RESEARCH PAPER

Understanding Shared Decision-Making in Healthcare: A Dual Perspective of Doctors and Patients

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ABSTRACT

Purpose: The purpose of the current study is to examine the role of immersive technology in doctor-patient interactions by exploring extent of awareness, exposure, perceived impact on communication, engagement, and shared decision-making, as well as the significant barriers influencing the adoption of this technology in healthcare environment. This study adopts a dual-stakeholder approach, by incorporating responses from both healthcare providers and patients.

Research Methodology: The present study adopts a descriptive, cross-sectional research design and makes use of survey data collected from doctors and patients. The analysis emphasizes on conceptual-empirical alignment rather than causal inference. Following data screening and cleaning procedures, doctor responses (N=100) and patient responses (N=200) were retained for analysis for the purpose of this study. The data were assessed for completeness and analyzed using frequency and percentage distributions. Likert-scale responses were aggregated to examine perceived benefits and constraints associated with immersive technologies.

Findings: The findings suggest that patients who have experienced immersive technologies in healthcare settings, demonstrate predominantly positive perceptions, including improved understanding of their medical conditions and available treatment options, higher engagement during consultations, and increased confidence in shared decision-making. In contrast, doctors have reported significant barriers to adoption, with high implementation costs, time constraints, training requirements, and ethical or privacy concerns emerging as major challenges in adoption of immersive technologies. While awareness about this technology among doctors was relatively high, actual usage in routine clinical practice has seen little progress.

Research Implications: The study relies on self-reported perceptions and descriptive analysis, which limits the ability to establish causal relationships. The cross-sectional nature of the data and the relatively low level of direct exposure to immersive technologies among respondents may affect generalizability. Future research using longitudinal designs, qualitative methods, or inferential modeling could provide deeper insight into adoption dynamics and outcome mechanisms.

Practical Implications: The results suggest that immersive technologies can serve as effective communication-enhancing tools in healthcare when implemented selectively and supported by adequate training, institutional readiness, and ethical governance. Healthcare providers, administrators and policymakers may make use of these findings to inform strategic deployment decisions that balance innovation with feasibility.

Originality: This study contributes to the literature by integrating patient and doctor perspectives within a single conceptual-empirical framework. The study provides a fair and adaptive perspective on the use of immersive technology in healthcare by relating these technologies to communication effectiveness, engagement, and shared decision-making while also considering adoption barriers.

Keywords: Immersive technology, healthcare providers, clinical procedures, patient-doctor interactions, shared-decision making

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1. INTRODUCTION

The healthcare sector is undergoing rapid digital transformation across the globe. This change is driven by advances in information technology, artificial intelligence, and human-computer interaction. Healthcare services these days are no longer evaluated solely on clinical outcomes but the efficiency increasingly relies on patient's experience, engagement during the medical procedures, and shared understanding between healthcare providers and patients (Tomita et al., 2025). The healthcare sector has seen a revolution in providing treatment and care for patients owing to the advent of the augmented and virtual reality, which offer innovative techniques to enhance the entire patient experience (Rautela et al., 2020). In this paradigm shift, an extensive trend toward patient-centered care, where patients actively participate in their diagnosis, treatment preparation and planning, and decision-making processes rather than being mere recipients of care, becomes more apparent.

Immersive technologies have been applied in medical education and training, surgical planning, rehabilitation, pain management, and patient education. These technologies present dynamic three-dimensional graphic presentations and interactive simulations that can simplify complicated anatomical structures, procedural steps, and treatment pathways. In contrast to the conventional educational tools, immersive systems facilitate experiential learning, which enhances comprehension, recall, and confidence among both healthcare providers and the patients. Despite increasing technological capability, the value of immersive technologies in healthcare prolongs far beyond technical performance. Their ability to support human-centered communication and foster shared understanding positions them as promising tools for strengthening doctor-patient interaction.

Doctor-patient communication is an extremely significant determinant that influences healthcare quality and efficacy. Clear explanations of the treatment, empathetic engagement during the procedures, and mutual understanding between the healthcare providers and patients holds importance in building trust and facilitating shared decision-making (SDM), a process in which healthcare providers and patients collaborate to make informed healthcare decisions (Elwyn et al., 2012). SDM has been associated with improved patient satisfaction, reduced decisional conflicts, and better alignment between treatment choices and patient values which leads to improvement in patient satisfaction.

The studies conducted recently in this contexts, have suggested that immersive technologies positively influence communication within healthcare settings. For doctors, immersive tools may enhance confidence in explaining procedures, support clinical training, and improve efficiency in patient education (Pottle, 2019). For patients, immersive visualizations have helped to improve understanding of medical conditions, increased engagement during consultations, and reduced anxiety during the medical procedure (Indovina et al., 2018). Patients increasingly perceive immersive experiences as much more engaging as compared to the conventional telehealth or face-to-face sessions due to inherent interactivity, multisensory feedback, and customizable features. Digitally enhanced healthcare environments enable patients to better comprehend their medical conditions, reduce anxiety, and actively participate in treatment decisions, leading to improved satisfaction and trust in healthcare systems (Riva & Wiederhold, 2020).

Existing research in this context, often examines healthcare professionals or patients in isolation, without exploring perceptual alignment or divergence between these two stakeholder groups that are directly involved in the procedures. Understanding how both doctors and patients perceive the communicative value of immersive technologies is essential for designing interventions that truly support patient-centered care. Positive emotional outcomes depend on balancing these technologies with emotional safety. Although patients appreciate how these tools can make therapies like exposure therapy more accessible and comfortable, but sometimes they feel demotivated without the presence of a physical therapist during the procedures. Studies have revealed that though immersive technologies make therapies more understandable and comfortable for the patients, they may sometimes experience lack of motivation due to absence of in-person accountability and existence of a real person (Ong et al., 2025). The study further added that some of the patients were unsure if the technology would make them feel realistic. Additionally, time constraints and the need for specialized training may limit clinicians' ability to adopt and effectively use immersive systems within busy clinical workflows. Ethical and legal considerations, including data privacy, informed consent, and clinical accuracy of virtual simulations have also been identified as critical concerns. Variability in digital literacy among patients and healthcare professionals further complicates adoption. These challenges underscore the importance of assessing not only perceived benefits but also institutional readiness and acceptance when assessing immersive healthcare technologies.

Although prior research highlights the technical capabilities and educational value of immersive technologies, there remains a notable lack of empirical studies that integrate both doctor and patient perspectives to evaluate their impact on clinical communication and shared decision-making. The majority of existing studies focus on isolated outcomes such as training effectiveness or patient anxiety reduction, without examining how immersive tools influence the relational dynamics between doctors and patients. Meanwhile, limited quantitative evidence exists on perceived alignment between healthcare professionals and patients regarding the pros and cons of immersive technologies in real-world clinical contexts. Addressing this gap is imperative to advance human-centered design, implementation strategies, and policy decisions associated with immersive healthcare innovations.

This study intends to fill the identified gap by:

1. Analyzing doctors' and patients' opinions about immersive technologies in the context of clinical

communication;
2. Assessing the perceived impact of immersive tools on patient comprehension, engagement, and shared decision-making; and
3. Identifying crucial barriers that influence the uptake as well as application of immersive technologies in healthcare environments.

Through the application of a dual-perspective, questionnaire-based methodology, this study aims to contribute empirical insights into the role of immersive technologies in enhancing doctor-patient interaction and patient-centered care.

2. LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

2.1 Immersive Technologies in Healthcare

Immersive Technology blurs the boundary between the real and virtual worlds, allowing users to experience a sense of immersion (Suh & Prophet, 2018). This form of technology blends or overlays digital content over the real world to create multi-sensory and highly interactive environments, which enables users to engage with information, objects, and simulations in ways that feel realistic and tangible. It includes a wide range of applications like AR, VR, MR, AV and XR, which enhance user engagement by establishing a sense of authenticity as well as realism.

Table 1 below provides an in-depth review of the fundamental concepts behind immersive technologies. It improves comprehension by providing definitions for important terms, outlining their significance, and emphasizing how they are used in a variety of settings.

Table 1. Understanding Immersive Technologies: Key Concepts

Concept	Definition	References
Immersive Technology	An assemblage of cutting-edge digital tools and systems that combine the real, virtual, and simulated worlds in a seamless manner to produce extremely engaging and interactive experiences that offers its users a profound sense of presence together with immersion.	(Suh & Prophet, 2018)
Augmented Reality (AR)	A blend of technologies that integrates digital data and images on the user's physical environment, establishing an innovative interface between the digital and physical worlds and enhancing the user's sense of reality.	(Rauschnabel, 2021)
Virtual Reality (VR)	Generates an immersive virtual world that mimics real-world situations. Non-Immersive VR: Users use conventional input devices like keyboards and mouse to engage with virtual content that is shown on a regular computer screen. Immersive VR: Requires users to wear specialized gear, such as a head-mounted display (HMD), and completely immerses them in a virtual environment.	(Hamad & Jia, 2022)
Mixed Reality (MR)	Digital and physical objects coexist and communicate in real time, combining the real and virtual worlds.	(Viglialoro et al., 2021)
Augmented Virtuality (AV)	Environments where an element of the physical world is augmented into the virtual environment, but the majority is virtual.	(Neges et al., 2018)
Extended Reality (XR)	A broad concept encompassing AR, VR, and MR. XR technologies create highly immersive and interactive experiences that go beyond traditional reality by integrating digital content with the physical world.	(Vasarainen et al., 2021)
Medical Extended Reality (MXR)	Subset of Extended Reality (XR) that is applied in the healthcare industry.	(Yang, 2023)

Source: Researcher's own work

Table 2 below, explains the differences and relationships between various immersive technologies AR, MR, AV, VR, and XR based on their use of the real and virtual worlds, and what kind of interaction or experience they offer.

Table 2. Reality Tech Comparison Matrix

Technology	Real Part	Virtual Part	Key Feature	Relationship Type
AR (Augmented Reality)	High	Low	Adds digital info onto real-world view	Enhances reality
MR (Mixed Reality)	Medium	Medium	Interactive merge of real and virtual elements	Integrates and interacts
AV (Augmented Virtuality)	Low	High	Inserts real-world elements into a virtual world	Enhances virtual
VR (Virtual Reality)	None	Full	Fully simulated digital environment	Immerses completely in virtual world
XR (Extended Reality)	Varies	Varies	Umbrella term covering AR, VR, MR, AV	Inclusive and combinatory

Source: Researcher's own work

Table 2 above shows the entire range of immersive technologies and the way they blend real and virtual elements in multiple ways. AR tends to maintain a high real-world presence with minimum virtual overlay, essentially adding digital information onto your real environment. VR represents the exact opposite, offering full immersion in a digital environment using a headset device, with no connection to real-world elements, creating an entirely simulated experience. MR has the middle ground with equal parts of real and virtual elements, allowing interactive integration where digital objects can be placed and manipulated within real spaces. AV reverses the AR concept by inserting real-world elements like your hands or face into a predominantly virtual environment, essentially enhancing digital worlds with real components. Lastly, XR serves as an umbrella term encompassing all these technologies, providing a comprehensive label for the entire spectrum of reality-virtuality combinations without specifying particular implementations, making it useful for discussing the broader field of immersive technologies that vary in their real-to-virtual ratios and interaction methods.

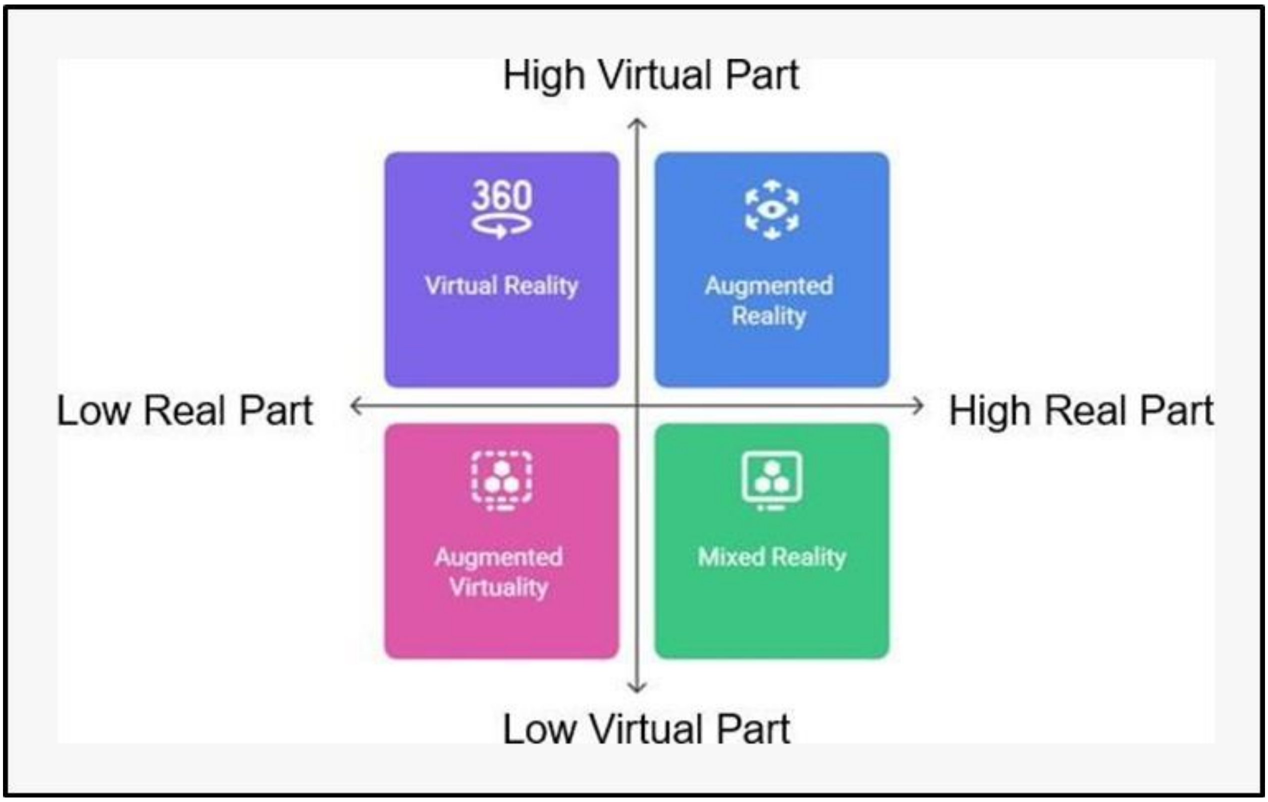

Figure 1. Reality-Virtuality Continuum

Source: Researcher's own work

Figure 1 mentioned above illustrates the Reality-Virtuality Continuum, which depicts how immersive technologies blend real and virtual elements together. VR is fully immersive, creating a complete digital world with little to no connection to reality, while AR keeps the real world central and adds digital overlays to enhance it. AV is mostly virtual but incorporates some real-world inputs, whereas MR combines both real and virtual elements in a way that they can interact seamlessly. Together, these four concepts explain how technology ranges from completely real to completely virtual experiences. All these technologies fall under the broader umbrella of XR, which encompasses every form of experience that connects, blends, or transitions between the real and virtual worlds.

Figure 2 below illustrates how different reality technologies exist along a spectrum that ranges from the fully real to the fully virtual. On the far left is the physical world we experience every day, without any digital elements. As we move along the spectrum, digital content begins to overlay the real environment, as seen in AR. Further along, technologies like Mixed Reality (MR) allow real and virtual elements to interact with each other in real time. As we continue toward the virtual end, the experience becomes mostly digital, but still includes some real-world components, this is known as AV. Finally, at the far right, VR offers a completely immersive digital environment, replacing the real world entirely. All these technologies together are part of a broader category called XR, which includes every experience that blends or transitions between the real and virtual worlds.

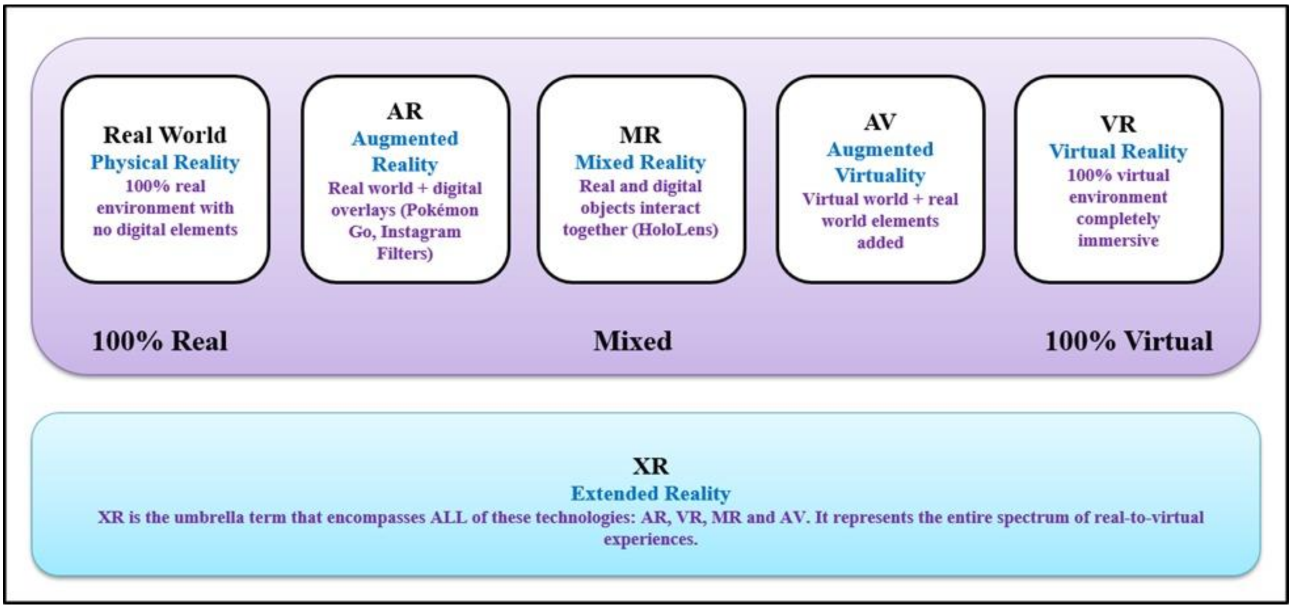

Figure 2. From Real to Virtual: The XR Spectrum

Source: Researcher's own work

According to Market Research Future Report, the Global Immersive Technology in Healthcare Market Size was valued at 5.2 USD Billion in 2024. Immersive Technology in Healthcare Market industry is projected to grow from 6.1 USD Billion in 2025 to 17.5 USD Billion by 2034 exhibiting a compound annual growth rate (CAGR) of 12.9% during the forecast period (2019 - 2034) (Analysis, 2019). This report further added that the Global Immersive Technology in Healthcare Market is undergoing remarkable evolution, strengthened by rapid advancements in VR and AR technologies.

Expanding adoption across surgical training, patient rehabilitation, and telehealth solutions is accelerating this transformation. Market growth is further encouraged by improved user experiences and favorable regulations, while the rising need for remote healthcare services amid economic changes underscores the critical role of adaptability and innovation (Analysis, 2019). The global demand for AR and VR in medicine, driven by advancements in patient care, medical simulations, and training is anticipated to expand at an annual growth rate of over 30%, according to the Healthcare Information and Management Systems Society (Analysis, 2019).

Figure 3 below highlights steady and strong growth in the adoption of immersive technologies in healthcare. The market is projected to be more than triple between 2024 and 2034, reflecting the rising importance of these technologies in medical training, patient care, and telehealth. In 2024, the market size was $5.2 billion. In 2025, it is projected to grow to $6.1 billion. By 2030, the market is expected to reach $12.3 billion. By 2033, it is anticipated to expand further to $15.8 billion. Finally, by 2034, the market size is projected to attain $17.5 billion.

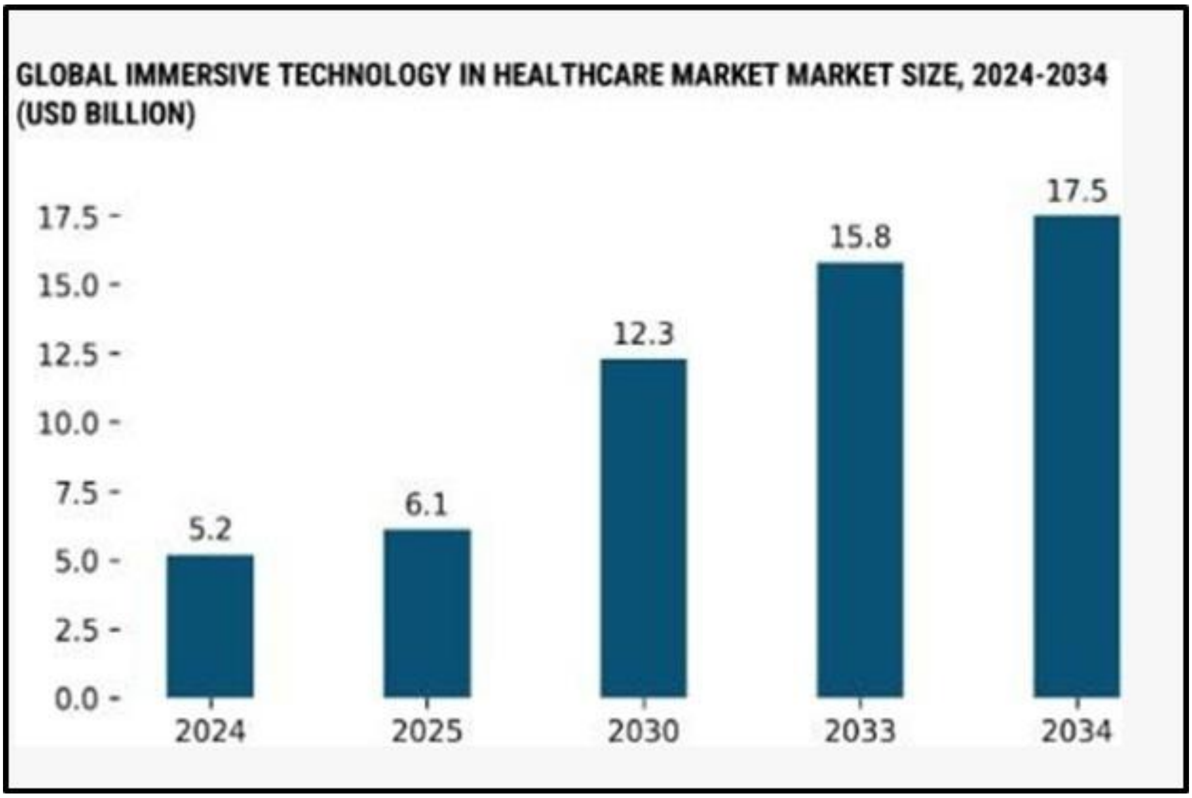

Figure 3. Global Immersive Technology in Healthcare Market Size, 2024-2034 (USD Billion)

Source: Global Immersive Technology in Healthcare Market Report (Analysis, 2019)

Overall, the trend highlights a strong upward trajectory, with the market expected to more than triple over the decade, underscoring the increasing importance of immersive technologies in transforming healthcare delivery, training, and patient care.

2.2 Immersive Technologies and Doctor-Patient Communication

Effective doctor-patient communication is crucial to deliver high-quality healthcare services. Traditional consultation methods are based on verbal explanations and images, which may be inadequate for communicating complex medical information, particularly under time constraints. Immersive technologies have introduced new methods to communicate that extend far beyond conventional verbal and two-dimensional visual approaches. Through three-dimensional visualization, interactivity, and experiential representation, technologies such as VR, AR, and MR enable clinicians to explain anatomical structures, disease progression, and treatment procedures in more intuitive and comprehensible ways. These immersive representations can reduce abstraction and allows patients to understand medical concepts that would otherwise be challenging to comprehend. Effective and clear communication improves patient's understanding of the medical procedures, patient satisfaction, adherence to treatment, and fosters trust in healthcare providers (Aliwi et al., 2023).

From the perspective of healthcare providers, immersive tools have the potential to facilitate clearer explanations and more structured communication during consultations. Prior studies suggest that visual and interactive demonstrations can increase healthcare provider's confidence in explaining risks, benefits, and procedural steps, while also reducing the need for repeated clarifications (Radianti et al., 2020). Immersive tools are particularly valuable in complex clinical contexts, where misunderstandings can contribute to patient anxiety and uncertainty in taking a decision.

From the perspective of the patients, immersive communication has been associated with improved comprehension, greater engagement, and increased willingness to participate in clinical discussions. Interactive visualizations can encourage patients to ask questions, express concerns, and actively engage with information presented during consultations. By transforming patients from passive recipients of information into active participants, immersive technologies may contribute to more collaborative and patient-centered interactions.

Regardless of these promising indications, existing empirical evidence remains fragmented. Many studies focus on isolated outcomes such as knowledge gain or anxiety reduction, without explicitly examining doctor-patient communication as a relational process which involves both the stakeholders. Additionally, few studies empirically assess whether doctors' perceptions of improved communication align with patients' experiences regarding understanding the treatment and engagement during the process. This gap highlights the need for dual-perspective study that examines how immersive technologies are perceived to influence communication within real-world clinical settings.

2.3 Immersive Technologies and Shared Decision-Making

Shared decision-making (SDM) is a core principle of patient-centered care, emphasizing collaboration between doctors and patients in healthcare decisions. SDM requires that patients understand their medical conditions, available treatment options, and associated risks and benefits (Elwyn et al., 2012). However, achieving meaningful SDM can be challenging when patients struggle to understand complex medical procedures or feel overwhelmed during consultations.

Digital tools are increasingly recognized as facilitators of SDM by supporting patient education and empowerment. Immersive technologies, precisely, offer experiential learning opportunities that enhances patient understanding of the medical procedures and builds confidence. VR-based visualizations can simulate treatment outcomes or procedural steps that allows patients to understand and be prepared about the scenarios in a controlled and comprehensible manner.

Existing research indicates that immersive interventions can reduce confusions and anxiety related to clinical decision making by providing patients with clear expectations of medical procedures (Indovina et al., 2018). Enhanced understanding may enable patients to engage more meaningfully in discussions with clinicians, supporting informed and shared decisions. Nevertheless, empirical research examining the role of immersive technologies in facilitating SDM from both doctor and patient perspectives remains limited, highlighting the need for integrative, perception-based investigations.

2.4 Barriers to Adoption of Immersive Technologies in Healthcare

Despite the potential benefits of Immersive Technology, the adoption in healthcare faces multiple challenges. One of the most frequently cited barriers is the high cost associated with acquiring, implementing, and maintaining immersive systems (Halbig et al., 2022). These costs may be prohibitive for smaller hospitals or resource-constrained healthcare institutions.

Time constraints and training requirements also pose significant challenges. Healthcare providers often operate under demanding schedules, limiting opportunities to learn and integrate new technologies into routine practice (Lassen et al., 2025). Without adequate training and institutional support, immersive tools may be perceived as disruptive rather than beneficial. Additionally, ethical concerns related to patient data privacy, informed consent, and the clinical accuracy of virtual simulations have been raised as critical considerations.

Patients' varying level of digital literacy makes adoption even more difficult. While some patients find immersive technology easy to use, others might find them challenging, which might lead to inequalities in access to healthcare. These problems underline the significance of examining not only perceived benefits but also readiness, acceptance, and barriers from the perspectives of both doctors and patients.

2.5 Research Gap and Need for a Dual-Perspective Approach

Although past research has shown technical feasibility and clinical efficacy of immersive technologies, significant gaps remain. First, most of the existing studies examine either healthcare providers or patients in isolation, offering limited insight into how both stakeholders perceive the communicative and relational impact of the immersive technology. Second, empirical evidence focusing specifically on doctor-patient communication and shared decision-making remains scarce, despite their central role in patient-centered care.

Additionally, there is limited quantitative research assessing perceptual alignment or divergence between doctors and patients regarding immersive technology adoption, benefits, and barriers. Understanding this alignment is essential for designing effective, human-centered immersive healthcare solutions and ensuring successful implementation within healthcare procedures.

2.6 Conceptual Framework and Hypothesis Development

Drawing upon prior research on immersive technologies, healthcare communication, and patient-centered care, this study proposes a conceptual framework to examine the perceived role of immersive technologies in shaping doctor-patient interaction and shared clinical decision-making. The framework adopts a dual-stakeholder perspective, recognizing both doctors and patients as central actors in the clinical communication process.

Within this framework, immersive technology use is positioned as a primary enabling factor that supports enhanced communication processes in clinical settings. Immersive visualizations and interactive representations are theorized to facilitate clearer explanations, improve patient comprehension of medical information, and promote greater engagement during clinical encounters. For healthcare professionals, immersive tools may also support confidence in conveying complex clinical information and structuring consultations more effectively. Collectively, these communication-related factors are expected to strengthen shared decision-making by enabling more informed, collaborative discussions between doctors and patients.

The framework further acknowledges that the successful integration of immersive technologies is contingent upon contextual and organizational conditions. Practical constraints such as financial investment, time availability, training requirements, and ethical considerations related to data privacy and clinical accuracy may shape healthcare professionals' readiness to adopt and consistently utilize immersive technologies. These factors are therefore conceptualized as influences on acceptance and adoption rather than direct clinical outcomes.

The below mentioned hypotheses are proposed for exploratory empirical examination:

- H1: Immersive technology use is positively associated with perceived effectiveness of doctor-patient communication.
- H2: Immersive technology use is positively associated with patient understanding and engagement during clinical interactions.
- H3: Enhanced communication associated with immersive technology use is positively related to shared decision-making between doctors and patients.
- H4: Perceived implementation challenges are negatively associated with acceptance and adoption of immersive technologies in healthcare settings.

This conceptual framework provides a theoretically grounded basis for empirical examination of immersive technologies in healthcare communication contexts, without presupposing specific implementation mechanisms. It offers a structured lens through which the relationships between immersive technology use, communication dynamics, and shared decision-making can be systematically analyzed.

3. RESEARCH METHODOLOGY

3.1 Research Design

This study adopts a cross-sectional, quantitative research design to examine perceptions related to the use of immersive technologies in healthcare settings. A survey-based approach was considered appropriate as the study focuses on understanding perceived communication effectiveness, patient engagement, shared decision-making, and adoption-related challenges associated with immersive technologies. The research is exploratory in nature and emphasizes a dual-stakeholder perspective, incorporating insights from both doctors and patients involved in clinical interactions.

3.2 Study Context and Participants

The study was conducted within healthcare settings where the respondents had either implemented, explored, or discussed immersive technologies such as Virtual Reality (VR), Augmented Reality (AR), or Mixed Reality (MR) for clinical or educational purposes in clinical contexts. Participants included healthcare providers from diverse clinical domains as well as the patients. The sample of healthcare providers comprised consultants, doctors, and junior residents, representing diverse clinical experience and institutional contexts. Patients participating in the study reflected diverse demographic backgrounds and clinical interactions. This diversity supports a broader understanding of how immersive technologies are perceived across different healthcare stakeholders.

3.3 Data Collection Approach

For this study, two structured questionnaires were designed, one specifically for doctors and one for patients, in order to understand how immersive technologies are used and experienced in healthcare settings. Both questionnaires included basic demographic questions using multiple-choice formats (such as age, department, experience for doctors, and age, previous treatment experience for patients). A 5-point Likert scale was used to measure agreement with statements related to comfort, usefulness, emotional experience, and ease of using immersive tools. Simple checkboxes helped respondents indicate the type of technology they had used (VR, AR, or other digital tools), while rating scales captured the frequency and quality of their interaction with these technologies. The flow of questions started with general impressions and moved gradually toward more specific experiences. The scaling techniques were chosen to keep the questionnaires simple yet strong enough to capture meaningful insights about how immersive technology influences clinical practice and patient experience. Measures were taken to avoid any misleading or technical questions so that both patients and doctors could answer comfortably. This final design supports accurate data collection and allows effective quantitative analysis of the responses.

3.4 Data Screening and Preparation

Following data collection, responses were screened to ensure data quality and suitability for analysis. Incomplete responses, unengaged answering patterns, and cases with substantial missing data were excluded from the final dataset. This screening process ensured consistency and reliability in the analytical sample.

Subsequently, responses were grouped at the construct level to represent key dimensions such as perceived communication effectiveness, patient understanding and engagement, shared decision-making, and perceived barriers to adoption. This approach reduced supported meaningful interpretation of results.

Initially, usable responses were obtained from 115 doctors and 265 patients. After data screening and cleaning, the final sample comprised 100 doctors and 200 patients. The extent of data cleaning required for doctors' responses was comparatively minimal, indicating a higher level of completeness and consistency, whereas greater refinement was necessary for patient responses to ensure accuracy and reliability. These responses were later analyzed systematically to validate the hypotheses and draw meaningful conclusions aligned with the research objectives.

3.5 Reliability and Validity Assessment

The reliability of the measurement approach was assessed through internal consistency analysis using Cronbach's alpha. As shown in Table X, the perceptual constructs examined in this study demonstrated satisfactory internal consistency, with Cronbach's alpha values exceeding the recommended threshold of 0.70. These results indicate that the indicators used to capture perceptions related to immersive technology in healthcare were measured consistently and provide a reliable basis for subsequent analysis. No item-level reporting was required, as reliability was assessed at the construct level in line with established empirical research practices.

Table 3. Reliability Analysis

Construct	Number of Indicators	Cronbach's Alpha
Immersive Technology Experience and Perception (Doctors)	5	0.86
Immersive Technology Perception (Patients)	5	≥ 0.80

Source: Researcher's own work

Cronbach's alpha values above 0.70 indicate acceptable internal consistency. Values are rounded to two decimal places.

3.6 Data Analysis Techniques

Table 4. Data Analysis

Tool	Structured Questionnaire
Sample	Sample method- non-probability, purposive sampling
Method	Descriptive survey method
Data Analysis Techniques	Descriptive statistics (frequency, percentage)
Software Used	SPSS (Statistical Package for the Social Sciences)

Source: Researcher's own work

Given the exploratory and perception-based nature of the study, the analysis focused on identifying patterns and relationships rather than establishing causal effects.

3.6 Ethical Considerations

Ethical principles were adhered to throughout the research process. Participation was voluntary, and respondents were informed of the study's purpose prior to data collection. Anonymity and confidentiality were maintained, and no personally identifiable information was used in the analysis. All findings are reported in aggregate form to ensure ethical compliance.

4. RESULTS AND ANALYSIS

4.1 Sample Characteristics

The study included responses from medical professionals and patients, forming a dual-stakeholder dataset. Data screening ensured that only complete and valid cases were retained for analysis.

Table 5. Demographic Characteristics of Doctors (N = 100)

Variable	Category	Frequency	Percentage (%)
Gender	Male	58	58
	Female	42	42
Age Group (years)	21–30	24	24
	31–40	38	38
	41–50	29	29
	51 and above	9	9
Designation	Consultant	14	14
	Doctor	79	79
	Resident / Intern / Research Scholar / Special Educator	7	7
Years of Clinical Experience	Less than 2	16	16
	2–5	11	11
	5–10	17	17
	10–15	20	20
	More than 15	36	36
	General Medicine / Primary Care	38	38
	Surgical Specialties	16	16

Department/Specialty	Medical Specialties (Cardiology / Neurology)	13	13
	Critical Care / Emergency Medicine	6	6
	Rehabilitation / Allied Health	5	5
	Women / Child Health	7	7
	Dentistry / Oral Health	5	5
	Mental Health / Behavioral Sciences	4	4
	Other	6	6
Type of Institution	Government Hospital	26	26
	Private Hospital	31	31
	Teaching / Academic Hospital	9	9
	Clinic / Individual Practice	34	34
Awareness of Immersive Technology	Aware	34	34
	Heard of it (not in detail)	51	51
	Not aware	15	15
Use / Observation in Practice	Actively used	17	17
	Observed use by others	51	51
	Never used or observed	32	32

Source: Researcher's own work

The final doctor sample consisted of 100 valid responses representing diverse clinical roles, experience levels, and institutional settings. Most of the participants were practicing doctors (79%), with over one-third reporting more than 15 years of clinical experience. Respondents were drawn from a wide range of medical specialties, with the largest proportion from General Medicine or Primary Care. While awareness of immersive technologies was relatively high, only a smaller proportion reported direct usage in clinical practice, indicating limited but emerging adoption.

Table 6. Demographic Characteristics of Patients (N = 200)

Variable	Category	Frequency	Percentage (%)
Gender	Male	105	52.5
	Female	95	47.5
Age Group (years)	1–10	1	0.5
	11–20	32	16
	21–30	68	34
	31–40	60	30
	41–50	21	10.5
	51 and above	18	9
Highest Level Education	Secondary School	29	14.5
	Bachelor's Degree	68	34
	Master's Degree	71	35.5
	Doctoral Degree	31	15.5
	Other / Not specified	1	0.5
Monthly Income	Less than 10,000	15	7.5
	10,000–25,000	14	7
	25,001–50,000	42	21
	50,001–1,00,000	38	19
	1,00,001–2,00,000	30	15
	More than 2,00,000	21	10.5
	Prefer not to say	40	20
Treatment / Service Received	General Consultation	94	47
	Surgery	5	2.5
	Physiotherapy	10	5
	Telemedicine / Online Consultation	12	6
	Health Education / Awareness Session	24	12
	Pain Management Therapy	5	2.5
	Other	2	1
	None	48	24
Use of Immersive Tools	Yes	34	17
	No	128	64
	Not sure	38	19

Source: Researcher's own work

The final patient sample consisted of 200 valid responses that were retained for analysis. The final sample exhibited a relatively balanced gender distribution and diverse age, education, and income profiles. Only a minority of patients reported direct exposure to immersive technologies during treatment, with virtual reality and three-dimensional visualizations being the most commonly experienced tools.

4.2 Awareness and Exposure to Immersive Technologies in Healthcare

This section presents descriptive statistical findings on awareness and exposure to immersive technologies among doctors and patients. The analysis is based on frequency and percentage distributions derived from the cleaned dataset and summarized in Table 5 (Doctors) and Table 6 (Patients).

Among doctors, the results indicate a generally high level of awareness regarding immersive technologies in healthcare. As reported in Table 5, 85% of respondents demonstrated at least basic familiarity, with 34% indicating clear awareness and 51% reporting partial awareness. Only 15% of doctors reported no awareness, suggesting that immersive technologies are increasingly recognized within clinical environments, even if not yet fully understood.

However, awareness does not translate proportionally into practical exposure. The distribution of responses shows that active use remains limited, with only 17% of doctors reporting direct involvement in using immersive technologies for patient care or training purposes. A larger proportion (51%) reported having observed the use of such technologies by colleagues, while 32% had neither used nor observed immersive technology in clinical contexts. This gap between awareness and hands-on use highlights the early stage of adoption within healthcare settings.

Patient-related findings, presented in Table 6, reveal an even lower level of direct exposure. Descriptive analysis shows that only 17% of patients reported experiencing immersive tools during treatment, whereas 64% reported no exposure, and 19% were uncertain. The presence of uncertainty among nearly one-fifth of respondents indicates that immersive elements may sometimes be embedded in clinical interactions without being explicitly identified or explained to patients.

Further examination of the subset of patients who reported exposure provides insight into the types of immersive technologies currently in use. As shown in Table 6, virtual reality headsets (32.4%) and three-dimensional animations or visualizations (29.4%) emerged as the most frequently experienced tools. Other modalities, such as interactive applications, simulation-based demonstrations, touchscreen kiosks, and virtual walkthroughs, were reported less frequently, suggesting selective and situational deployment rather than standardized use.

Overall, the descriptive statistical patterns presented in Tables 5 and 6 indicate that while immersive technologies are increasingly visible within healthcare environments, their application remains uneven and limited in scope, particularly from the patient perspective. These findings establish an empirical foundation for examining how immersive technologies influence communication quality, patient engagement, and shared decision-making, which are explored in subsequent sections.

4.3 Perceived Impact on Communication, Engagement, and Shared Decision-Making

This section presents descriptive statistical results examining perceptions regarding the impact of immersive technologies on doctor-patient communication, patient understanding, engagement, and shared decision-making, alongside key constraints influencing their adoption. The analysis is based on aggregated Likert-scale responses obtained from doctors and patients and summarized using frequency and percentage distributions.

Patient perceptions regarding the experiential impact of immersive technologies are presented in Table 7 below.

Table 7. Perceived Impact of Immersive Technologies on Engagement – Patients

Perception Dimension	Agree	Neutral	Disagree
Improved understanding of condition	79.4%	17.6%	3.0%
Helped understand treatment options	76.5%	20.6%	2.9%
Made consultation more engaging	82.4%	14.7%	2.9%
Increased confidence in decisions	73.5%	23.5%	3.0%
Improved interaction with doctor	78.0%	19.0%	3.0%

Source: Computed from Patient Analysis

Patients who used immersive technologies have reported mostly favorable results, as seen in Table 7 above. The expansive majority (79.4%) responded that immersive tools enhanced their knowledge of their health conditions and treatment alternatives that are available (76.5%). Notably higher acceptance was established in engagement-related results where 82.4% of the respondents acknowledged that immersive technologies have increased their level of engagement during discussions with healthcare providers.

Patient confidence and interaction also exhibited favorable trends, with agreement levels exceeding 70% across dimensions. The invariably low disagreement rates (approximately 3%) conveyed that immersive technologies are well adopted by the patients when implemented in healthcare settings, reinforcing their promising role in patient-centered care.

While patients reported strong perceived benefits, doctor perceptions demonstrates important contextual constraints that influence the extent to which immersive technologies can be integrated into routine clinical practice. These findings are summarized in Table 8 below.

Table 8. Perceived Barriers to Adoption of Immersive Technologies – Doctors

Barrier Dimension	Strongly Agree / Agree	Neutral	Strongly Disagree/ Disagree
High implementation cost	93.40%	5.00%	1.60%
Time constraints in practice	86.70%	11.70%	1.60%
Need for specialized training	81.70%	15.00%	3.30%
Ethical and privacy concerns	80.00%	16.70%	3.30%
Lack of institutional readiness	33.3% (Agree)	25.00%	41.7% (Disagree)

Source: Computed from Doctor Analysis

As indicated in Table 8, cost emerged as the most significant barrier, with over 93% of doctors agreeing that implementation costs hinder adoption. Time constraints (86.7%) and training requirements (81.7%) were also widely acknowledged, highlighting operational challenges in busy clinical environments.

Ethical and privacy concerns were highlighted by 80% of the respondents, underlining the importance of governance frameworks and preventive measures alongside technological integration. Institutional readiness showed mixed perceptions, with only 41.7% of doctors perceiving their institutions as adequately equipped, reflecting variability across healthcare settings.

The findings from Tables 7 and 8 together, represents a clear contrast between perceived patient-level benefits and system-level constraints. While immersive technologies are strongly associated with improved communication, engagement, and shared decision-making from the patient perspective, their broader adoption is highly impacted by financial, operational, ethical, and institutional challenges identified by doctors.

This integrated interpretation reinforces the role of immersive technologies as communication-enabling tools whose effectiveness is contingent upon contextual readiness, thereby aligning empirical findings with the study's conceptual framework.

4.4 Conceptual-Empirical Model Integration

Figure 4 below represents the conceptual-empirical model developed based on the descriptive findings of the study. The model illustrates how immersive technologies are perceived to influence doctor–patient interaction from both patient and doctor perspectives.

From the patient perspective, immersive technologies are associated with improved communication quality, better understanding of medical conditions and treatment options, and higher levels of engagement during clinical consultations. These factors collectively support shared decision-making, as patients feel more informed and confident when participating in healthcare decisions.

From the doctor perspective, adoption barriers such as high implementation costs, time constraints, training requirements, and ethical or privacy concerns influence the extent to which immersive technologies can be integrated into routine practice. These barriers act as contextual constraints that may limit the consistent use of immersive tools despite their perceived benefits.

The model does not imply causal relationships but demonstrates alignment between the proposed hypotheses and the descriptive empirical evidence obtained in this study. It provides a structured representation of how immersive technologies can enhance patient-centered communication while being shaped by organizational and operational factors.

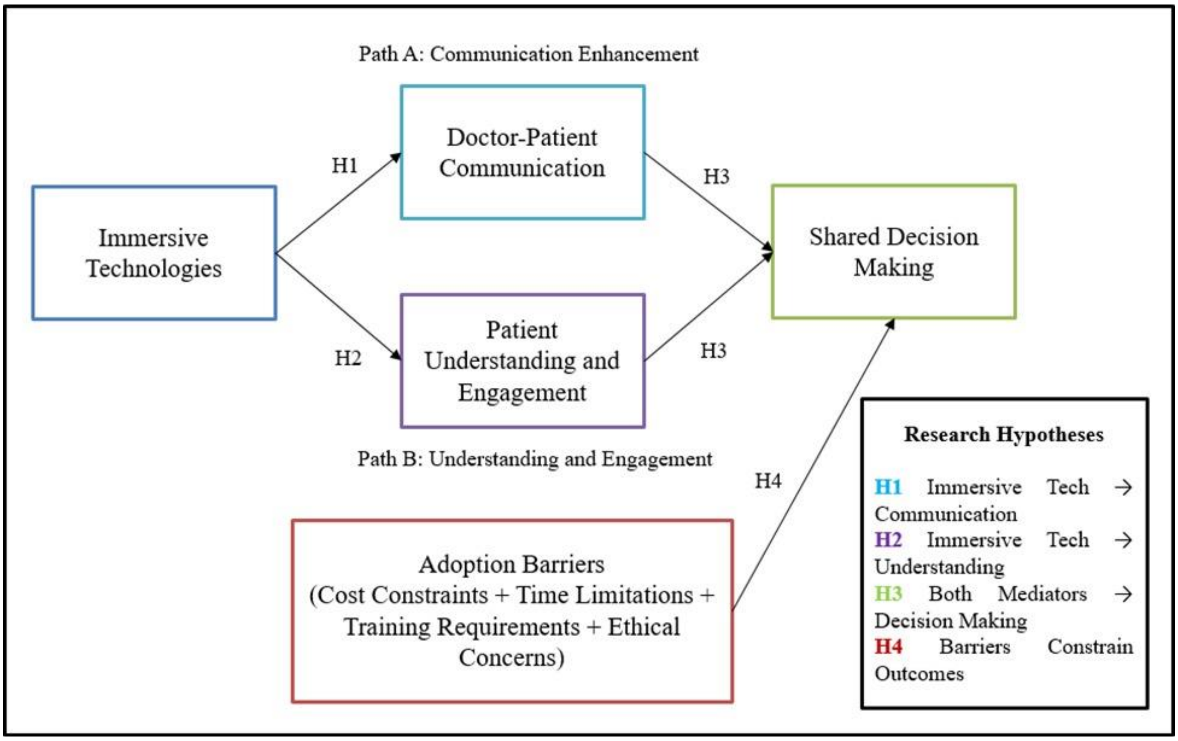

Figure 4. Conceptual Model of Immersive Technologies in Doctor-Patient Interaction

Source: Researcher's own work

Figure 4 above illustrates the conceptual-empirical model developed from the descriptive findings of this study. Immersive technologies represent the primary enabling factor influencing doctor-patient interaction. As shown, immersive technologies are associated with improved doctor-patient communication (H1) and enhanced patient understanding and engagement (H2). These improvements collectively support shared decision-making during clinical consultations (H3). However, the effective integration of immersive technologies is influenced by adoption barriers identified by doctors, including cost, time constraints, training requirements, and ethical concerns, which act as contextual constraints on shared decision-making outcomes (H4).

5. DISCUSSION

This study examines how immersive technologies are perceived to influence doctor-patient communication, patient engagement, and shared decision-making from a dual-stakeholder perspective, while also identifying significant constraints that affects the adoption of immersive technology in healthcare settings. By integrating patient-reported experiential outcomes with doctor-reported adoption barriers, the findings offer a balanced understanding of both the potential and the practical limitations of immersive technologies in clinical contexts.

5.1 Interpretation of Key Findings

The findings indicate a clear divergence between perceived experiential benefits and implementation-related constraints. From the patient perspective, immersive technologies were strongly associated with improved understanding, engagement, and confidence during clinical consultations. High agreement levels across communication- and engagement-related dimensions suggest that immersive tools function as effective facilitators of information exchange and interaction quality. These outcomes align with patient-centered care principles, which emphasize informed participation and collaborative decision-making.

In contrast, doctor responses highlighted significant systemic and operational barriers that shape the feasibility of integrating immersive technologies into routine practice. Despite relatively high awareness levels among doctors, actual usage remained limited. This gap between awareness and application underscores that perceived usefulness alone is insufficient to drive adoption in healthcare environments characterized by time pressure, resource constraints, and ethical accountability.

5.2 Discussion of Hypotheses

The descriptive findings provide conceptual and empirical alignment with the hypotheses proposed in this study.

H1, which proposed an association between immersive technologies and improved doctor-patient communication, is supported by patient-reported improvements in interaction quality and consultation engagement. Enhanced visual explanations and interactive elements appear to facilitate clearer communication, especially in explaining complex medical procedures.

H2, suggesting that immersive technologies enhance patient understanding and engagement, is strongly supported by high patient agreement regarding improved comprehension of medical conditions and treatment options. These findings suggest that immersive tools may reduce information asymmetry between doctors and patients, thereby enabling more meaningful participation during consultations.

H3, which proposed that improved communication and engagement support shared decision-making, is also descriptively supported. Elevated confidence levels reported by patients indicate that immersive technologies contribute not only to understanding but also to patients' readiness to participate in healthcare decisions. This reinforces the role of communication quality as a critical pathway linking technology use to participatory outcomes.

H4, which addressed perceived barriers to adoption, is clearly reinforced by doctor responses. High agreement regarding cost, time constraints, training requirements, and ethical concerns suggests that organizational readiness and institutional support play a decisive role in determining whether immersive technologies can be sustainably integrated into clinical workflows.

Together, these findings validate the conceptual-empirical model presented in Figure 4, demonstrating alignment between theory-driven expectations and observed perceptual patterns without implying causal relationships.

5.3 Comparison with Prior Literature

The results are consistent with prior research highlighting the communicative and educational value of immersive technologies in healthcare. Previous studies have emphasized the role of immersive visualization in enhancing patient comprehension, engagement, and satisfaction, particularly in complex or anxiety-inducing clinical scenarios. The present findings extend this literature by empirically demonstrating similar perceptions across a broader patient sample and by explicitly linking these outcomes to SDM.

At the same time, the prominence of cost, training, and ethical concerns among doctors aligns with existing literature on digital health adoption, which consistently identifies organizational readiness and resource availability as critical determinants of implementation success. The mixed perceptions regarding institutional readiness observed in this study further support calls in the literature for structured implementation frameworks, governance guidelines, and targeted capacity-building initiatives.

By combining patient-level benefits from their experience with doctor-level adoption constraints, this study contributes a more integrated perspective than studies focusing on a single stakeholder group.

5.4 Theoretical Implications

From a theoretical standpoint, the study reinforces communication-centered models of digital health adoption by demonstrating that immersive technologies operate primarily through relational and cognitive mechanisms rather than purely technical ones. The findings support frameworks that position communication quality, understanding, and engagement as mediating processes linking technology use to shared decision-making outcomes.

Furthermore, the results underlines the importance of contextualizing technology acceptance models within healthcare-specific constraints. The inclusion of adoption barriers in the conceptual-empirical model emphasizes that technology effectiveness is shaped not only by perceived benefits but also by institutional and ethical environments.

5.5 Practical Implications

The results have numerous practical implications for healthcare institutions, healthcare providers and policymakers. First, the strong patient-reported benefits indicates that immersive technologies can be strategically deployed to enhance communication in consultations, where complex
diagnoses, treatment planning, or patient education are involved. This integration helps patients to understand and comprehend the treatment and outcomes. Second, the barriers identified in this study recommends the need for investment in training, workflow integration, and ethical governance by the healthcare institutions to support enhanced adoption.

Healthcare providers and administrators can consider implementation strategies in multiple phases, pilot programs, and interdisciplinary collaboration to stabilize this transformation with operational attainability. Transparency in communication with patients regarding the use and purpose of immersive tools may also reduce uncertainty and prepare them well for the adoption and implementation.

5.6 Summary of Discussion

Comprehensively, the discussion concludes that immersive technologies hold considerable promise for enhancing doctor-patient communication and SDM, as perceived by patients. However, their effective integration into healthcare practice is dependent upon addressing systemic barriers identified by doctors. By presenting a dual-stakeholder perspective, this study provides an understanding of immersive technology adoption that bridges experiential outcomes and institutional realities.

6. CONCLUSION AND FUTURE RESEARCH

6.1 Conclusion

This study explored the role of immersive technologies in doctor-patient interaction by examining awareness, exposure, perceived benefits, and adoption constraints from both patient and doctor perspectives. Using descriptive statistical analysis of survey data collected from healthcare providers and patients, this study contributes empirical insight into how immersive technologies are at present perceived and experienced within healthcare settings.

The findings demonstrate that immersive technologies are strongly correlated with improved patient understanding, engagement, and confidence during medical procedures. Among the respondents, patients who have reported exposure to immersive tools, they perceived consultations as more engaging and interactive, with clearer communication of medical conditions and available treatment alternatives. These results demonstrate the benefits of immersive technology as a tool for improving communication that is consistent with patient-centered care and SDM.

Conversely, the study also highlights a substantial gap between perceived benefits and practical implementation. While doctors demonstrated relatively high levels of awareness, actual use of immersive technologies in routine clinical practice remained limited. Key barriers identified include high implementation costs, time constraints, the need for specialized training, and ethical and privacy concerns. Institutional readiness emerged as an additional contextual factor, with mixed perceptions across healthcare settings.

By integrating patient-reported experiential outcomes with doctor-reported adoption barriers, the study presents a balanced and realistic perspective on immersive technology use in healthcare. The conceptual-empirical model developed in this research demonstrates alignment between theoretical expectations and descriptive empirical evidence, illustrating how immersive technologies may enhance communication and shared decision-making while being shaped by organizational and operational constraints. Importantly, the study does not claim causal relationships but rather highlights perceptual and contextual associations.

6.2 Contributions of the Study

This research makes several contributions to the existing literature on digital and immersive technologies in healthcare. First, it contributes empirical evidence from a dual-stakeholder perspective, addressing both patient experiences and doctor concerns within a single analytical framework. This approach provides a more comprehensive understanding than studies focusing on only one group.

Second, the study extends conceptual discussions of immersive technologies by linking them explicitly to communication quality, engagement, and shared decision-making rather than focusing solely on technical performance or clinical outcomes. The inclusion of adoption barriers within the conceptual-empirical model further strengthens its practical relevance.

Third, the study offers context-specific insights into the early-stage adoption of immersive technologies, highlighting the uneven and selective nature of their use in healthcare environments. These findings are particularly valuable for healthcare administrators and policymakers seeking to balance innovation with feasibility and ethical responsibility.

6.3 Practical Implications

The findings suggest that immersive technologies have the potential to enhance patient-centered communication when applied strategically. Healthcare institutions may benefit from deploying immersive tools in scenarios where patient understanding and engagement are critical, such as treatment planning, informed consent discussions, rehabilitation education, and health awareness sessions.

At the same time, addressing adoption barriers is essential for sustainable integration. Investment in training programs, workflow adaptation, and ethical governance frameworks can support more effective use of immersive technologies. Clear institutional guidelines and patient communication regarding the purpose and use of immersive tools may further enhance acceptance and trust.

6.4 Limitations of the Study

Despite its contributions, this study has certain limitations that should be acknowledged. The analysis is based on self-reported perceptions, which may be subject to response bias or variations in individual interpretation. The cross-sectional nature of the data limits the ability to assess changes over time or establish causal relationships.

Furthermore, only a minority of patients and doctors reported direct exposure to immersive technologies, which may influence the generalizability of experiential findings. The study also relied primarily on descriptive statistical analysis, which, while appropriate for exploratory research, limits inferential conclusions.

6.5 Directions for Future Research

Future research can build upon these findings in several ways. Longitudinal studies may help examine how perceptions and adoption patterns evolve as immersive technologies become more widely implemented. Experimental or quasi-experimental designs can further explore the mechanisms through which immersive technologies influence communication and decision-making outcomes.

Further studies may also investigate the role of moderating factors such as age, education, clinical specialty, and digital literacy in shaping both patient and doctor perceptions. Qualitative research, including interviews or focus groups, could provide deeper insight into experiential nuances and ethical considerations that are not fully captured through survey methods.

Finally, future research can integrate advanced analytical techniques, such as structural equation modeling or multivariate regression analysis, to test the relationships proposed in the conceptual model more rigorously, while maintaining sensitivity to the ethical and contextual complexity of healthcare environments.

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