach's alpha = .868

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.868
Bartlett's Test of Sphericity	Approx. Chi-Square	328676.002
	df	10
	Sig.	.000

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Factor analysis

Rotated Component Matrix[a]

	Component 1	Component 2
Relative advantage	.216	.889
EOU	.454	.729
Time	.573	.615
Perceived Risk	.849	.272
Perceived Usefulness	.809	.325

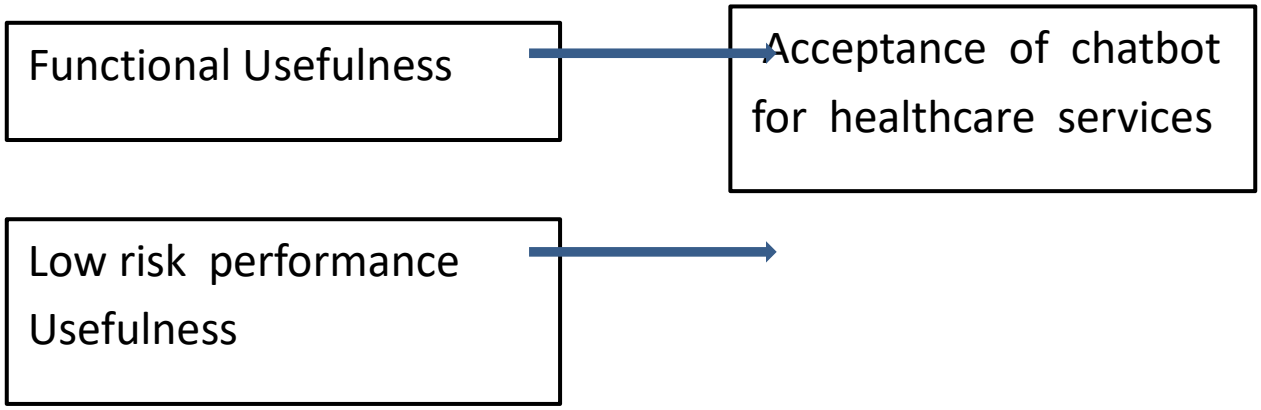
Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.[a]

Eigen value

Total Variance Explained

Component	Initial Eigenvalues Total	% of Variance	Cumulative %	Extraction Sums of Squared Loadings Total	% of Variance	Cumulative %
1	3.287	65.736	65.736	3.287	65.736	65.736
2	.548	10.969	76.705	.548	10.969	76.705
3	.427	8.531	85.235			
4	.395	7.908	93.144			
5	.343	6.856	100.000			

A model depicting the chatbot usage



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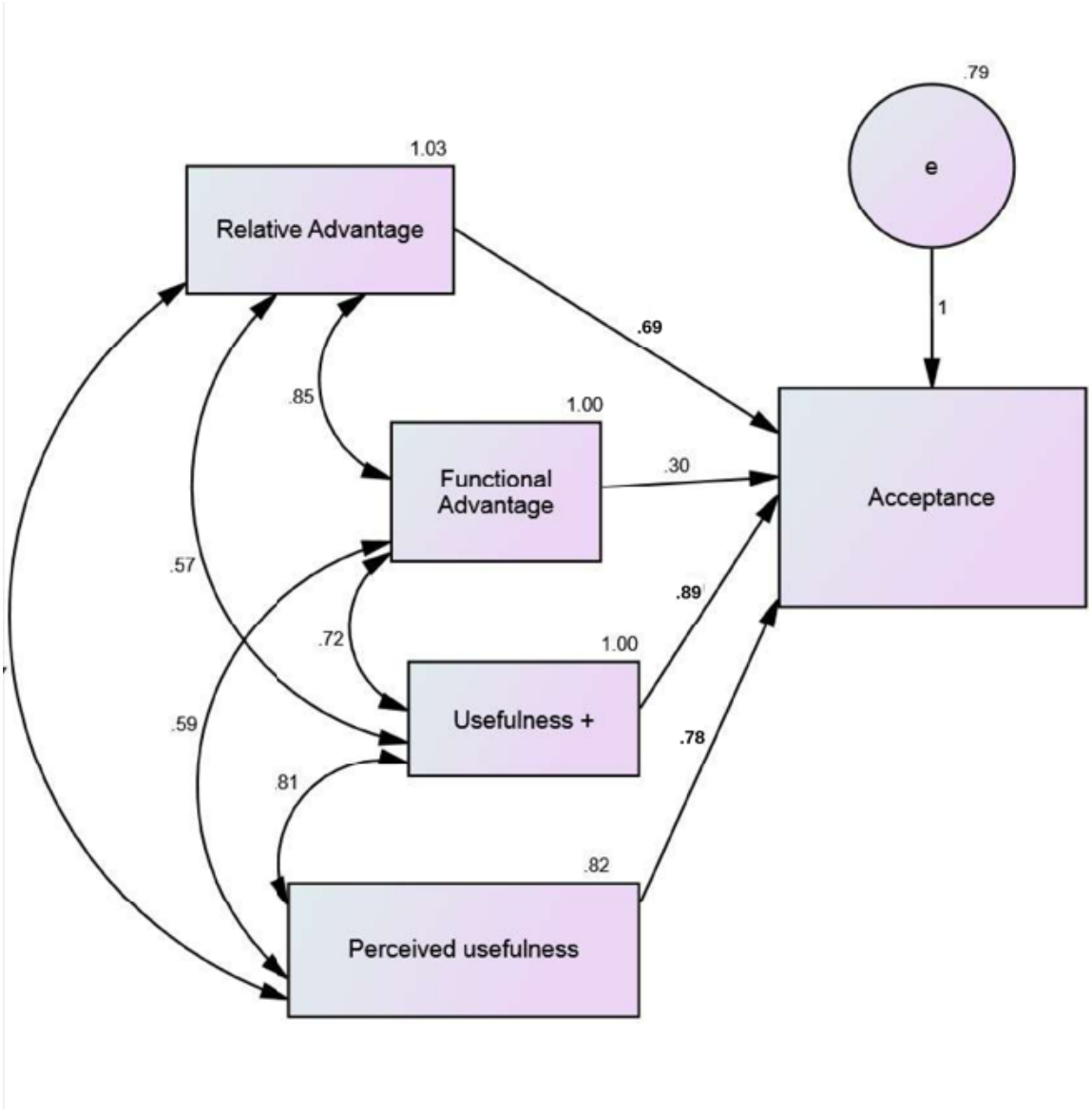
Data analysis using SPSS and AMOS

Components that emerged as the most significant determinants of Chatbot usage for healthcare services.

Data analysis in SEM AMOS



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Data analysis

- Perceived usefulness along with perceived risk impacts the chatbot the most with the .89 RW. This means people want healthcare mostly for its usefulness if low risk is involved.
- Perceived usefulness alone impacts acceptance by .78 RW.
- Relative advantage by .69 RW.
- RA + EoU + T = .30 RW.

Conclusion

The respondents who were the actual users of the chatbot based vaccination drive are positive about using chatbot based technology for receiving healthcare services in the future. This satisfies RQ1 that chatbot based technology will be significantly accepted by the users in future such drives. The actual users of chatbot usage during covid vaccination drive was very high, this proves the effectiveness of using chatbots for vaccination drive during covid-19 (RQ2). Technology acceptance model along with the perceived risk and time, provides a statistically significant framework for the analysis of Chabot acceptance for healthcare management. Perceived usefulness along with perceived risk impacts the chatbot the most with the .89 RW. This means people want healthcare mostly for its usefulness if low risk is involved. Perceived usefulness alone impacts acceptance by .78 RW. Relative advantage by .69 RW. RA + EoU + T = .30 RW.

All the factors had positive acceptance towards chatbot usage, with perceived usefulness and perceived risk having highest impact.

The integration of AI models like ChatGPT in healthcare saw a significant boost during the COVID-19 pandemic, addressing the immediate needs for remote care, information dissemination, and efficient management of resources. These advancements not only helped mitigate the impact of the pandemic but also set the stage for the continued evolution and integration of AI in healthcare beyond COVID-19. The literature highlights the significant impact of chatbots in healthcare, demonstrating their potential to enhance patient engagement, streamline administrative tasks, and disseminate critical medical information. The COVID-19 pandemic has further accelerated their adoption, showcasing their utility in managing healthcare challenges and improving system efficiency. As technology advances, the role of chatbots in healthcare is expected to expand, offering more sophisticated and personalized solutions. With the return of covid in many places in 2025, it is crucial to look into the chabot usage by government in the past situations.

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