

Evaluating the People's Awareness and Acceptance of AI Technologies in Personalized Pharmacotherapy

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ABSTRACT

This cross-sectional study evaluates public awareness and acceptance of Artificial Intelligence (AI) technologies in personalized pharmacotherapy across a diverse demographic. Utilizing a stratified random sampling method, we surveyed 3,216 participants to quantitatively assess their awareness, acceptance, perceived benefits, and concerns about AI in pharmacotherapy. The results highlight a moderate level of awareness of AI applications in healthcare, with 43.84% of respondents acknowledging familiarity. Acceptance of AI-driven treatment plans is cautiously optimistic, evidenced by 46.70% of participants expressing some level of trust in AI for diagnostics. However, concerns regarding privacy, data security, and the potential for AI errors are prevalent, with over 57% of respondents citing these as significant deterrents. Education level emerged as a critical determinant of AI acceptance, with higher educational attainment correlating with more favorable perceptions. This study underscores the necessity for healthcare professionals, policymakers, and technologists to collaboratively enhance public education and address privacy and security concerns to facilitate the ethical integration of AI into healthcare.



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1. INTRODUCTION

The integration of Artificial Intelligence (AI) in healthcare, particularly in pharmacotherapy, represents a paradigm shift towards more personalized and efficient medical treatments. The advent of AI technologies, including machine learning and data analytics, has the potential to revolutionize the field of pharmacology

by enabling the development of personalized medicine, optimizing drug discovery, and enhancing patient care.

2. Literature Review

Recent advancements in AI have shown significant promise in drug discovery, formulation, and testing. [1] highlighted AI's capability to analyze extensive biological data, thereby identifying disease-associated targets and predicting drug interactions, which is crucial for personalized medicine. Similarly, [2] discussed AI's potential in optimizing therapy for personalized medicine by predicting drug release profiles and incorporating patient-specific factors. These studies demonstrate AI's transformative role in developing targeted therapies and optimizing drug development, aligning with the objectives of personalized pharmacotherapy.

The integration of AI in healthcare raises questions about public awareness and acceptance. [5] emphasized the digital transformation in medicine driven by genomics, imaging, and new data sources, necessitating AI support for personalized treatments. However, they also pointed out the need to address issues such as explainability, liability, and privacy to mainstream AI in healthcare. [6] explored the adaptation of AI in clinical pharmaceutical services, highlighting the importance of AI literacy among clinical pharmacists to navigate the AI era effectively. These insights are crucial for understanding public perceptions and the factors influencing the acceptance of AI in healthcare.

While AI offers numerous benefits in healthcare, it also raises concerns regarding privacy, accuracy, and the lack of human oversight. [3] stressed the importance of robust evaluation to ensure AI tools enhance clinical practice safely and equitably. [4] discussed the potential and pitfalls of AI in clinical pharmacology, highlighting the need for an ethical framework to support AI integration. Addressing these concerns is essential for fostering public trust and acceptance of AI technologies in healthcare.

Demographic and psychographic characteristics significantly impact public acceptance of AI in healthcare. Understanding these factors is crucial for developing strategies to increase public trust in AI-driven solutions. Moreover, providing additional information about the benefits and workings of AI in personalized pharmacotherapy could alter perceptions and increase acceptance. The role of information and education in shaping public attitudes towards AI in healthcare cannot be overstated. The primary aim of this study is to systematically evaluate and understand the public's awareness, acceptance, and perceptions of Artificial Intelligence (AI) technologies in personalized pharmacotherapy.

3. Methodology

This study's methodology was designed to systematically assess public awareness and acceptance of AI technologies in personalized pharmacotherapy. It utilized a quantitative research approach within a cross-sectional survey framework, aiming to capture and analyze prevailing attitudes and perceptions toward the application of AI in healthcare settings.

3.1 Sample Selection

The study employed a stratified random sampling technique to ensure a representative sample of the population. The stratification criteria included age, gender, education level, and previous experience with healthcare technology. This approach aimed to capture a wide range of perspectives on AI in personalized pharmacotherapy from a diverse population sample.

3.2 Survey Design

The survey was structured to include only closed-ended questions, facilitating quantitative analysis. These questions were designed to assess quantitatively:

Level of acceptance of AI-driven personalized pharmacotherapy.

Specific concerns related to privacy, data security, and the reliability of AI recommendations.

Each question offered a set of predefined response options, such as Likert scale ratings, yes/no options, or multiple-choice answers, to quantify participants' attitudes and perceptions.

3.3 Data Collection

Data collection was conducted through an online survey platform, enabling efficient and wide-reaching participation. The survey was disseminated via various online channels, including social media, healthcare forums, and patient advocacy groups, to ensure a broad and diverse respondent base.

3.4 Data Analysis

Statistics analysis was employed to succinctly summarize the collected data, providing an overview of the participants' responses. This included calculating means, medians, and modes for continuous variables and frequencies and percentages for categorical variables to clearly show the central tendencies and variability within the data set. This statistical analysis helped identify significant patterns and correlations between demographic factors and participants' levels of awareness, acceptance, and concerns regarding AI in personalized pharmacotherapy.

3.5 Ethical Considerations

This study followed strict ethical guidelines, focusing on protecting participant confidentiality and data security. Approval was granted by the Research Ethics Committee at the University of Hail (Approval No. H-2024-204, dated 25/3/2024). We obtained informed consent from all participants, ensuring they understood the study's purpose, the anonymity of their responses, and their right to withdraw at any time.

The study, titled "Evaluating the Public's Awareness and Acceptance of AI Technologies in Personalized Pharmacotherapy," was thoroughly reviewed and approved, reflecting our commitment to ethical standards

4. Result

The demographic profile of survey participants is detailed as follows: The gender distribution showed that females constituted 69.84% (n=2,246) of the respondents, with males making up 30.16% (n=970). This indicates a higher participation rate among females as seen in (Table 1). In terms of age distribution, the younger age groups were more prominently represented. The 18-24 age group included 26.00% (n=836) of the participants, closely followed by the 25-34 age group at 25.44% (n=818). The 35-44 and 45-54 age groups comprised 19.84% (n=638) and 19.59% (n=630) of the respondents, respectively. The 55-64 age group accounted for 8.08% (n=260) of the participants, while those aged 65 and above represented 1.00% (n=32).

Regarding education levels, the majority of respondents, 72.64% (n=2,336), reported having a college/bachelor's degree. Those with a High School Graduate diploma constituted 13.68% (n=440), followed by individuals with a Graduate Degree at 9.70% (n=312). A smaller portion of the participants, 3.98% (n=128), indicated having an education level of Less than High School. This demographic overview highlights a diverse participant group, predominantly younger and female, with a significant proportion holding a college or bachelor's Degree.

Table 1: Demographic Characteristics of Study Participants

Demographic Category	Description	Frequency (N)	Percentage (%)
Gender	Female	2246	69.84
	Male	970	30.16
Age Group	18-24	836	26
	25-34	818	25.44
	35-44	638	19.84
	45-54	630	19.59
	55-64	260	8.08
	65+	32	1
Education Level	College/bachelor's degree	2336	72.64
	High School Graduate	440	13.68
	Graduate Degree	312	9.7
	Less than High School	128	3.98

The survey explored various aspects related to the awareness and understanding of AI in personalized pharmacotherapy among participants. The results revealed that 43.84% (n=1,409) of respondents were aware of AI applications in medicine, while 39.05% (n=1,256) were not. The mean response value for awareness, calculated based on a binary encoding scheme, was 1.47 with a standard deviation of 0.50, indicating a slight leaning toward awareness among participants as indicated in (Table 2).

In assessing the understanding of AI technologies in healthcare, responses varied across the scale from 'Very Good' to 'Very Poor'. A notable 23.69% (n=761) rated their understanding as 'Very Good', and 24.56% (n=791) as 'Good'. Moderate understanding was reported by 21.52% (n=692), while 21.95% (n=705) found their understanding to be 'Poor', and 8.21% (n=264) 'Very Poor'. The overall mean response for understanding was 3.34, with a standard deviation of 1.28, suggesting that, on average, respondents felt they had a moderate to good understanding of AI technologies in healthcare.

When asked about the usage of AI in healthcare services or products, 15.80% (n=508) of the participants acknowledged having used such services, contrasting with 68.97% (n=2,218) who had not, and 15.24% (n=490) who were unsure. The mean response for this category, calculated with a ternary encoding scheme, was 1.99 with a standard deviation of 0.56, reflecting a predominant lack of personal experience with AI healthcare services among the survey respondents.

Table 2: Awareness and Understanding of AI in Personalized Pharmacotherapy

Variable	Response Options	Frequency (N)	Frequency (%)	Mean Response	Standard Deviation
Awareness of AI in Medicine	Yes	1,409	43.84%	1.47	0.5
	No	1,256	39.05%		
Understanding of AI in Healthcare	Very Good	761	23.69%	3.34	1.28
	Good	791	24.56%		
	Moderate	692	21.52%		
	Poor	705	21.95%		

	Very Poor	264	8.21%		
Used AI Healthcare Service	Yes	508	15.80%	1.99	0.56
	No	2,218	68.97%		
	Not Sure	490	15.24%		

The survey also delved into participants' acceptance of AI in pharmacotherapy, focusing on trust in AI for diagnostics, comfort with AI-driven medication recommendations, and willingness to share health data with AI for personalized treatment plans. In the realm of diagnostics, a significant portion of respondents, 46.70% (n=1,501), expressed 'Somewhat Trust' in AI for diagnosing health conditions, while 12.90% (n=415) showed complete trust. This suggests a cautious optimism towards AI's diagnostic capabilities among the surveyed individuals.

Regarding medication recommendations made by AI, 13.90% (n=447) of participants felt 'Very Comfortable' with AI's suggestions, and a more substantial 34.00% (n=1,093) were 'Comfortable'. This indicates a general acceptance and readiness to consider AI-driven recommendations in medication plans, highlighting the potential for AI to support personalized pharmacotherapy. When asked about their willingness to share personal health data with AI to enhance treatment personalization, 33.30% (n=1,070) of the respondents were 'Definitely Yes', and 37.20% (n=1,196) were 'Probably Yes'. This demonstrates a considerable openness among participants to engage with AI technologies for improved healthcare outcomes, contingent on the assurance of data privacy and security for more information (Table 3).

Table 3: Acceptance of AI in Pharmacotherapy

Variable	Response Options	Frequency (N)	Frequency (%)
Trust AI for Diagnosing Health Conditions	Completely Trust	415	12.90%
	Somewhat Trust	1,501	46.70%
Comfort with AI Recommendations on Medication	Very Comfortable	447	13.90%
	Comfortable	1,093	34.00%
Willingness to Share Health Data with AI	Definitely Yes	1,070	33.30%
	Probably Yes	1,196	37.20%

The survey further explored participants' perceptions and concerns about the integration of AI in pharmacotherapy, revealing insightful viewpoints on several critical issues. Privacy and data security emerged as significant concerns, with approximately 36.90% (n=1,187) of respondents highlighting this as a key issue. This underscores the paramount importance of robust data protection measures in the deployment of AI technologies in healthcare. About 41.60% (n=1,405) of the participants also expressed concern about the accuracy of AI recommendations. This highlights the need for continuous improvement and validation of AI algorithms to ensure their reliability and effectiveness in clinical settings.

Loss of human oversight was a concern for 50.00% (n=1,670) of respondents, indicating a strong desire for maintaining a human element in healthcare decision-making, even as AI technologies become more prevalent. Potential for AI errors was the most cited concern, with 57.00% (n=1,833) of participants wary of the implications of incorrect AI-driven decisions. This reflects the critical need for comprehensive testing, transparency, and mechanisms for oversight in AI applications within healthcare. A smaller proportion of

respondents, 5.60% (n=190), expressed other unspecified concerns, suggesting that there may be additional, less common issues that need to be addressed as AI technologies continue to evolve and integrate into pharmacotherapy practices. The mean concern score of 38.22, along with a standard deviation of 8.27, quantitatively encapsulates the overall level of concern among participants. These figures indicate a moderate level of concern across the surveyed population, with a notable spread in the degree of concern among individuals as demonstrated in (Table 4).

Table 4: Perceptions and Concerns about AI in Pharmacotherapy

Concerns	Frequency (N)	Frequency (%)
Privacy and Data Security	1,187	36.90%
Accuracy of AI Recommendations	1,405	41.60%
Loss of Human Oversight	1,670	50.00%
Potential for AI Errors	1,833	57.00%
Other	190	5.60%
Mean Concern Score	-	38.22
Standard Deviation of Concern Score	-	8.27

The survey's exploration into the impact of additional information on the acceptance of AI in pharmacotherapy yielded notable insights. A substantial portion of participants, 56.90% (n=1,828), indicated that additional information would lead to a somewhat increased acceptance of AI ("Yes, somewhat"), highlighting the value of transparent and accessible information in fostering a positive perception of AI technologies. A significant number, 22.50% (n=723), felt that more information would significantly enhance their trust in AI ("Yes, significantly"), demonstrating the potential of detailed, quality information to shift perceptions and acceptance substantially.

Conversely, 9.40% (n=302) of the respondents believed that additional information would not alter their stance ("No Change"), suggesting a segment of the population with fixed perceptions of AI in healthcare, regardless of new information. A smaller group, 5.10% (n=164), expressed that further information might decrease their trust in AI ("No, Would Trust Less"), pointing to concerns that might be exacerbated by more detailed knowledge of AI applications or limitations. The mean response value of 3.03 and a standard deviation of 0.75 indicate an overall tendency towards a positive impact of additional information on AI acceptance. The mean suggests that, on average, participants lean towards the belief that more information would somewhat increase their acceptance of AI. The standard deviation reflects a moderate range of opinions among respondents, highlighting diverse perspectives on how additional information influences AI acceptance for more information (Table 5).

Table 5: Impact of Information on Acceptance of AI in Pharmacotherapy

Impact of Additional Information	Frequency (N)	Frequency (%)	Assigned Value
Yes, significantly	723	22.50%	4
Yes, somewhat	1828	56.90%	3
No change	302	9.40%	2
No, would trust Less	164	5.10%	1
Mean response	-	-	3.03

Standard Deviation	-	-	0.75
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The provided bar chart (Figure 1), under the title "Perceptions and Concerns," shows the distribution of responses across different apprehensions relating to AI. It reveals that general concerns categorized as 'Other' garnered the least attention, with only 176 responses. Privacy and data security issues prompted a significantly higher response, with 1,192 individuals acknowledging it as a concern. The accuracy of AI recommendations was noted by 1,298 respondents, indicating a moderate level of concern. A more substantial concern is reflected in the 1,576 responses regarding the loss of human oversight in healthcare decisions. Topping the chart, the potential for AI to make errors emerges as the predominant worry, with the highest number of responses at 1,808. This hierarchy of concerns showcases individuals' varying levels of unease towards different aspects of AI integration into society.

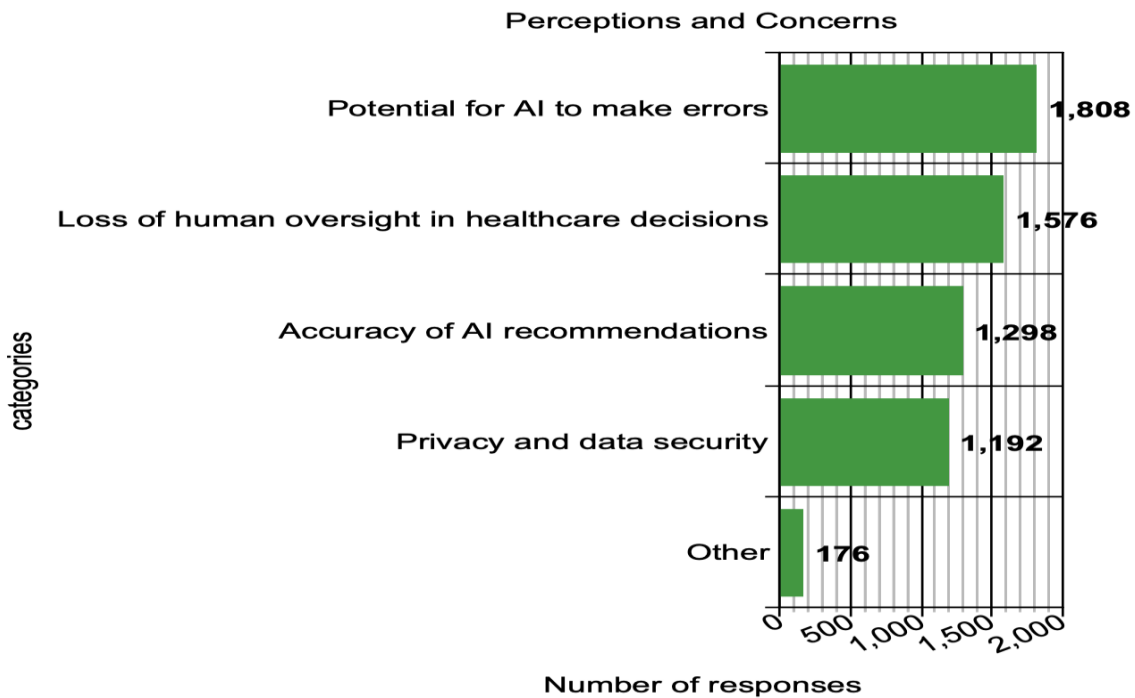


Figure 1: Comfort with the Use of AI in Healthcare Based on Information Type

The second bar chart (Figure 2), titled "Information Type," presents the count of responses to various types of information people find valuable. Detailed explanations lead to the highest number of responses at 2,040, suggesting a strong preference for thorough information. Success stories and case studies followed closely, which received 1,620 responses, indicating a significant interest in real-world applications and outcomes. Endorsements from trusted sources also hold considerable sway, evidenced by 1,602 responses. While less than the previous categories, information on privacy and security still shows a notable concern with 1,162 responses. Lastly, the 'Other' category, encompassing various unspecified types of information, has the fewest responses at 254, reflecting its relatively lesser direct importance to the respondents.

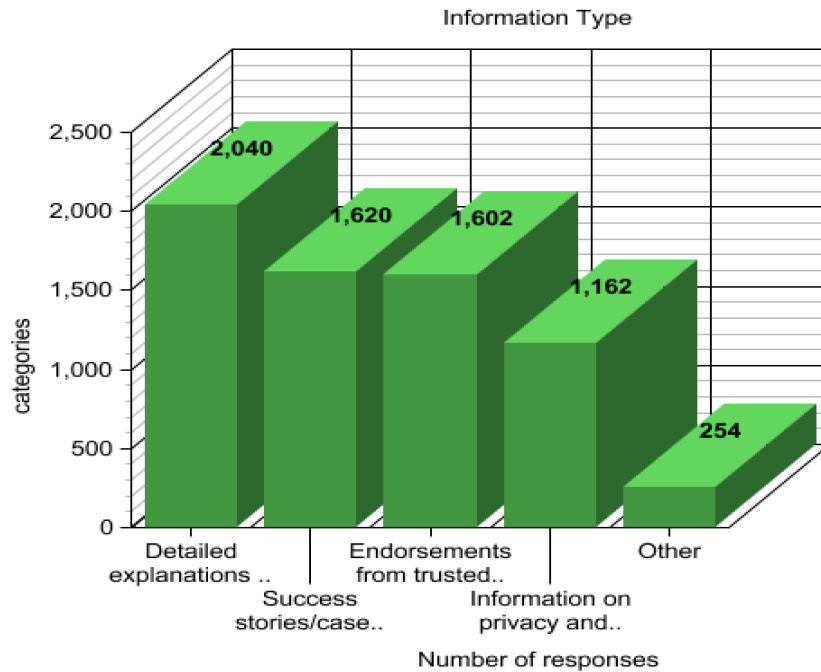


Figure 2: Comfort with the Use of AI in Healthcare Based on Information Type

Our analysis extends to examining the statistical associations between various demographic factors and key variables related to AI perceptions in pharmacotherapy, as presented in Table 6. The findings from Chi-Square tests reveal significant relationships, emphasizing the influence of demographic nuances on public perceptions and acceptance of AI in healthcare.

Table 6: Associations Between Demographic Factors and Key Variables

Demographic Factor	Key Variable	Chi-Square Statistic	p-value
Age Group	Awareness of AI in Medicine	30.09	0.037
	Understanding of AI in Healthcare	52.2	0.007
Gender	Understanding of AI in Healthcare	22.23	<0.001
Education Level	Awareness of AI in Medicine	26.48	0.002

In assessing the predictive power and accuracy of logistic regression and Random Forest models in forecasting public acceptance of AI-driven pharmacotherapy, (Table 7) encapsulates the performance metrics of these models. The enhanced performance of the Random Forest model, in particular, highlights the efficacy of advanced machine learning techniques in navigating the complex landscape of public perceptions and acceptance of AI in healthcare.

Table 7: Performance Metrics of Predictive Models

Model	Metric	Value
Logistic Regression	Accuracy	49.28%

	Precision (Overall)	45.77%
	Recall (Overall)	49.28%
	F1-Score (Overall)	41.19%
RandomForest	Accuracy	64.18%
	Precision (Overall)	63.99%
	Recall (Overall)	64.18%
	F1-Score (Overall)	63.82%

5. Discussion

AI integration in healthcare, particularly in personalized pharmacotherapy, has been met with a mix of enthusiasm and scepticism by the public. This study's findings contribute to a growing body of literature that seeks to understand public perceptions, acceptance, and concerns regarding AI in healthcare.

[7] conducted a study exploring lay individuals' perceptions of AI-empowered healthcare systems, finding a generally positive attitude towards such systems despite low awareness and experience among participants. This aligns with our findings, where a significant portion of respondents expressed comfort and willingness to use health AI systems. The study by Zhang et al. also highlighted the importance of intrinsic factors such as education background and technology literacy in shaping perceptions, suggesting that efforts to enhance public understanding of AI in healthcare could improve acceptance rates.

Researchers in 2023 explored American public opinion on AI in healthcare, revealing a strong preference for human medical professionals over AI for medical decision-making, despite acknowledging the potential for AI to reduce cultural biases in decisions [8], [9]. This dichotomy reflects the complex relationship the public has with AI in healthcare, where the trust in AI's capabilities is tempered by a desire for human oversight and empathy. Our study's findings on concerns regarding privacy, data security, and the accuracy of AI recommendations further demonstrate the need for transparent and ethical AI deployment to build public trust.

[10- 13] have undertaken a suite of studies within the Kingdom of Saudi Arabia (KSA) aimed at evaluating the public's knowledge and receptiveness towards Artificial Intelligence (AI). These investigations uncovered that a noteworthy segment of participants acknowledged AI's advantages while exhibiting a fair level of comprehension regarding the subject matter. In a separate vein, [15] harnessed data from social media platforms to probe into societal attitudes towards AI in the medical sphere. Their research unearthed a predominantly affirmative stance towards AI, with a considerable number of individuals endorsing the notion that AI holds the capacity to augment or even entirely substitute human physicians in certain contexts [14]. This inquiry, rooted in social media discourse, affords a unique vantage point on the collective sentiment, often portraying a more optimistic perspective on medical AI among the general populace as opposed to medical practitioners. This discrepancy demonstrates the necessity for sustained dialogue and educational efforts to mitigate extant apprehensions and rectify misconceptions about AI's role in healthcare, thereby fostering a more informed public consensus.

In 2020, a study investigated the acceptance of AI in medicine among Japanese doctors and the public, finding that doctors were more optimistic about AI-driven medicine than the general public [15]. This study highlights

the variability in acceptance levels across different demographic groups and demonstrates the importance of considering diverse perspectives in the implementation of AI in healthcare. Multiple recent studies in KSA indicated that the Saudi Arabai population perceives the benefits and is willing to use different types of technologies for multiple aspects of their lives [16- 23].

6. Conclusion

This comprehensive investigation of public attitudes towards AI in personalized pharmacotherapy has demonstrated the multifaceted nature of societal engagement with emerging healthcare technologies. It highlights the critical need to address the awareness-comprehension gap, manage privacy and security concerns, and enhance public trust through transparent, informative communication. As healthcare continues to advance with the integration of AI, healthcare providers, policymakers, and technology developers must collaborate to foster an informed, receptive environment. Future research should aim to track the shifting dynamics of public perceptions and investigate the impact of targeted educational interventions on enhancing the acceptance and ethical integration of AI in healthcare.

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Questionnaire

Research Title: Evaluating the Public's Awareness and Acceptance of AI Technologies in Personalized Pharmacotherapy: A Cross-Sectional Population Survey

Purpose of the Questionnaire

This questionnaire aims to assess public awareness, acceptance, and perceptions of Artificial Intelligence (AI) in pharmacotherapy. The questionnaire seeks to understand how different demographics perceive AI's role in healthcare, particularly in medication management and personalized medicine. It will explore trust levels, comfort with AI-assisted services, and concerns about privacy, data security, and the reliability of AI decisions. Insights gained will help healthcare professionals and AI developers address barriers and enhance the integration of AI in healthcare.

Participation Voluntariness:

Participation in this study is entirely voluntary. You have the right to withdraw from the research at any point without any penalty or loss of benefits to which you are otherwise entitled. Your decision to participate will not affect your current or future relations with affiliated institutions or organizations. All responses will be kept confidential and will only be used for the purposes of this research.

The expected time is 1 min – 2 minutes.

Section 1: Demographics

This section gathers basic demographic information to analyze responses based on different population segments.

1. Age Group:

- 18-24
- 25-34
- 35-44
- 45-54
- 55-64
- 65+

2. Gender:

- Male
- Female

3. Education Level:

- Some High School
- High School Graduate
- Some College
- Bachelor's Degree
- Graduate Degree

4. Employment Status:

- Employed (full-time)
- Employed (part-time)
- Unemployed
- Student
- Retired
- Other

Section 2: Awareness of AI in Pharmacotherapy

This section assesses the respondent's awareness of AI applications in healthcare, specifically in pharmacotherapy.

5. Before this survey, were you aware of the use of AI technologies in personalized medicine?

- Yes
- No
- Not sure

6. How would you rate your understanding of AI technologies in healthcare?

- Very good
- Good
- Moderate
- Poor
- Very poor

7. Have you ever used any healthcare service or product that utilizes AI?

- Yes
- No
- Not sure

Section 3: Acceptance of AI in Pharmacotherapy

This section gauges the willingness of the public to accept AI-driven personalized pharmacotherapy.

8. Would you trust AI to assist in diagnosing health conditions?

- Completely trust
- Somewhat trust
- Neutral
- Somewhat distrust
- Completely distrust

9. How comfortable are you with AI technologies making recommendations about your medication?

- Very comfortable
- Comfortable
- Neutral
- Uncomfortable
- Very uncomfortable

10. Would you be willing to share your personal health data with AI systems to receive personalized medication recommendations?

- Definitely yes
- Probably yes
- Unsure
- Probably no
- Definitely no

Section 4: Perceptions and Concerns

This section identifies common perceptions and concerns regarding AI in pharmacotherapy.

11. What is your biggest concern about using AI in healthcare? (Select all that apply)

- Privacy and data security
- Accuracy of AI recommendations
- Loss of human oversight in healthcare decisions
- Potential for AI to make errors
- Other

12. Do you believe AI can improve the efficiency and effectiveness of healthcare services?

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

Section 5: Impact of Information on Acceptance

This section explores how additional information might influence public acceptance of AI in pharmacotherapy.

13. Would receiving more information about how AI is used in healthcare increase your trust in it?

- Yes, significantly
- Yes, somewhat
- No change
- No, would trust less
- Not sure

14. What type of information would make you more comfortable with the use of AI in healthcare? (Select all that apply)

- Detailed explanations of how AI works
- Success stories/case studies
- Information on privacy and data protection measures
- Endorsements from trusted healthcare professionals
- Other