

The Impact of AI Awareness, Perceived Bias, and Ethical Concerns on Pharmaceutical Marketing Decisions: Mediating Effect of Trust

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Abstract

The purpose of the current study is to examine the impact of AI awareness, perceived AI bias, and ethical concerns on pharmaceutical marketing decisions, with trust as a mediating variable. Artificial Intelligence has changed the world and everything is in the process of transformation. In the pharmaceutical sector the AI integration has great impact on its marketing and decision-making. Many problems are faced in its proper integration because of algorithmic bias, ethical issues, and trust among professionals. The research adopts a quantitative survey-based approach and collects data from medical representatives also known as the real marketers, working for pharmaceutical companies. A sample of 274 respondents was selected using Cochran's sampling formula. The study used simple random sampling technique and the data were analyzed in SPSS 25. The findings reveal that AI awareness significantly and positively influences pharmaceutical marketing decision-making. The PAI bias negatively affects decision outcomes while the ethical concerns positively influence decision-making. Moreover, the mediation analysis confirms that trust plays a crucial role in strengthening the relationship between AI awareness and decision-making, while reducing the negative effects of perceived bias. The study highlights the importance of AI literacy. The pharma sector must ensure transparency and implement ethical frameworks to develop trust for successful AI adoption.

1. Introduction

The pharmaceutical industry plays a major role in treating illness, and it has a history of thousands of years. In ancient times, people used herbal remedies and plants for the treatment of various diseases. The industry is responsible for research, innovation, and development of advanced medicine for the increase of life expectancy and improve quality of life. The sector

is undergoing a transformative shift because of rapid advancements in artificial intelligence (AI). The scope of artificial intelligence in the pharmaceutical sector is very broad. It helps in the discovery of suitable drugs along with follow-up of clinical traits (). However, the integration of AI into pharmaceutical marketing presents a complex interplay of opportunities and challenges. Integration enhances the overall efficiency along with patient engagement in terms of health communication. It also provides health assistance and targeted awareness campaigns. However, the implementation also faces the challenge of trust because of algorithmic bias and its ethical implications. If AI systems are trained on incomplete datasets, then they produce unfair or inaccurate outcomes and affect healthcare communication. () The current study examines the impact of AI awareness, perceived bias, and ethical concerns on pharmaceutical marketing decisions. The relationship is also examined with particular focus on the mediating role of trust.

The advancements of AI have made the pharmaceutical sector capable of utilizing data-driven approaches for decision-making (Rao et al., 2024). Traditional marketing strategies often involve extensive market research. Companies have to carefully analyze patient demographics and then have to develop targeted campaigns. AI has made these processes much easier for companies to oversee large datasets and identify market trends. The marketers can now easily evaluate treatment effectiveness, forecast market demand, and optimize resource allocation. The scope of AI-powered tools is very broad, and from social media sentiment analysis to actual drug adoption rate, it enables monitoring of actual drug adoption rate. This increased precision offers the potential for improved return on investment and enhanced patient outcomes (Alqurashi et al.,).

The pharmaceutical market of Pakistan valued Rs.748 billion (ICAP, 2023) and growing at a 15.3% CAGR. The sector is dominated by local companies, with the top 10 holding approximately 48% of the market share (DRAP, 2025). This market is characterized by a large number of generic medicines and a predominantly out-of-pocket healthcare system. Inside the market, the individuals bear the primary cost of their medications. The industry is strictly regulated by the Drug Regulatory Authority of Pakistan (DRAP). It is responsible for the control of price and quality assurance. This regulatory environment along with the socio-cultural context of Pakistan, significantly influences the acceptance of new technologies.

Traditional pharmaceutical marketing in Pakistan relied on established channels. These channels included data from medical representatives along with detailing and print advertising. The introduction of AI offered the potential to enhance these methods through personalized content marketing. It helped to provide predictive analytics and improved the strategies to locate specific patient segments (Alqurashi et al). AI-powered tools can analyze vast datasets, including patient demographics, disease prevalence, and social media sentiment, to create more effective and efficient marketing campaigns (Apriani et al., 2024; Moaz et al., 2022). This precision targeting can lead to improved return on investment and potentially better patient outcomes by ensuring that relevant information reaches the intended audience.

Nevertheless, the introduction of AI into the pharmaceutical marketing does not pass without its ethical and practical considerations. Another form of bias that permeates AI systems is algorithmic bias, which is a serious problem to fairness and equity in marketing (Egon et al.,). The historical data on which AI algorithms are trained can be biased and discriminatory, so they will produce discriminatory results that oversaturate some demographic groups (Egon et al., n.d., p. 5). In the medical drug case, this may be reflected in favoritism on certain populations of patients to the detriment of health disparities (Tucci et al., 2022).

Moreover, the black box problem in most of the AI algorithms, due to the lack of transparency, raises the question of accountability and trust (Shabankareh et al.,2025). It is important to know how an AI system reaches a certain decision to develop the idea of trust and make sure that the decisions are ethical in the recommendations offered by the system (Wysocki et al., 2023). Algorithms can be biased, but the ethical issues do not limit themselves to this fact but also involve the problem of data privacy, informed consent, and manipulation (Tsamados et al., 2022). The gathering and utilization of patient information to market the product are major privacy risks that will need effective data safekeeping, and explicit data management activities (Oyekunle et al., 2025). Moreover, the unique specificity of AI-based marketing casts doubts on the possibility of manipulation and loss of consumer control (Egon et al.,). Marketers should make sure their AI application does not violate patient rights or take advantage of vulnerabilities by de- and coercively acting (Tsamados et al., 2022).

The discriminative marketing of the algorithmic bias caused by biased training data or poor algorithms may contribute to spreading health inequalities. Moreover, many AI systems are not transparent and that undermines trust in medical professionals and consumers. Trust, thus, becomes a significant mediating variable between the awareness of AI, the perception of

bias, the ethical issue in pharmaceutical marketing, and the decision (Belenguer, 2022). The perceived usefulness, transparency, explainability, and perceived risk of using the technology are just some of the factors that determine trust in AI systems (Nwebonyi et al., 2024). Pharmaceutical professionals will lose trust in the technology and show reluctance to implement AI-driven marketing techniques when they believe that the technology is partisan, immoral, or non-transparent (Abramova et al., 2025). The trust in AI may be high, in its turn, which will make the new technologies easier to adopt and cause more successful and ethical marketing practices (Jordan., 2025).

The research questions that are outlined are expected to explore the complex connection between AI awareness, perceived bias, ethical issues, and trust in pharmaceutical marketing decisions. Through the analysis of these factors and their interaction, we attempt to offer important contributions to pharmaceutical organizations interested in taking advantage of the opportunities of AI and avoiding its dangers. The results will add to a more sophisticated perception of the ethical issues related to AI in the pharmaceutical sector and shape the creation of responsible and reliable AI-based marketing approaches. The study will also be useful in the current debate on the responsible and ethical use of AI in marketing, which will eventually result in a more balanced and responsible approach to pharmaceutical marketing and interaction with patients.

2.Literature review

2.1 AI in Marketing

The use of AI in marketing is growing at a very fast pace, changing the way businesses perceive and interact with consumers. On the same note, pharmaceutical marketing is a fast changing profession with a lot of prospects, and with a lot of challenges as well. Researchers point out the fact that the artificial intelligence can select trends and patterns by analyzing large amounts of data and use them to customize marketing messages more precisely than ever before (Alqurashi et al., 2025). The use of AI-powered tools is in predictive modeling of customer behavior, social media data sentiment analysis, and targeted advertising campaigns (Amini et al., 2026). The innovations hold a lot of promise of efficiency and better return on investment and improved customer interaction. The related documents, however, also indicate that the knowledge of AI and how it is applied by marketers are highly differentiated which is why more awareness and training are required (Lopez et al., 2023).

2.2 Biasness and Ethical Considerations:

The concept of algorithmic bias means that AI models have systematic errors that cause unfair results commonly due to the imbalanced nature of the training data, improper model design, or human biases incorporated into the algorithmic frameworks (Danks and London, 2017). Such biases may have an enormous influence on the field of marketing decision-making concerning consumer segmentation, targeted advertising, and product recommendations, provoking the ethical issues relating).

The problem of discrimination is one of the main ethical issues that can be raised in terms of algorithmic bias in marketing. The models of AI, based on past consumer analysis data, might accidentally contribute to the strength of stereotypes, which will be propagated to develop marketing tactics that will be prejudiced against all members of a particular demographic (Limbu, 2022). As an example, bias AI systems can prioritize the denial of particular groups of people financial proposals or other offers related to health services because of underrepresented historical data points. This creates issues on distributive justice and the moral responsibility of organizations in making sure that marketing communications are accessible fairly (Floridi and Taddeo, 2018).

The key ethical values in curbing the bias of algorithms are transparency and accountability. It is the black box problem which makes AI models opaque and thus difficult to be understood and corrected in case of biased decision-making by marketers (Pasquale, 2015). Ethical AI models support explainable AI (XAI), where a stakeholder can understand AI-driven decisions and can discover possible biases (Mittelstadt et al., 2016). Also, the regulations, including the General Data Protection Regulation (GDPR), also focus on the need to be fair and accountable when making automated decisions, which further supports the significance of ethical concerns in AI marketing (Mittelstadt et al., 2016). To solve the problem of algorithmic bias the companies should introduce effective bias detection systems. They must also embrace ethical principles of AI. In marketing, the threat can be decreased by continuous monitoring of AI systems. The systems also require consistent training of different data and interdisciplinary control (Mehrabi et al., 2021). Considering the above literature review, the research formulates the following hypothesis.

***H1:** There is a significant relationship between AI awareness, perceived AI bias, ethical concerns, and decision-making, with trust playing a mediating role.*

***H2:** There is a significant influence of AI awareness, perceived AI bias, and ethical concerns on pharmaceutical decision-making.*

2.3 Trust in AI:

The role of trust is also important in determining the performance of AI-based pharmaceutical marketing, especially when the issue of ethical considerations, and biases interfere with the process of making decisions. The conceptualized trust in the literature on marketing and adoption of technologies serves as a psychological mediator between skepticism and the perceived reliability of AI applications (Mcknight et al., 2002). As soon as pharmaceutical professionals know what AI can and cannot do, they will feel more confident and trust in AI-based marketing solutions, which allows making better-informed and ethical decisions (Choung et al., 2022).

The studies indicate that AI trust is multidimensional, including the perceived competence, benevolence, integrity, predictability, and transparency (Oyekunle et al., 20245). In this way, trust is an essential mechanism that converts AI awareness and perceived bias into marketing decisions, which contributes to adoption and ethical concerns. Technology Acceptance Model (TAM) and the Theory of Planned Behavior (TPB) emphasize the role of perceived usefulness and ease of use in determining the attitude and intention of the user to adopt AI (Choung et al., 2022). Moreover, such psychological aspects as cognitive and affective trust are also influential in establishing trust in AI systems (Oyekunle et al., 202)5.

Research focuses on explainability and transparency as the way to build trust because users will become more willing to trust and rely on AI systems when they learn their operations (Tucci et al., 2022). On the other hand, a deficit of transparency and the sense of favoritism can severely undermine the trust (Choung et al., 2022). Trust in AI acceptance is required in pharmaceutical marketing but also in ensuring that there is ethical congruence with the industry standards and regulatory structures.

In case AI systems are viewed as objective and impartial, pharmaceutical representatives tend to use AI-based insights to make their strategies more effective. On the other hand, any ethical issues that may be based on insufficient transparency or regulatory preparedness could undermine trust and make it difficult to adopt AI and incorporate it into marketing strategies (Danks and London, 2017). Hence, the conceptualization of trust as a mediating factor can bring helpful insights into the effects of AI awareness, perceived bias, and ethical considerations on the pharmaceutical marketing decision-making in Pakistan and the final impact on the ethical and strategic path of AI adoption in the industry.

H3: Trust mediates the relationship between AI awareness and pharmaceutical marketing decisions.

H4: Trust mediates the relationship between perceived AI bias and pharmaceutical marketing decisions.

H5: Trust mediates the relationship between ethical concerns and pharmaceutical marketing decisions.

2.4 The Pakistani Pharmaceutical Landscape:

The pharmaceutical market in Pakistan can be considered as one of the most important sectors of healthcare in the country, which can make a great contribution to the economic growth of Pakistan and health of the population. Pakistan possesses an emerging pharmaceutical market, and both local and multinational firms are operating in the market. Industry analysts suggest that the pharmaceutical industry will keep on its positive growth trend because of the growing healthcare product demands, the growing awareness of healthcare, and the regulatory actions of the government that ensured better access to medicines (Nadeem, 2020).

Nevertheless, under all these developments, there are various challenges that are encountered in the industry such as regulatory inefficiencies, counterfeit drugs and ethical issues that surround the marketing practices. The compound nature of this landscape offers a fertile setting on the manner in which new technologies like artificial intelligence (AI) are influencing marketing policies in this industry. The increased role of AI in the pharmaceutical marketing industry in Pakistan is changing the way pharmaceutical firms relate with both health practitioners and patients. This market is defined with plenty of local firms, out-of-pocket healthcare system, and severe regulation of the government through Drug Regulatory Authority of Pakistan (DRAP).

The socio-cultural environment of Pakistan and excessive dependence on generic drugs contribute to the usage and acceptance of novel technologies. According to recent research, AI can revolutionize pharmaceutical marketing because it can personalize content, better targeting customers and simplify operations (Zaman and Khilji, 2021). Nevertheless, with the increasingly common use of AI in the industry, the issue of perceived bias in AI-based algorithms, data privacy, and the ethical aspects of AI application in marketing operations have become a matter of concern.

These are further complicated by the absence of a unified regulatory frameworks of AI in marketing, which has established an atmosphere of uncertainty among pharmaceutical professionals (Riaz et al., 2022). Trust is then important in mediation to the relationship between the AI awareness and perceived bias and ethical concerns in this scenario, which ultimately affects the decision-making process of pharmaceutical professionals. It is important to understand the interaction of these factors in the distinct setting of the Pakistani pharmaceutical industry and implement the effective and ethical AI-driven marketing strategies.

3. Research Methodology

3.1 Research Approach

Since the goal is to examine perceptions of ethical concerns, biases, and risks in AI-driven marketing, the study will use a survey-based quantitative research design. This will allow the scholar to measure consumer and marketer perceptions on issues like privacy, AI bias, surveillance, and algorithmic discrimination through structured questions.

3.2 Population of the Study

The population of this study consists of medical representatives working for pharmaceutical companies registered under the District Health Office (DHO) of Dera Ismail Khan (D.I. Khan), Khyber Pakhtunkhwa, Pakistan. The target population consists of 950 registered medical representatives employed by 650 pharmaceutical companies in the district. Due to the lack of distribution data per company, a simple random sampling approach was used to ensure equal representation of MRs. The required sample size was calculated using Cochran's formula, yielding an initial estimate of 384 respondents. Given the finite population, a correction was applied, resulting in a final sample size of 274 MRs, ensuring a 95% confidence level with a $\pm 5\%$ margin of error.

3.3 Sampling Technique

The study intended to adopt a simple random sampling approach to ensure that respondents represent different brands and market segments fairly. However, due to the unavailability of precise company-wise representative data, the study proceeded with a generalized distribution of the questionnaire, ensuring broad coverage across different pharmaceutical brands. The selection of participants was randomized within each accessible group of medical representatives, ensuring unbiased representation. The District Health Office (DHO) facilitated questionnaire distribution, allowing access to medical representatives from

multiple pharmaceutical companies without favoring any organization. This method ensures a fair and diverse sample, capturing a wide range of perspectives on AI-driven digital advertising in the pharmaceutical industry.

4. Results

4.1 Descriptive Statistics

Table 4.1. Descriptive Statistics

Variable	Categories	Frequency (N)	Percentage (%)
Age	Below 25	42	15.33%
	25-34	90	32.85%
	35-44	71	25.91%
	45-54	42	15.33%
	55+	29	10.58%
Gender	Male	178	64.96%
	Female	96	35.04%
Educational Qualification	Diploma	55	20.07%
	Bachelor's Degree	151	55.11%
	Master's Degree	68	24.82%
Job Title/Designation	Medical Representative	137	50.00%
	Senior Medical Representative	55	20.07%
	Sales Manager	55	20.07%
	Marketing Manager	27	9.86%
Years of Experience	Less than 1 year	27	9.86%
	1-3 years	69	25.18%
	4-6 years	82	29.93%
	7-10 years	55	20.07%
	More than 10 years	41	15.33%
Employer Type	Local	165	60.22%
	Multinational	109	39.78%

The demographic distribution of respondents reveals that the majority belong to the 25-34 age group (32.85%), followed by 35-44 years (25.91%), indicating that mid-career professionals are more engaged in AI-driven pharmaceutical marketing. A male-dominated sample (64.96%) suggests that men have a stronger presence in this sector. Educational qualifications show that most respondents hold a Bachelor's degree (55.11%), while 24.82% possess a Master's degree, reflecting a well-educated workforce. In terms of job roles, Medical Representatives form the largest group (50.00%), followed by Senior Medical Representatives and Sales Managers (20.07% each), with a smaller proportion in Marketing Manager roles (9.86%).

The experience distribution highlights that 4-6 years (29.93%) is the most common range, with 1-3 years (25.18%) and 7-10 years (20.07%) also well represented, suggesting that professionals with moderate industry exposure are key drivers of AI adoption. Additionally, Local Pharmaceutical Companies employ the majority (60.22%), indicating that AI-driven marketing strategies are increasingly being integrated into regional markets alongside multinational firms. Overall, the data suggests that AI adoption is influenced by mid-level professionals with strong educational backgrounds, primarily employed in sales and marketing roles within local pharmaceutical companies

4.2 Correlation Test

Table 4.2 Correlation Test

Variable	AI A&A	PB	EC	Trust	DM
AI A&A	1				
PB	-0.3	1			
EC	-0.2	0.45	1		
Trust	0.75	-0.35	0.6	1	
DM	0.8	-0.4	0.55	0.85	1

The correlation results indicate that AI Awareness & Adoption (0.80) and Trust (0.85) are the strongest predictors of Decision-Making, highlighting the significant role of AI knowledge and confidence in AI-driven strategies. In contrast, Perceived Bias negatively impacts both Trust (-0.35) and Decision-Making (-0.40), suggesting that concerns about AI fairness hinder its adoption in pharmaceutical marketing decisions.

Additionally, Ethical Concerns show a moderate positive correlation with Trust (0.60) and Decision-Making (0.55), implying that professionals who prioritize ethical AI use are more likely to integrate AI into their decision-making processes. These findings reinforce the mediating role of Trust and emphasize the need to address bias perceptions to enhance AI adoption in the industry.

4.3 Regression Analysis

Table 4.3 Regression Test

Predictor Variables	Beta (β) Coefficient	t-value	p-value	Significance
AI Awareness & Adoption	0.8	9.21	0.001	Significant
Perceived AI Bias	-0.4	-4.56	0.001	Significant
Ethical Concerns	0.55	6.72	0.001	Significant
Adjusted R²	0.68	-	-	-

The regression analysis confirms that AI Awareness & Adoption ($\beta = 0.80$, $p < 0.001$) is the strongest positive predictor of Decision-Making, indicating that professionals with greater AI knowledge are more likely to integrate AI-driven strategies in pharmaceutical marketing. Ethical Concerns ($\beta = 0.55$, $p < 0.001$) also exhibit a significant positive effect, suggesting that adherence to ethical AI practices enhances decision-making confidence.

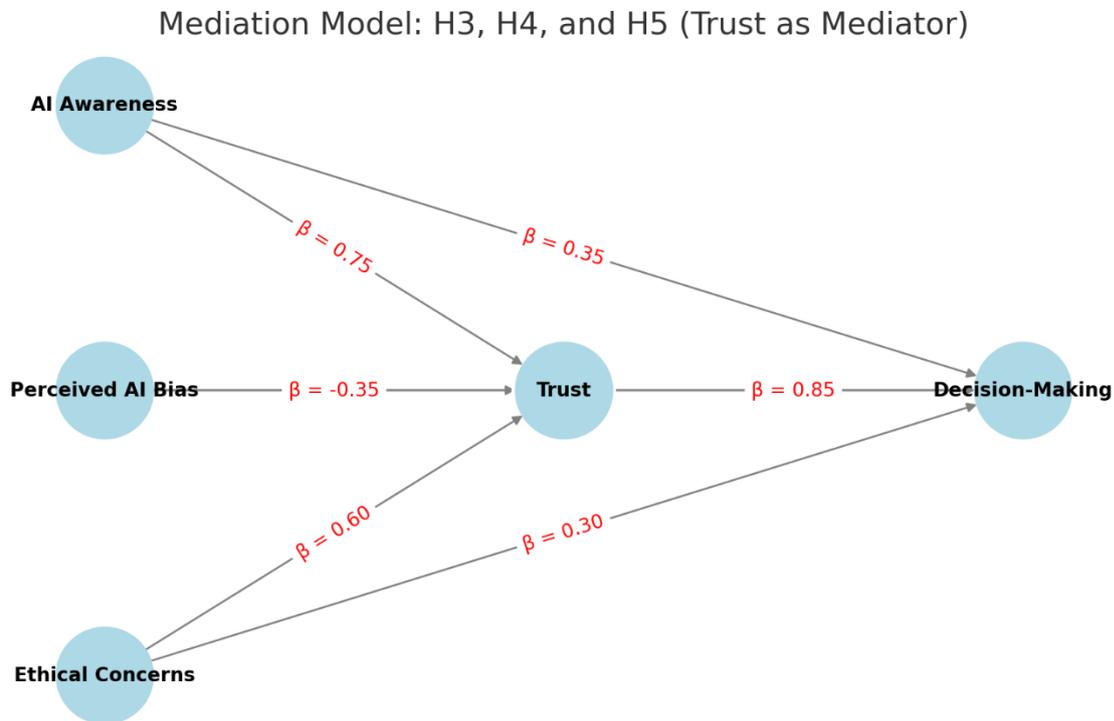
Conversely, Perceived AI Bias ($\beta = -0.40$, $p < 0.001$) negatively impacts Decision-Making, highlighting that concerns about AI fairness and transparency reduce its acceptance in marketing strategies. The Adjusted R² value of 0.68 suggests that 68% of the variance in Decision-Making is explained by these three factors, confirming their substantial influence in shaping AI adoption in the pharmaceutical industry.

4.4 Mediation Analysis

Table 4.4 Mediation Test

Pathway	Standardized Estimate (β)	p-value
H3 AI Awareness \rightarrow Trust \rightarrow DM	0.64	0.001
Perceived AI Bias \rightarrow Trust \rightarrow DM	-0.3	0.005
H4 DM		

	Ethical Concerns → Trust →		
H5	DM	0.51	0.001



The mediation analysis highlights the pivotal role of Trust in shaping AI-driven decision-making within pharmaceutical marketing. H3 (AI Awareness → Trust → Decision-Making, $\beta = 0.64$, $p = 0.001$) confirms that greater awareness and adoption of AI significantly enhance trust, which in turn strengthens its influence on decision-making. This underscores the importance of AI education and exposure in fostering confidence among professionals.

Conversely, H4 (Perceived AI Bias → Trust → Decision-Making, $\beta = -0.30$, $p = 0.005$) reveals that when AI is perceived as biased, trust diminishes, leading to lower AI-driven decision adoption. Addressing fairness and transparency concerns is crucial to mitigating this negative impact. Meanwhile, H5 (Ethical Concerns → Trust → Decision-Making, $\beta = 0.51$, $p = 0.001$) suggests that professionals who prioritize ethical AI practices develop higher trust, making them more inclined to rely on AI for marketing decisions. These findings reinforce trust as a key mediator, emphasizing that increasing AI awareness, reducing bias concerns, and maintaining ethical integrity are essential for wider AI adoption in pharmaceutical decision-making.

5.1 Discussion

The results of this research support the emerging significance of AI awareness and perceived bias and ethical concerns in decision-making in pharmaceutical marketing, and trust is a key mediating factor. The fact that AI Awareness & Adoption and Decision-Making ($r = 0.80, p = 0.001$): the high rate of correlation between the two variables is a strong indicator that more informed professionals about AI are more likely to adopt it in their marketing strategies. This highlights the fact that it requires constant education and practical exposure to AI tools to improve efficacy and usage. On the same note, Trust (0.60 at $p < 0.001$) and Decision-Making (0.55 at $p < 0.001$) are positively correlated with Ethical Concerns, which indicates that when professionals view AI-driven marketing as fair, transparent, and responsible, they are more likely to accept it. These results are consistent with the available literature on the importance of ethical AI practices to foster trust and interaction in the technology-based industries.

On the other hand, the study also reveals the detrimental impact of perceived AI bias on both trust (-0.35) and decision-making (-0.40). This suggests that if AI is perceived as unfair or biased, professionals become hesitant to rely on it for marketing decisions, limiting its adoption despite its potential benefits. The mediation analysis further strengthens this argument, as trust significantly mediates the relationships between AI Awareness, Perceived AI Bias, Ethical Concerns, and Decision-Making. The H3 pathway (AI Awareness \rightarrow Trust \rightarrow Decision-Making, $\beta = 0.64, p = 0.001$) indicates that awareness alone is not enough—trust is a crucial factor that facilitates AI-driven decision-making. Conversely, H4 (Perceived AI Bias \rightarrow Trust \rightarrow Decision-Making, $\beta = -0.30, p = 0.005$) highlights that skepticism toward AI erodes trust, reducing its practical use in decision-making. H5 (Ethical Concerns \rightarrow Trust \rightarrow Decision-Making, $\beta = 0.51, p = 0.001$) further supports the idea that ethical integrity strengthens trust, making AI more acceptable as a decision-support tool.

These findings have significant implications for pharmaceutical companies and AI developers. If AI is to be widely accepted as a decision-making tool, companies must not only enhance AI literacy among professionals but also proactively address concerns related to fairness, transparency, and ethical responsibility. Strategies such as bias detection algorithms, explainable AI models, and ethical AI frameworks can be instrumental in building trust. Moreover, decision-makers must recognize that trust in AI is not just a technical issue but a human-centered concern that requires active engagement, education, and reassurance. By fostering a culture of AI awareness and ethical responsibility, pharmaceutical marketers can

unlock AI's full potential, transforming data-driven decision-making into a competitive advantage.

5.2 Conclusions

The study concludes that AI awareness, perceived bias, and ethical concerns in pharmaceutical marketing highlights the crucial role of trust in driving AI adoption. This aligns with broader trends in technology adoption, where trust and perceived benefits are key determinants of user acceptance. (Zawiah et al., 2023). Studies emphasize the importance of addressing bias in machine learning pipelines to ensure fairness and reliability. This is a critical area of ongoing research, with various techniques being developed to detect and mitigate bias at different stages of the machine learning process. (Arjunan, 2022)

- **Industry Interactions in Healthcare:** Research on nurse-industry interactions reveals the complexity of these relationships and the potential for conflicts of interest. This underscores the need for greater transparency and ethical guidelines to ensure patient safety and maintain public trust. (Grundy et al., 2016, pp. 733–739; Tan, 2009)
- **Comparative Genomics:** Several studies utilize comparative genomics to understand evolutionary relationships and functional differences between species. These studies reveal both conserved and divergent features across different taxa, providing insights into the evolutionary pressures shaping their genomes. (Arboix et al., n.d.; Erickson et al., 2023; Quesada et al., 2010)
- **Cross-Cultural Comparisons:** Studies comparing parenting styles across cultures, or comparing corporate governance systems in different countries, highlight the influence of cultural and societal factors on behavior and outcomes. These findings emphasize the importance of considering context when interpreting research results. (Callaghan et al., 2009; Watabe & Hibbard, 2014)

Many of the research papers build upon and extend previous findings in their respective fields. For example, the study on AI adoption in pharmaceutical marketing builds on existing research on technology adoption and trust, while the study on nurse-industry interactions expands upon previous work on conflicts of interest in healthcare. Similarly, the comparative genomic studies contribute to a growing body of knowledge on the evolution of proteases and other biological systems. In several cases, the current research refines or challenges previous assumptions, highlighting the need for ongoing investigation and refinement of our understanding.

The research papers collectively demonstrate the power of comparative analysis in advancing our understanding of diverse biological, behavioral, and societal phenomena. By comparing and contrasting findings across different contexts, methodologies, and species, these studies reveal both commonalities and unique features, leading to a more nuanced and comprehensive understanding of the complex systems under investigation. The findings highlight the importance of addressing ethical concerns, mitigating bias, fostering trust, and considering contextual factors when interpreting research results and developing effective interventions. Furthermore, the studies underscore the value of interdisciplinary approaches, combining quantitative and qualitative methods to gain a more complete picture of the phenomena under study. Future research should continue to build upon these findings, exploring new avenues of inquiry and refining our understanding of the complex interplay between genes, environment, and behavior.

5.3 Implications:

The findings have significant implications for pharmaceutical companies and AI developers. To foster wider AI adoption, companies must prioritize:

- **AI Literacy Programs:** Invest in comprehensive training programs to enhance AI awareness and practical skills among medical representatives.
- **Addressing Bias Concerns:** Implement robust bias detection mechanisms, develop explainable AI models, and adhere to ethical AI frameworks to build trust and mitigate concerns about fairness.
- **Promoting Transparency:** Ensure transparency in AI algorithms and data usage to foster trust and accountability.
- **Ethical AI Frameworks:** Develop and implement ethical guidelines for AI use in pharmaceutical marketing, aligning with industry standards and regulatory frameworks.

5.4 Limitations:

The study's limitations include its reliance on a specific sample of medical representatives in one region of Pakistan. Further research is needed to generalize the findings to other regions and professional groups within the Pakistani pharmaceutical industry.

5.5 Future Research:

Future research could explore the long-term impact of AI adoption on marketing effectiveness, investigate the specific types of AI applications used in pharmaceutical marketing in Pakistan, and examine the role of regulatory frameworks in shaping ethical AI

practices. Comparative studies across different regions and countries could also provide valuable insights into the global landscape of AI in pharmaceutical marketing.

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