A Study on the Intention of Dental Medical Device Acceptance of Dental Workers in the 4th Industrial Revolution

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"주의 약속은 어떤이의 더디다고 생각하는 것 같이 더딘 것이 아니라 오직 너희를 대하여 오래 참으사 아무도 멸망치 않고 다 회개하기에 이르기를 원하시느니라." 벧후 3:9

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ABSTRACT

A Study on the Intention of Dental Medical Device Acceptance of Dental Workers in the 4th Industrial Revolution

This study aims to empirically identify the key factors determining the intention of dental professionals to adopt medical devices applied with 4th industrial revolution technologies through the UTAUT model and to examine the mediating effect of trust in the relationships among these factors. For this purpose, a survey was conducted among dental professionals located in the metropolitan area of South Korea. from the 20th of September to the October 11th 2024, and 232 participants survey were used for the final analysis after excluding 9 insincere respondents. The survey results were analyzed using the SPSS 28.0 statistical program. First, among the adoption factors, performance expectancy (β=0.315), effort expectancy (β=0.236), and social influence (β=0.227), in that order, had a significant positive effect on trust. Second, trust was found to have a significant positive effect on the intention to adopt. Third, among the adoption factors, social influence (β=0.348), effort expectancy (β=0.327), and performance expectancy (β=0.147), in that order, had a significant positive effect on the intention to adopt. Fourth, in the relationship between adoption factors and the intention to adopt, the mediating effects of performance expectancy effect=0.0993, effort expectancy effect=0.0877, and social influence effect=0.0757 were confirmed. This study is significant in that it empirically verifies the intention to adopt 4th industrial revolution dental medical devices and elucidates the mediating effect of trust. However, as the research participants were limited to dental professionals located in the metropolitan area, caution is needed when generalizing the results. Therefore, future research needs to include dental professionals located outside the metropolitan area to ensure geographic diversity and enhance the generalizability of the results.

Keywords: 4th Industrial Medical devices, Dental Medical Devices Technology, Intention to introduce, Medical Technology, UTAUT

1. Introduction

1.1 Background and Purpose

The medical device industry leads a paradigm shift with the convergence of the Internet of Things, AI, biotechnology, nanotechnology, big data, and medical technologies in the rapid advancements of the Fourth Industrial Revolution amid an aging population, the emergence of new viruses, and growing fears of various diseases (Biotechnology Research Center, 2017). In South Korea, the medical device market size reached 12,883.1 billion won in 2021, marking a 27.1% increase from 2020, and the average annual growth rate from 2017 to 2021 was 22.5%, which means the production scale continued to grow (Press Release by the Ministry of Food and Drug Safety, 2022).

The rapid growth of the medical device industry and market size contributes to advancing medical technologies, which lay significant foundation for improving the quality of human life. Recently, along with the advancement of Fourth Industrial Revolution technologies, various innovative medical devices have been developed. The effective use of such technologies is expected to enhance treatment efficacy for patients and improve the quality of medical services. These technologies, which include digital imaging, 3D printing, robotic surgical devices, and artificial intelligence (AI), play a crucial role in enhancing the quality of healthcare services and enabling personalized treatment.

In the dental field, the Fourth Industrial Revolution drives innovative changes through the integration of various advanced technologies that improve the quality of care and facilitate personalized treatment (Song & Kim, 2017). Advanced technologies include digital imaging, 3D printing, robotic surgical devices, and artificial intelligence (AI) (JS & Ahn HC, 2019). Digital imaging and analysis tools play a vital role in dental care. Devices such as digital X-rays, Cone Beam CT (CBCT), and intraoral cameras enable more precise diagnostics. Imaging analysis tools combined with AI provide crucial information for accurately diagnosing diseases and establishing treatment plans. 3D printing technology has brought about revolutionary changes in the dental field. This technology allows for the rapid and customized production of prosthetics, implant guides, and orthodontic devices, contributing to reduced treatment times and increased accuracy of outcomes. The introduction of robotic surgical devices offers high precision and stability in complex dental surgeries. In particular, the assistance of robots in accurately placing implants at the correct positions and angles can lead to shorter recovery times and improved surgical outcomes for patients. The application of AI technology spans various areas of dental care,

including diagnostic support, treatment planning, and patient management. AI can predict diseases and suggest the most effective treatment methods by learning from large medical Data and can provide personalized treatment information by analyzing patient records. Thus, the introduction of Fourth Industrial Revolution technologies increases the accuracy and efficiency of dental care processes and expands the possibilities for personalized treatment. With ongoing technological advancements, the future of the dental field is expected to evolve in more Innovative directions.

Regarding the successful introduction and utilization of innovative medical devices incorporating these Fourth Industrial Revolution technologies, it is necessary to take into account not only technical aspects but also medical staff's intention to accept them. This is because each one of medical staff has different levels of adaptability to new technologies and may fail to recognize the usefulness and convenience of innovative medical devices positively. Such situations can become barriers to the utilization of already introduced innovative medical devices or delay the adoption of future ones in healthcare institutions. Therefore, in order to enhance the understanding of the successful introduction and utilization of innovative medical devices, it is essential to consider not only technical aspects but also medical staff’s intention to accept them. The Unified Theory of Acceptance and Use of Technology (UTAUT) model, a representative theory of technology acceptance, provides a theoretical framework that helps identify and analyze the influential factors on technology acceptance. Thus, it can explain medical staff's intention to accept innovative medical devices. Nevertheless, previous studies on medical staff's technology acceptance have focused on wearable healthcare devices (JS, 2020), healthcare apps (Bae YI, 2020), medical information systems (Choi SR et al., 2022), and mobile healthcare services (Jo SR, Jeong SC, 2022) from consumer perspectives. Up to now, research on medical staff's intention to accept innovative medical device products has been quantitatively insufficient. Therefore, it is meaningful to explore medical staff’s intention to accept advanced and high-tech innovative medical devices at this time.

In the meantime, trust has been reported as a crucial factor in promoting the introduction of new medical equipment in various fields (Jin JH, Kim MJ, 2017). Trust in medical devices enables medical staff to have confidence in the performance, safety, and effectiveness of these devices. If medical staff trust innovative medical devices, they are likely to have assurance in their performance, safety, and effectiveness, reduce risk perception, and thereby use and introduce these devices actively. Accordingly, trust can be viewed as a precursor that influences the active use, introduction, and acceptance of innovative medical devices.

Therefore, this study aims to empirically identify the key factors determining dental medical staff's intention to accept medical devices that incorporate Fourth Industrial Revolution technologies by using the UTAUT model. Additionally, it will examine the mediating effect of trust in the relationships among these factors.

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1.2. Contents and Scope

The purpose of this study is to empirically identify the key factors determining dental medical staff's intention to accept medical devices that incorporate Fourth Industrial Revolution technologies and to examine the mediating effect of trust in the relationships among these factors.

This paper is structured into five chapters.

Chapter 1, the introduction, addresses the background and purpose of this study, and discusses the importance of Fourth Industrial Revolution technologies in the current medical device field and the issues arising in technology acceptance.

Chapter 2, the theoretical review, explains the interaction between Fourth Industrial Revolution technologies and medical devices, and introduces the UTAUT model, an important theoretical framework for technology acceptance. This model presents four key constructs to explain users' technology acceptance: performance expectancy, effort expectancy, social influence, and facilitating conditions. Additionally, it introduces the concept of trust to analyze how trust in medical devices affects users' acceptance.

Chapter 3, the research method, describes the practical procedure of this study. It includes the selection of survey participants, data collection methods, the establishment of the research model, and hypothesis formulation, as well as details about the measurement tools used and the analysis methods.

Chapter 4, the research results, presents the findings of hypothesis testing based on the collected data. The results include those from the analysis on the general characteristics of the study participants, the reliability and validity testing of the measurement tools, descriptive statistics and correlation analysis. This chapter interprets the results focusing on the technology acceptance factors through the UTAUT model and the influence of trust on medical devices and verifies the reliability and validity of the introduction intention additionally.

Chapter 5, the discussion and conclusion, draws theoretical and practical implications based on the research results, and discusses the limitations of the study and the directions for future research.

2. Theoretical Considerations

2.1. Fourth Industrial Revolution Technologies and Medical Devices

The medical device industry is on the Continuous growth through the integration of various scientific and technological fields. Based on clinical medical knowledge, technologies such as electrical and electronic engineering, mechanical engineering, materials science, and optics are being integrated to enhance the functionality and performance of medical devices. This convergence increases the complexity of products and leads to more innovative medical devices. In particular, advanced technologies that require high levels of technical integration, such as information and communication technology (ICT), biotechnology, and robotics, have been applied to medical devices, resulting in significantly improved safety and efficacy compared to previous generations of medical devices and treatments. For example, robotic surgical systems enable precise surgeries, shorten patient recovery times and reduce the risk of complications during surgery. Additionally, medical devices integrated with wearable technology allow for real-time monitoring of patients' health status and data analysis, and thereby help medical staff establish more accurate diagnoses and efficient treatment plans. These innovative medical devices overcome existing limitations and open new possibilities for treatment. In South Korea, these advanced medical devices are defined as 'innovative medical devices,' as stated in Article 2 (4) of the Act on Nurturing Medical Devices Industry and Supporting Innovative Medical Devices. According to the legal definition, innovative medical devices refer to those that have shown or are expected to show noticeable improvements in safety and efficacy compared to existing products or treatments. This framework allows the medical device industry to achieve more systematic development and provides opportunities to offer enhanced medical services to a larger number of patients.

The medical device industry rapidly advances through technological innovations, among which the applications of 3D printing and robotics are particularly noteworthy. 3D printing technology plays a significant role in providing customized solutions in the medical field. This technology enables the precise production of patient-specific artificial joints and dental Implants and contributes to increased surgical accuracy and reduced recovery times. For example, by producing custom-fitted artificial bones with the use of a 3D printer, it is possible to expect higher prevention of complications and better functional recovery than conventional standardized implants (Lee JS, 2022).

The advancement of robotic technology also plays a crucial role in the medical device sector. The importance of robotic-assisted surgery is especially emphasized in surgical procedures requiring high precision. Surgery using robotic arms minimizes a surgeon's hand tremors, supports very intricate maneuvers, reduces a patient’s recovery times and lowers the risk of postoperative complications. Additionally, the introduction of robotic technology in the field of rehabilitation devices provides personalized rehabilitation programs that aid faster functional recovery. For instance, robot-assisted gait trainers analyze patients' walking patterns and provide tailored training, and thus contribute to improving mobility in stroke patients. Recently, the concept of software as a medical device (SaMD) newly emerges (Han GY et al., 2022).

This refers to software products that utilize artificial intelligence and big data to assist in diagnoses or improve patient management. For example, AI-based imaging diagnostic software analyzes diagnostic images with the use of vast databases, detects subtle changes and thereby improves diagnostic accuracy. Such software helps medical staff make more accurate diagnoses and plays an important role in suggesting personalized treatment plans based on the information gained from big data analysis. As such, the combination of these innovative technologies increases the effectiveness of diagnosis and treatment in the medical device industry, enables optimized care for individual patients and overall improves the quality of medical services. These technological Advancements make the future of the medical device industry bright and attract more investment in research and development in this field.

When innovative medical devices are introduced, they often apply technologies that are entirely different from existing products, which can lead to confusion in the medical service setting. Medical devices that integrate new technologies require medical staff to adapt to unfamiliar functions or operating methods, making it difficult for them to use these devices initially. For example, the introduction of highly automated diagnostic equipment or robotic surgical devices often necessitates specialized training and requires medical staff to acquire advanced skills they have not previously used. Furthermore, medical devices with new technologies can cause medical staff’s resistance or uneasiness since they are quite different from established treatment methods or procedures. Such feelings can act as significant barriers to medical staff’s acceptance of new technologies and, as a result, may limit patient access to innovative products that are needed. The uneasiness and resistance of medical staff can increase, particularly when there is a lack of confidence in the safety and effectiveness of treatments, which can negatively impact the treatment outcomes of patients.

To address these issues, medical staff, medical institutions, and manufacturers should cooperate to introduce new medical devices to medical institutions quickly and safely. Medical institutions should provide appropriate training and education to staff to enhance their understanding of new devices and ensure they are familiar with their usage. Manufacturers need to supply sufficient clinical data to prove the safety and effectiveness of medical devices and continuously improve the devices based on user feedback. Additionally, medical institutions and manufacturers should offer regular training sessions, workshops, and hands-on opportunities to help medical staff utilize new technologies with confidence.

2.2. UTAUT Model

2.2.1 Definition of UTAUT

It is essential to examine consumer acceptance factors in response to newly developed information Technologies for the stable advancement of these technologies. The Unified Theory of Acceptance and Use of Technology (UTAUT) is currently the most widely applied theory in research on user acceptance factors. This theory, proposed by Venkatesh et al. (2003), integrates several existing theories related to information technology acceptance.

The UTAUT model is composed of eight representative information technology acceptance models: The Theory of Reasoned Action (TRA), Technology Acceptance Model (TAM), the combined model of TAM and TPB (OTAM-CBT), Theory of Planned Behavior (TPB), Motivational Model (MM), Model of PC Utilization (MPCU), Innovation Diffusion Theory (IDT), and Social Cognitive Theory (SCT). Each of these models explains the technology acceptance process from specific perspectives, collectively providing a more comprehensive understanding.

The UTAUT model offers higher explanatory power in predicting user technology acceptance than previous models. It explains user technology acceptance by focusing on four main constructs: performance expectancy, effort expectancy, social influence, and facilitating conditions. Aside from that, variables such as age, gender, experience, and voluntariness interact with these factors to analyze the degree of Technology acceptance in detail.

The UTAUT introduced four key variables by complementing perceived usefulness (PU) and perceived ease of use (PEOU) as variables of the TAM. The four key variables are: performance expectancy, effort expectancy, social influence, and facilitating conditions. Performance expectancy and effort expectancy expand on the concepts addressed in the TAM, reflecting the outcomes users expect from accepting Technology and the efforts required to use it. Performance expectancy refers to the degree of improvement in performance that a user can accomplish by using a Specific technology. Effort expectancy refers to users' expectation of how easy it will be to use the system.

Social influence reflects how users perceive the opinions of others, whom they consider important, regarding the use of technology. It explains the extent to which the attitudes or opinions of those around users affect their decision to accept technology. Facilitating conditions represent the presence or absence of organizational or technical support necessary for users to use a Technology. When users feel that the support is sufficient, they can accept and use the technology more easily.

Additionally, the UTAUT model analyzes various aspects of technology acceptance more intricately through moderating variables such as demographics, experience, and voluntariness. Demographic characteristics, such as age and gender, show how they impact technology acceptance intention and use behavior. For instance, younger generations are likely to accept and use technology more rapidly, while older adults may require more support and encouragement for Technology acceptance. Voluntariness reflects the degree of users' voluntary intentions to use a Technology, and experience refers to the extent to which users have engaged with the technology. All of them significantly influence technology acceptance and use behavior.

Research on technology acceptance has evolved along with the rapid growth of information technology and the increasing necessity for diverse technological applications. The initial Technology Acceptance Model (TAM) was developed to explain users' intentions to accept the use of Computer, and its validity has been supported by various studies. However, the model has faced criticism for Insufficiently considering external variables (Yoo JH & Park C, 2010). Accordingly, researchers modified the existing UTAUT model and tried to enhance the model's explanatory power by adding environmental factors that trigger technology use, such as habits, price value, and hedonic motivation (Venkatesh et al., 2012; Wang & Scheepers, 2012). This extended technology acceptance model (ETAM) aims to enhance explanatory power not only regarding the technology itself but also concerning user characteristics and non-work-related use intentions (Venkatesh & Davis, 2000). This

more refined and detailed model has improved the understanding of consumers' intentions to accept information technology.

What matters most in the process of accepting a Technology is how much users can trust and use the technology. This trust plays a crucial role in reducing the risks users perceive when they accept a new Technology. Trust refers to the attitude of the trusting party, who becomes vulnerable to the trusted entity based on the expectation that the entity will take important actions. This concept can be understood in relation to individuals' intentions or behaviors during transactional processes (Gefen, 2000; Mayer et al., 1995).

2.2.2. Constructs

(1) Performance Expectancy

Performance expectancy can be seen as a concept similar to perceived usefulness in the TAM. It represents users' Expectation of improved job performance through the use of technology, which is particularly significant in the field of dental medical devices. For example, in the case where dentists introduce new dental equipment, their expectation that the equipment will enhance treatment efficiency and increase patient satisfaction indicates performance expectancy. This aligns with concepts such as external motivation, job fit, relative advantage, and outcome expectation. According to the study by Kim and Nam(2019), performance expectancy is one of the primary motivations for technology Acceptance and is evaluated based on the relative advantages and outcome expectation that technology can provide. In the case of dental medical devices, there are users' expectations that a new technology will enhance job performance by providing advantages, such as improved treatment accuracy or reduced procedure time. This performance expectancy serves as a critical basis in the decision-making process for introducing dental medical devices and is a key consideration in establishing strategies for the effective use of technology.

(2) Effort Expectancy

Effort expectancy is one of the Constructs of the TAM and represents users' perception of the ease of use of a system or technology. It refers to the degree of effort users expect in using the Technology and reflects the extent of the belief that they can achieve goals with the technology. Effort expectancy is defined by Lee HG and Han MS

(2019) as the extent of belief in the ease of use of a system or technology. It can be viewed as a concept very similar to the perceived ease of use in TAM. Effort expectancy includes the expectation that users will not have to exert much effort to use a system or Technology and indicates their belief that they can easily use it (Davis, 1989).

From the perspective of the use of dental medical devices, effort expectancy can be a very important factor. The ease of use of dental medical devices can vary depending on their technical complexity and users' experience. Therefore, medical staff evaluates effort expectancy in the process of learning and adapting to new devices. For instance, when a new dental implant system or diagnostic equipment is introduced, factors such as whether the equipment's interface is intuitive and user-friendly, whether the setup and operation of the equipment are straightforward and easy to understand, and whether the equipment has easy-to-access help features when needed are crucial determinants of whether users will accept and effectively use the technology. Additionally, the convenience of information technology plays an important role in using the equipment and helps users quickly learn and effectively use technology.

(3) Social Influence

Social influence) Social influence can be defined as the degree to which important people around users convey the feeling that users should adopt new information technologies (Venkatesh et al., 2003). For example, actions such as encouraging others to embrace a new system or perceiving it as a useful technology fall under this category. Lee JM (2005) distinguishes social influence into informational influence and normative Influence. Informational influence refers to the impact of accepting information obtained from others as evidence of reality. Normative influence means the pressure to comply with the expectations or requirements of others or the group to which one belongs. According to Hartwick & Barki (1994), subjective norms can have different impacts depending on the stage of innovation diffusion.

In the early diffusion stage, subjective norms have a significant influence on the intention to use. That is because the influence of reference groups plays a crucial role in forming the intention to use innovative technologies in the initial step. In the introduction and use of dental medical devices, social influence can also be an important factor. When new technologies are introduced in the dental field, sharing experiences among dentists or discussing the effectiveness of new devices is a form of informational influence. Additionally, recommendations from professional organizations or academic societies of

dentists regarding new treatment methods or devices can act as normative influence and thereby can motivate dentists to accept them. This social influence works more significantly in the initial stage where dental medical devices are newly introduced to the market. At this stage, the acceptance of these devices is heavily influenced by the social factor and contributes to effectively introducing and disseminating new technologies that can evaluate use fulness of these devices and enhance treatment quality.

(4) Facilitating Conditions

Facilitating Conditions) Facilitating conditions refer to the conditions that support users in using new technology. It is defined as the extent to which users believe that organizational and technological infrastructure exists to support the use of a system (Oh JC, 2015). It is known that these facilitating conditions can trigger positive attitudes toward technology acceptance when an organization takes an active attitude toward technology acceptance or provides intensive training on the technology to accept (Kim & Noh 2008). Particularly, these facilitating conditions are crucial in the dental medical device industry, and sufficient training and technical support are essential for the successful introduction and use of dental medical devices. In the initial stage of introducing new dental technologies, these facilitating conditions tend to have a significant impact on users' intention to use them.

Furthermore, when an organization is equipped with appropriate support systems and infrastructure, users are more likely to accept and effectively use technologies, which can enhance the overall technology acceptance rate. Therefore, institutions aiming to introduce dental medical devices must carefully consider these facilitating conditions and provide support to employees for the effective use of new technologies.

2.3. Trust

The concept of trust has been defined in various ways depending on the researchers and their approaches and is somewhat different from common understandings. Traditionally ‘trust’ has been considered an ambiguous and mysterious factor, and has frequently been confused with terms like confidence, reliance, expectation, and hope (Giffin, 1976). To clarify this confusion, Roter (1971) defined trust as a generalized expectancy that the words, promises, and oral, or written statements of others can be relied upon. In other words, trust is seen not just as a momentary emotion arising in specific

situations, but rather as a general attitude and feeling towards others.

Various scholars have defined trust in different ways. For instance, Johnson-George and Swap (1982) describe trust as “the willingness to take risks.” Larzelere and Huston (1980) define it as “the extent that a person believes another person (or persons) to be benevolent and honest.” Robinson (1966) defined trust as “the expectation, assumption, or belief that another person will not harm one's interests.” Mayer (1995) defined it as the “willingness of a party to be vulnerable to the action of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party." These definitions suggest that trust is not merely a generalized attitude but a specific attitude that arises depending on situations.

As such, trust can be defined in various ways by different researchers, but interpersonal trust typically encompasses three key elements.

First, trust requires interdependence between the trusting person (e.g., an employee) and the trusted person (e.g., a supervisor). Without this interdependence, it is hard to establish a trust relationship. For example, if an employee trusts a department head from another division rather than their own direct supervisor, it holds little significance. If the employee believes that his or her work is unrelated to the supervisor, there is no need for him or her to trust the supervisor at all. Thus, trust is a concept that cannot exist outside of individual social relationships.

Second, trust is grounded in uncertainty. Uncertainty occurs when one cannot determine the Probability distribution of gains and losses associated with specific alternatives. In the context of innovative dental medical devices, if there is insufficient information on the effectiveness or side effects of a new dental device, uncertainty increases and makes it hard to build trust.

Lastly, trust is formed at the time of accepting the vulnerability that may arise from the introduction of dental medical innovations. This vulnerability refers to the trustor’s subjective perception of the medical risk that can arise from the use of the device. Although vulnerability and risk are often used interchangeably, risk refers to the objective danger associated with the use of medical devices; vulnerability represents the degree of an individual’s subjective perception of that risk. Accepting the perceived risks that may arise from the use of dental medical devices stems from the expectation or belief that the

technology will function as intended (Lane, 1998).

Trust can be defined as an implicit expectation that based on a high level of belief and dependence on another party, their intentions or actions will not harm oneself. This concept has been a significant research topic across various fields, including management, sociology, economics, and social psychology. It generally refers to a belief in people or products and is considered to be a crucial element of consumer evaluation (Choi & Kim 2015). Particularly, trust, which is complex and is sometimes used as a comprehensive single dimension, is significant in the healthcare industry where innovative medical technologies and devices play a critical role (Aaker, 1990).

In the dental field, this is equally true; trust that medical staff have in innovative dental devices instills confidence in their performance and quality and leads to the medical staff's tendency towards their active use and introduction of the equipment. Trust in dental medical devices or systems directly influences medical staff's introduction and use of the equipment, which in turn enhances the quality and efficiency of medical services and contributes to increasing the competitiveness of dental institutions and improving patient satisfaction (Park JH & Kim JS, 2020). Therefore, dental medical institutions, medical staff, and device manufacturers should make continuous efforts to enhance trust in innovative dental equipment.

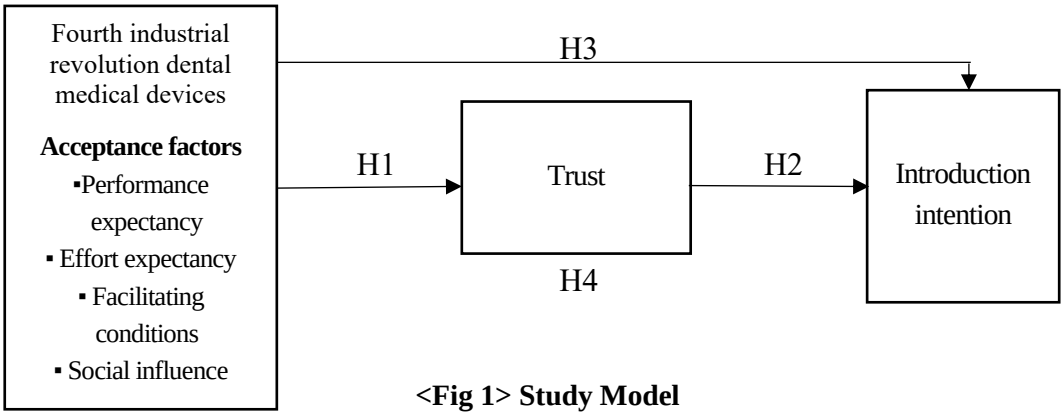
3. Research Method

3.1. Survey Participants and Data Collection

Survey Participants and Data Collection - A questionnaire survey was conducted with healthcare workers located in the metropolitan area of South Korea. Out of 241 respondents, 9 who provided insincere answers were excluded, and 232 participants were used for the final analysis. To comply with research ethics, participants were informed about the survey and provided their consent before taking part in the self-administered survey. Since no personal information was collected, the anonymity and confidentiality of the research participants were ensured.

3.2. Model and Hypothesis

As shown in <Fig 1>, the study model was design with UTAUT factors as independent variables, the intention to introduce as a dependent variable, and trust as a mediating variable.



<Fig 1> Study Model

Based on this model, the following hypotheses were derived

H1. The acceptance factors of Fourth Industrial Revolution medical devices will significantly and positively (+) influence trust.

H1-1. Performance expectancy will significantly and positively (+) influence trust.
H1-2. Effort expectancy will significantly and positively (+) influence trust.
H1-3. Facilitating conditions will significantly and positively (+) influence trust.
H1-4. Social influence will significantly and positively (+) influence trust.

H2. Trust in 4th industrial revolution dental medical devices will significantly and positively (+) influence the intention to introduce.

H3. The acceptance factors of Fourth Industrial Revolution medical devices will significantly and positively (+) influence the intention to introduce.

H3-1. Performance expectancy will significantly and positively (+) influence the intention to introduce.
H3-2. Effort expectancy will significantly and positively (+) influence the intention to introduce.
H3-3. Facilitating conditions will significantly and positively (+) influence the intention to introduce.
H3-4. Social influence will significantly and positively (+) influence the intention to introduce.

H4. Trust will have a mediating effect on the relationship between the acceptance factors of 4th industrial revolution dental medical devices and the intention to introduce.

H4-1. Trust will have a mediating effect on the relationship between performance expectancy and the intention to introduce.
H4-2. Trust will have a mediating effect on the relationship between effort expectancy and the intention to introduce.
H4-3. Trust will have a mediating effect on the relationship between facilitating conditions and the intention to introduce.
H4-4. Trust will have a mediating effect on the relationship between social influence and the intention to introduce.

3.3. Measurement Tools

Regarding the measurement tools for the UTAUT factors, the tools used by Koo JH (2021) and Heo JM (2022) (Cronbach's Alpha (α) > .700) were modified and supplemented and were finally designed with 4 items for each of the 4 sub-factors, or a total of 16 items. The trust measurement tool was adapted from Heo JM (2022) (Cronbach's α = .741) and consolidated into a single factor with 4 items. Regarding the intention to introduce factor the tool used by Heo JM (2022) (Cronbach's α = .781) was also modified to create a single factor with 4 items tailored for this study.

3.4. Analysis Method

The collected data were statistically processed with SPSS 28.0 and SPSS Macro 3.4. First, frequency analysis was conducted to find the general characteristics of the study participants, deriving frequencies and percentages.

Second, exploratory factor analysis (EFA) was performed to verify the validity and reliability of the items that were used to measure the acceptance factors of fourth industrial revolution dental medical devices (UTAUT), trust, and intention to introduce, and reliability analysis was carried out to calculate Cronbach's α coefficient.

Third, descriptive statistical analysis was conducted to find the levels of the acceptance factors, trust, and intention to introduce which were perceived by the participants, and to calculate means, standard deviations, ranges, skewness, and kurtosis.

Fourth, Pearson correlation analysis was performed to examine the correlations among the acceptance factors, trust, and intention to introduce for fourth industrial revolution dental medical devices. Fifth, multiple regression analysis was conducted to analyze the relationships among these variables, and the mediating effect of trust between the acceptance factors and intention to introduce was verified with the use of bootstrapping via SPSS Macro (Model 4).

4. Research Results

4.1. General Characteristics of the Study Participants

Regarding general characteristics, as shown in <Table 1>, the total number of respondents was 232, and the distribution based on general characteristics is as follows. By gender, there were 162 males (69.8%) and 70 females (30.2%). By age,104 respondents (44.8%) were in their 30s-40s, and 128 respondents (55.2%) were aged 50 and above. Regarding medical institution experience, there were 18 respondents (7.8%) with less than 3 years, 21 respondents (9.1%) with 3-5 years, 25 respondents (10.8%) with 5-7 years, 61 respondents (26.3%) with 7-9 years, and 107 respondents (46.1%) with over 9 years of experience. By hospital type, there were 171 respondents (73.7%) in private clinics, 25 respondents (10.8%) in hospital grade, 17 respondents (7.3%) in general hospitals, and 19 respondents (8.2%) in tertiary hospitals.

<Table 1> General Characteristics of the Study Participants(N=232)

Classification		**N**	**%**
Gender	Male	162	69.8
	Female	70	30.2
Age	30s-40s	104	44.8
	50s and above	128	55.2
Medical institution experience	Less than 3 years	18	7.8
	3-5 years	21	9.1
	5-7 years	25	10.8
	7-9 years	61	26.3
	Over 9 years	107	46.1
Hospital type	Private clinics	171	73.7
	Hospital Grade	25	10.8
	General hospitals	17	7.3
	Tertiary hospitals	19	8.2

4.2. Verification of Reliability and Validity of Measurement Tools

Verification of Reliability and Validity of Measurement Tools) To measure the validity and reliability of the measurement tools, exploratory factor analysis (EFA) and reliability analysis were conducted. First, factor analysis was performed with the use of orthogonal rotation (varimax) for the survey items of each variable. The criteria for factor extraction were set as an eigenvalue of 1.0 or higher and a factor loading of 0.5 or higher, and the items not exceeding 0.5 were removed in the factor analysis process. Reliability analysis was conducted for the items belonging to each factor, and reliability was verified with the use of Cronbach's alpha coefficient.

4.2.1. Reliability and validity of UTAUT Measurement Items

The Exploratory factor analysis <Table 2> on the 16 items of UTAUT was repeated. As a result, item 12 hindered the Validity, so it was excluded from the analysis. The KMO (Kaiser-Meyer-Olkin) value for assessing sampling adequacy was .932. The results of Bartlett's test of sphericity for factor analysis appropriateness indicated x^2=3021.759, D f=105, p<.001. These results confirm the appropriate use of factor analysis and indicate the existence of common factors. From the factor analysis, four factors were identified, and all items showed a factor loading of 0.5 or higher, which indicates sufficient validity. Additionally, reliability analysis revealed the following results: performance expectancy had a Cronbach's α of .940, effort expectancy had a Cronbach's α of .888, social influence had a Cronbach's α of .918, and facilitating conditions had a Cronbach's α of .887. All these values exceeded the reference value of 0.6, so the internal consistency of the measurement data was confirmed.

<Table 2> Reliability and Validity of UTAUT Measurement Items

Item	Factor loading			
	Performance expectancy	Effort expectancy	Social influence	Facilitating conditions
1. I think that Fourth Industrial Revolution medical devices will be more useful than existing systems.	.783	.328	.202	.191
2. I think that the introduction of Fourth Industrial Revolution medical devices will speed up	.780	.287	.275	.268

treatment processing.				
3. I think that the introduction of Fourth Industrial Revolution medical devices will improve the accuracy of treatment	.830	.331	.248	.159
4. I think that the introduction of Fourth Industrial Revolution medical devices will make patient interactions easier	.807	.284	.290	.248
5. I think I will easily adapt to the use instructions of Fourth Industrial Revolution medical devices.	.165	.796	.202	.194
6. I think that it will be easy to learn how to use Fourth Industrial Revolution medical devices.	.356	.725	.253	.192
7. I think that after the introduction of Fourth Industrial Revolution medical devices the number of patients will increase.	.287	.823	.117	.134
8. I think that the introduction of Fourth Industrial Revolution medical devices will improve the clinical environment.	.337	.753	.237	.111
9. I think that our medical institution has the necessary resources to introduce Fourth Industrial Revolution medical devices.	.257	.178	.307	.776
10. I think that our medical institution is well aware of the necessity of introducing Fourth Industrial Revolution medical devices.	.194	.135	.269	.827
11. I think that our medical institution can obtain expert assistance when using Fourth Industrial Revolution medical devices.	.208	.246	.376	.779
13. Patients think that our hospital will introduce Fourth Industrial Revolution medical devices.	.339	.318	.629	.268

14. Major partners will recommend that our institution introduce Fourth Industrial Revolution medical devices.	.231	.161	.813	.343
15. I think that patients are well aware of the advantages of Fourth Industrial Revolution medical devices.	.200	.197	.810	.336
16. Since other medical institutions introduce Fourth Industrial Revolution medical devices, I think that our institution should do the same.	.323	.279	.784	.261
Eigen Value	3.371	3.139	3.072	2.565
Variance Explanatory Power (%)	22.475	20.927	20.477	17.097
Cronbach's alpha	.940	.888	.918	.887

KMO=.932, Bartlett's test=3021.759(p<.001), D f=105

4.2.2. Reliability and Validity of Trust Measurement Items

According to the <Table 3> Exploratory factor analysis on the four items for trust, a KMO value of .805, and Bartlett's test of sphericity showed x^2=423.819 (D f =6, p<.001). These results support the appropriateness of the analysis and indicate the existence of common factors. One factor was extracted from the analysis, and all items showed a factor loading of 0.5 or higher, which indicates sufficient validity. The reliability analysis revealed a Cronbach's α of .852 for trust, which exceeds the reference value of 0.6. Therefore, the internal consistency of the measurement tool was confirmed.

<Table 3> Reliability and Validity of Trust Measurement Items

Item	**Trust** (Factor loading)
1. I think that Fourth Industrial Revolution medical devices will provide safe medical services	. 775
2. I think the technology of Fourth Industrial Revolution medical devices has high accuracy.	.785
3. I think that the technology of Fourth Industrial Revolution medical devices has no errors.	.878
4. I think that Fourth Industrial Revolution medical devices are reliable.	.895
Eigen Value	2.789
Variance Explanatory Power (%)	69.728
Cronbach's alpha	.852

KMO=.805, Bartlett's test=423.819(p<.001), D f=6

4.2.3. Reliability and Validity of Introduction Intention Measurement Items

According to the <Table 4> Exploratory factor analysis on the four items for the intention to introduce, the KMO value was .785, and Bartlett's test resulted in x^2=523.792, D f =6, p<.001. This confirms the appropriateness of the factor analysis and the existence of common factors. One factor was extracted, and all items showed a factor loading of 0.5 or higher, which indicates sufficient validity. Additionally, the reliability analysis revealed a Cronbach's α of .883 for the intention to introduce, which exceeds the reference value of 0.6. Therefore, the internal consistency of this measurement tool was confirmed.

<Table 4> Reliability and Validity of Introduction Intention Measurement Items

Item	**Introduction intention** (Factor loading)
1. I think that our medical institution will have the Introduction intention Fourth Industrial Revolution medical devices in the future.	.852
2. I think that our medical institution will strive to introduce Fourth Industrial Revolution medical devices in the future.	.876
3. I think that when Fourth Industrial Revolution medical devices are introduced, our medical institution will use them as a top priority.	.875
4. I think that the introduction of Fourth Industrial Revolution medical devices will encourage medical staff to actively use it in order for them to acquire new knowledge and adapt to their work.	.838
Eigen Value	2.962
Variance Explanatory Power (%)	74.042
Cronbach's alpha	.883

KMO=.785, Bartlett's test=523.792(p<.001), df=6

4.3. Descriptive Statistics and Correlation Analysis

Descriptive Statistics and Correlation Analysis, to understand the overall trends of the key variables, means, standard deviations, and ranges were examined. To assess the normality assumption, skewness and kurtosis were calculated. Typically, if the absolute value of skewness exceeds 3.0 or the absolute value of kurtosis exceeds 10.0, the normality assumption is considered to be not satisfied. As shown in <Table 5>, the given variables in this study met the normality assumption.

<Table 5> Descriptive Statistics of Major Variables

Variable		Mean	Standard deviation	Range	Skewness	Kurtosis
Acceptance factors of fourth industrial revolution medical devices (UTAUT)	Performance expectancy	3.57	0.96	1-5	-.408	-.149
	Effort expectancy	3.63	0.82	1-5	-.392	-.339
	Facilitating conditions	3.24	0.93	1-5	.002	-.662
	Social influence	3.35	0.91	1-5	-.323	-.221
Trust		3.49	0.85	1-5	-.217	-.457
Introduction intention		3.44	0.83	1-5	-.245	-.196

The results from the analysis of the correlations among all included variables are presented in <Table 6>. The UTAUT sub-factors, including performance expectancy ($r = .687$, $p < .001$), effort expectancy ($r = .640$, $p < .001$), facilitating conditions ($r = .565$, $p < .001$), and social influence ($r = .649$, $p < .001$), showed a positive correlation with trust. Performance expectancy ($r = .665$, $p < .001$), effort expectancy ($r = .689$, $p < .001$), facilitating conditions ($r = .606$, $p < .001$), and social influence ($r = .716$, $p < .001$) were positively correlated with the intention to introduce. Trust ($r = .752$, $p < .01$) had a positive correlation with the intention to introduce.

<Table 6> Correlation between Major Variables

Variable		UTAUT				Trust	Introduction intention
		Performance expectancy	Effort expectancy	Facilitating conditions	Social influence		
Acceptance factors of fourth industrial revolution dental medical devices	Performance expectancy	1					
	Effort expectancy	.693***	1	1			
	Facilitating conditions	.582***	.508***	1			
	Social influence	.666***	.598***	.723***	1		
Trust		.687***	.640***	.565***	.649***	1	
Introduction intention		.665***	.689***	.606***	.716***	.752***	1

****p<.001*

4.4. Hypothesis Testing

The results of testing the influence of the Fourth Industrial Revolution dental medical acceptance (UTAUT) factors on trust are shown in <Table 7>. First, prior to analysis, whether multicollinearity among the independent variables has any issue was examined. VIF values ranged from 2.062 to 2.687, all of which were below 10. Therefore, the multicollinearity had no issue. The Durbin-Watson (D/W) statistic was found to be 1.883 close to 2, which indicates no correlation among the residuals. Regarding explanatory power, the UTAUT factors explaining trust had an R^2 value of .570, indicating a 57.0% explanatory power. The F-Statistic was 75.191. Therefore, the regression model was significant at the alpha level of .001. Among the acceptance factors, performance expectancy ($\beta = .315$, $p < .001$), effort expectancy ($\beta = .236$, $p < .001$), and social influence ($\beta = .227$, $p < .01$) had significant positive effects on trust, and the relative influence ranked as performance expectancy, effort expectancy, and social influence. In conclusion, regarding the influence of the UTAUT factors on trust, hypotheses H1-1, H1-2, and H1-4 were accepted, but hypothesis H1-3 was rejected. (Dependent variables)

<Table 7> The Impact of Acceptance Factors of Fourth Industrial Revolution Dental Medical Devices (UTAUT) on Trust

Factor	Non-standardized coefficient		Standardized coefficient	t	p	VIF
	B	SE	β			
(Constant)	.620	.177		3.505	.001	
Performance expectancy	.276	.060	.315	4.646***	.000	2.431
Effort expectancy	.244	.065	.236	3.770***	.000	2.062
Facilitating conditions	.089	.059	.098	1.524	.129	2.184
Social influence	.211	.066	.227	3.178**	.002	2.687
Dependent variable: Trust						
R^2=.570, Adjusted R^2=.562, F=75.191***, p=.000, D/W=1.883						

***p<.01, ***p<.001*

The results of examining the impact of trust in fourth industrial revolution dental medical devices on the intention to introduce are presented in <Table 8>.
Regarding explanatory power, the trust in these devices explained an R^2 of .566, indicating a 56.6% explanatory power. The F-Statistic was 299.408. Therefore, the regression model was significant at the alpha level of .001. Trust ($\beta = .752$, $p < .001$) showed a significant positive effect on the intention to introduce. In conclusion, regarding the impact of trust in fourth industrial revolution dental medical devices on the intention to introduce, hypothesis H2 was accepted.

<Table 8> The Impact of Trust in Fourth Industrial Revolution Dental Medical Devices on Introduction Intention

Factor	Non-standardized coefficient		Standardized coefficient	t	p
	B	SE	β		
(Constant)	.873	.152		5.725	.000
Trust	.735	.042	.752	17.303***	.000
Dependent variable: Introduction intention					
R^2=.566, Adjusted R^2=.564, F=299.408***, p=.000, D/W=1.705					

****p<.001*

The results of testing the influence of the UTAUT factors on the intention to introduce are shown in <Table 9>. Prior to analysis, whether multicollinearity among the independent variables has any issue was examined. VIF values ranged from 2.062 to 2.687, all of which were below 10. Therefore, the multicollinearity had no issue. The Durbin-Watson (D/W) Statistic was 1.819 close to 2, which indicates no correlation among the residuals.

Regarding explanatory power, the UTAUT factors explaining the intention to introduce had an R^2 of .634, indicating a 63.4% explanatory power. The F-Statistic was 98.508. Therefore, the regression model was significant at the alpha level of .001. Among the acceptance factors, performance expectancy ($\beta = .147$, $p < .05$), effort expectancy ($\beta = .327$, $p < .001$), and social influence ($\beta = .348$, $p < .001$) had significant positive effects on the intention to introduce, and the relative influence ranked as social influence, effort expectancy, and performance expectancy. In conclusion, regarding the influence of UTAUT factors on the intention to introduce, hypotheses H3-1, H3-2, and H3-4 were accepted, but hypothesis H3-3 was rejected.

<Table 9> The Impact of Acceptance Factors of Fourth Industrial Revolution Dental Medical Devices (UTAUT) on Introduction Intention

Factor	Non-standardized coefficient		Standardized coefficient	t	p	VIF
	B	SE	β			
(Constant)	.431	.159		2.700	.007	
Performance expectancy	.126	.054	.147	2.348*	.020	2.431
Effort expectancy	.331	.058	.327	5.674***	.000	2.062
Facilitating conditions	.092	.053	.103	1.739	.083	2.184
Social influence	.316	.060	.348	5.286***	.000	2.687
Dependent variable: Introduction intention						
R^2=.634, Adjusted R^2=.628, F=98.508***, p=.000, D/W=1.819						

****p<.05, ***p<.001*

To the acceptance of dental medical devices in the context of the Fourth Industrial Revolution, this study analyzed the mediating role of trust between UTAUT factors and introduction intention. To this end, data analysis was conducted with the SPSS Macro (Model 4) in a bootstrapping technique <Table 10>.

Bootstrapping is a method for assessing the reliability of indirect effects by calculating the 95% confidence interval for the mediating effect. If the interval does not include 0, the effect is deemed statistically significant at the 0.05 level.

In this study, 5,000 bootstrap samples were used to calculate the upper and lower bounds of the confidence interval for the mediating effect. Based on the calculated values, the mediating role of trust was validated.

First, the path from performance expectancy → trust → introduction intention yielded an indirect effect coefficient of .0993, a lower bound of .0456 and an upper bound of .1731. As the confidence interval did not include 0, the mediating effect was found to be significant. Therefore, hypothesis H4-1 was accepted.

The path from effort expectancy → trust → introduction intention showed an indirect effect coefficient of .0877, with a lower bound of .0304 and an upper bound of .1596. As the

confidence interval did not include 0, the mediating effect was found to be significant. Therefore, hypothesis H4-2 was accepted.

The path from facilitating conditions → trust → introduction intention had an indirect effect coefficient of .0321, a lower bound of -.0077 and an upper bound of .0812. As the confidence interval included 0, this mediating effect was deemed not significant, and hypothesis H4-3 was rejected.

Lastly, the path from social influence → trust → introduction intention showed an indirect effect coefficient of .0757, a lower bound of .0236 and an upper bound of .1484. As the confidence interval did not include 0, the mediating effect was significant. Therefore, hypothesis H4-4 was accepted.

<Table 10> Verification of the Mediating Effect of Trust in the Relationship between Acceptance Factors of Fourth Industrial Revolution Dental Medical Devices (UTAUT) and Introduction Intention

Path	**Effect**	**Boot SE**	95% confidence interval	
			LLCI	**ULCI**
Performance expectancy→Trust→ Introduction intention	.0993	.0329	.0456	.1731
Effort expectancy→Trust → Introduction intention	.0877	.0329	.0304	.1596
Facilitating conditions→Trust→ Introduction intention	.0321	.0223	-.0077	.0812
Social influence→Trust→ Introduction intention	.0757	.0311	.0236	.1484

5. Discussion

5.1 Analysis of Hypothesis Verification Results and Previous Studies

The discussions based on the results of the hypothesis testing are presented as follows.

First, among the factors influencing the acceptance of 4th industrial revolution dental medical devices, performance expectancy, effort expectancy, and social influence were found to have a significantly positive (+) effect on trust. The relative influence was identified in the order of performance expectancy, effort expectancy, and social influence.

(1) Performance Expectancy refers to the performance or benefits users anticipate when they introduce technology. In other words, users expect improvements in diagnosis, treatment efficiency, and patient satisfaction by using dental medical devices. When these expectations are met, trust in the Technology increases.

(2) Effort expectancy represents the extent of effort required to learn and use a new Technology. When users can minimize their effort, they tend to place a higher level of trust in the Technology.

(3) Social Influence reflects the opinions of people around users or the social pressure for technology acceptance. When colleagues or industry leaders positively evaluate and encourage the use of new technology, it becomes a crucial factor in enhancing an individual's acceptance and trust in the technology.

These findings suggest that strategies for developing and marketing fourth industrial revolution dental medical devices should focus on enhancing users' performance expectancy, effort expectancy, and social influence. In other words, by emphasizing factors such as device efficiency, ease of use, and positive perceptions among fellow medical professionals, it is necessary to promote acceptance of the technology among dental practitioners, and ultimately to find a strategy for improving the quality of patient care. This approach can Lays a significant foundation for the effective introduction and application of fourth industrial revolution technologies in the dental medical field.

Research by Ko DS (2024) analyzed the application of AI referees in sports and verified the moderating effect of trust with the use of the UTAUT model. The study found that performance expectancy, effort expectancy, and social influence significantly affected the acceptance of AI referee technology through trust. This is consistent with the findings on

the acceptance of fourth industrial revolution dental medical devices, indicating that performance expectancy, effort expectancy, and social influence play a crucial role in positively affecting technology acceptance and that trust acts as an important mediating variable. Similarly, Jeong BK (2019) focused on the mediating effect of trust in the acceptance of mobile banking technology. This research confirmed that key influential factors on technology acceptance were strengthened through trust which positively affected technology acceptance. It also supports the conclusion that factors influencing the acceptance of fourth industrial revolution dental medical devices are positively affected by trust. These studies emphasize the importance of trust as a mediating variable in technology acceptance across various fields related to fourth industrial revolution technologies. Particularly, these research findings indicate that when development and marketing strategies for dental medical devices are established, building and enhancing user trust emerges is a critical element for facilitating technology acceptance and improving patient care quality.

Second, trust was found to have a significantly positive (+) effect on the intention to introduce the dental medical devices based on fourth industrial revolution technologies. This confirms the theoretical framework that user trust in technology increases the likelihood of technology acceptance in the context of the Technology Acceptance Model (TAM). The trust that users feel towards new technologies directly relates to the likelihood of realizing the benefits the technologies offer, and ultimately influences the decision-making process to introduce them. In the medical service field, especially dentistry, the introduction of technologies requires a high level of precision and safety. Since almost no room for error is allowed in patient care and treatment, trust in medical devices becomes a critical factor in the introduction of these technologies. a reliable Technology can enhance patient treatment outcomes, increase efficiency of the treatment process, and reduce the risks of potential medical accidents. These findings underscore the importance of building and maintaining user trust for developers and manufacturers of medical devices that incorporate fourth industrial revolution technologies. Strategies reflecting user trust in the technology development process—such as thoughtful design, transparent information sharing, and the creation of user training programs—are crucial for the successful introduction of these technologies.

Park JH and Kim JS (2020) confirmed that trust, as one of the characteristics of blockchain technology, significantly affected the intention to accept technology in the medical service sector. Their study emphasizes that user trust plays a crucial role in accepting blockchain technology in the healthcare field. Additionally, research by Jang et al. (2023) further supports this context by investigating the factors affecting the continued use intention of

AI-based voice assistant services and revealing the influential relationship of trust in artificial intelligence. This research shows that trust is an influential variable on the acceptance of AI technology.

Third, among the factors influencing the acceptance of 4rth industrial revolution dental medical devices, performance expectancy, effort expectancy, and social influence, were found to have a significant positive (+) effect on the introduction intention. The relative influence was identified in the order of social influence, effort expectancy, and performance expectancy. Performance expectancy refers to the expected effects or benefits users anticipate from their introduction of new technology.

This is a crucial factor for both medical staff and patients. Particularly, expectations that medical devices will improve treatment outcomes, reduce consultation times, and enhance accuracy can drive technology introduction. Effort expectancy means users' perception that using and learning a new technology will not impose a significant burden. As users more perceive that the Technology is easy to use and has a gentle learning curve, technology acceptance becomes easier. Social Influence refers to users' perceptions of how others around them perceive and accept technology, significantly impacted by external factors such as expert opinions in the medical circle, peer evaluations, and patient expectations. The stronger the social influence, the more individuals feel pressured to accept new technologies and thereby the more they intend to introduce them. The reason why social influence is ranked highest in the relative influence is that technology introduction in healthcare is significantly influenced by the opinions and policies of expert groups and social Expectation more than individual judgments.

The reason for the assessment that performance expectancy outweighs effort expectancy is that in the medical device context, the actual medical value and performance provided by medical devices are prioritized over the ease of use. These findings offer critical implications in establishing the Strategies for developing and introducing dental medical devices in the era of the fourth industrial revolution. It is necessary to build positive perceptions through influential figures both inside and outside the medical community in terms of social influence, and to facilitate Technology acceptance through proactive marketing strategies. Additionally, developers and manufacturers of medical devices should enhance users' performance expectancy by clearly delivering the performance and efficacy of their Technologies and manage effort expectancy and minimize the learning burden by improving user education programs and interfaces.

These results align with the findings of previous studies. Song and Kim (2018) analyzed the factors affecting technology acceptance of medical devices in South Korea based on

acceptance intention and behavior intention under the Unified Theory of Acceptance and Use of Technology (UTAUT). This research revealed that performance expectancy, effort expectancy, and social influence positively affected the intention to accept medical devices.

In addition, the study by Baek MR, Choi HH, and Lee HY (2015) investigated the acceptance intention of wearable smart healthcare devices across different age groups. It confirmed that social influence and performance expectancy served as significant factors. These previous studies support the findings of this research.

Fourth, the mediating effect of trust was confirmed in the relationship between the acceptance factors of 4th industrial revolution dental medical devices-performance expectancy, effort expectancy, and social influence-and the intention to introduce these technologies.

Performance expectancy refers to the extent of performance users expect when they use technology. This expectation is one of Primary motivations for users to accept the technology. It reflects users' belief that the Technology will Actually Improve their work performance. Effort expectancy indicates the degree of effort required for users to effectively use the Technology.

The lower the expected effort is, the higher the likelihood of acceptance is. Social Influence represents users' perceptions of how significant others (e.g., colleagues, supervisors, family) view the use of the Technology. This social influence can affect users' Decision to accept or reject the technology.

The finding that trust mediates the relationship between these factors and intention to introduce suggests that trust in the effectiveness, safety, and ease of use of medical devices plays a crucial role in technology acceptance. Trust significantly serves to reduce uncertainty, increase predictability, and minimize perceived risks associated with the Technology. Thus, when users trust a medical device, their intention to introduce it based on performance expectancy, effort expectancy, and social influence becomes stronger.

6. Conclusion

6.1. Academic Value and Additional Guidelines

This study has academic significance in that it expands the Unified Theory of Acceptance and Use of Technology (UTAUT) model to the field of medical technology by identifying the medical staff's trust in fourth industrial revolution medical devices in terms of their acceptance of dental medical devices based on fourth industrial revolution technologies.

Specifically, it Confirmed that factors such as performance expectancy, effort expectancy, and social influence positively affect the intention to introduce technology through trust. This provides a new perspective by adding the importance of trust to the existing technology acceptance theory. Therefore, this study has academic value in the point that it provides a scholarly basis for the effective introduction and acceptance promotion of medical technologies in the era of the 4th Industrial Revolution.

This finding holds significant implications for medical device manufacturers and developers. They should design and provide high-quality medical devices that meet users' performance expectancy and effort expectancy in Order to build trust. Additionally, they should foster a positive perception in the medical community in terms of social influence, and thereby should develop strategies for promoting Technology acceptance.

This finding can contribute to Facilitate the introduction and diffusion of medical devices and ultimately improving the quality of patient care and is significantly meaningful in practical aspects. In other words, it holds significant implications for the development of dental medical devices and marketing strategies.

To build user trust, it is essential Design products and provide information in consideration of performance expectancy (treatment efficacy), effort expectancy (ease of use), and social influence (positive perceptions among fellow medical professionals).

In particular, this study suggests that trust-based design, transparent information sharing user education improve user trust and enhance the intention to introduce technology. This is a critical factor that contributes to increasing technology acceptance and improving the quality of patient care.

Despite the academic and practical significance presented above, this study has limitations. As it was conducted with the dental medical staff located in the metropolitan areas, it is difficult to generalize the findings to all dental medical staff nationwide. There may be

differences in results based on regional characteristics. Therefore, in future research, it will be necessary to expand the sample to include dental medical staff from diverse regions across the country in order to increase the generalizability of the findings.

Additionally, to examine changes in the intention to accept technology over time, it will be essential to conduct a longitudinal study to observe the long-term changes in the acceptance factors for dental medical devices.

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Survey Form

Q) Innovative medical devices refer to advanced medical equipment that applies cutting-edge information and communication technology developed as a result of the Fourth Industrial Revolution. These devices include CAD/CAM systems, intraoral 3D scanning, medical imaging-based 3D modeling software, and 3D printing technology and affect a paradigm shift of dental treatment. While the introduction of computers in traditional dental practices served to assist with some processes, the innovative medical devices now play a crucial role throughout the overall treatment process, including CBCT imaging based diagnosis, obtainment of digital impressions with intraoral scanners, CAD software based prosthetics design, CAM operations, and 3D printing based prosthetics production. The introduction of these innovative medical devices enables more precise and efficient dental treatment and innovative changes for personalized treatments.

All items are answered using a 5-point scale.

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

1. Items about UTAUT factors

Performance Expectancy

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

- I think that innovative medical devices will be more useful than existing systems.

- I think that the introduction of innovative medical devices will speed up treatment processing.

- I think that the introduction of innovative medical devices will improve the accuracy of

treatment.

- I think that the introduction of innovative medical devices will make patient interactions easier.

Effort Expectancy

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

- I think I will easily adapt to the use instructions of innovative medical devices.

- I think that it will be easy to learn how to use innovative medical device systems.

- I think that after the introduction of innovative medical devices, the number of patients will increase.

- I think that the introduction of innovative medical devices will improve the clinical environment.

Facilitating Conditions

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

- I think that our medical institution has the necessary resources to introduce innovative medical devices.

- I think that our medical institution is well aware of the necessity of introducing innovative medical devices.

- I think that our medical institution can obtain expert assistance when using innovative medical devices.

- I think that our medical institution has medical equipment compatible with innovative

medical devices.

Social Influence

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

- Patients think that our hospital will introduce innovative medical devices.
- Major partners will recommend that our institution introduce innovative medical devices.
- I think that patients are well aware of the advantages of innovative medical devices.
- Since other medical institutions introduce innovative medical devices, I think that our institution should do the same.

2. Trust

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

- I think that innovative medical equipment will provide safe medical services
- I think the technology of innovative medical equipment has high accuracy.
- I think that the technology of innovative medical equipment has no errors.
- I think that innovative medical equipment is reliable.

3. Introduction Intention

1	2	3	4	5

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

- I think that our medical institution will have the intention to introduce innovative medical equipment in the future.

- I think that our medical institution will strive to introduce innovative medical equipment in the future.

- I think that when innovative medical equipment is introduced, our medical institution will use it as a top priority.

- I think that the introduction of innovative medical equipment will encourage medical staff to actively use it in order for them to acquire new knowledge and adapt to their work.

4. General Characteristics (UTAUT)

- AGE : People in their 30s ~40s and 50s

- Gender : Male/Female

- Experience in medical institutions (less than 3 years, less than 3-5 years, less than 5-7 years, less than 7-9 years, more than 9 years)

- Hospital type (Private Clinics, Hospital grade, General hospital, Tertiary hospital)

Abstract in Korean

제4차 산업혁명시대 치과종사자의 치과 의료기기 수용의도에 관한 연구

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한 유 나

본 연구는 UTAUT(Unified Theory of Acceptance and Use of Technology) 모델을 통해 치과 의료진이 4차 산업 기술이 적용된 의료기기를 수용하는 주요 요인을 분석하고, 신뢰의 매개효과를 분석하는 것을 목적으로 하였다. 이를 위해 대한민국 수도권, 서울에 소재한 치과 전문가를 대상으로 2024년 9월 20일부터 10월 11일까지 설문조사를 실시했으며, 불성실 응답자 9명을 제외한 후 232명의 참여자 설문 조사 결과를 SPSS 28.0 통계프로그램을 이용하여 통계적 분석을 수행하였다. 분석결과는 다음과 같다. 첫째, 채택 요인 중 성과기대(β=.315), 노력 기대(β=.236), 사회적 영향력(β=.227), 순으로 신뢰에 유의한 정적 영향을 미치는 것으로 나타났다. 둘째, 신

뢰 (β=.752)는 채택 의도에 유의한 정적 영향을 미치는 것으로 나타났다. 셋째, 채택 요인 중 사회적 영향력(β=.348), 노력 기대감 (β=.327). 성과 기대감(β=.147), 순으로 채택 의도에 유의한 정적 영향을 미치는 것으로 나타났다. 넷째, 채택 요인과 채택 의도 간의 관계에서 (성과 기대감 effect=.0993, 노력 기대감 effect=.0877, 사회적 영향력 effect=.0757),의 매개 효과를 확인하였다. 본 연구는 4차 산업혁명 치과 의료기기 채택 의도를 실증적으로 검증하고 신뢰의 매개 효과를 규명한다는 점에서 의미가 있다. 그러나 연구 참여자가 수도권에 소재한 치과 전문가로 한정되었기 때문에 결과를 일반화할 때 주의가 필요하다. 따라서 향후 연구에서는 수도권 외 지역에 소재한 치과 전문가를 포함시켜 지리적 다양성을 확보하고 결과의 일반화 가능성을 높일 필요가 있다.

핵심되는 말 : 4차 산업 의료기기, 도입의도, 의료기술, 치과의료기기, UTAUT.