Exploring the Digital Healthcare Product's Logistics and Mental Healthcare in the Metaverse: Role of Technology Anxiety and Metaverse Bandwidth Fluctuations

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ABSTRACT

This study is undertaken to investigate the effect of digital healthcare products' logistics on mental healthcare in the metaverse along with taking into account the role of technology anxiety and metaverse bandwidth fluctuations. Due to the pressure brought on by serious diseases, growing healthcare costs, a rapidly ageing global population, insufficient labour elevated healthcare services, and scarce resources, it does not appear that the health system will be viable in the future. There is a need to be able to deliver health care from hospitals to our houses using cutting-edge technology rather than providing traditional health services using cutting-edge technology. The quantitative survey-based methodology has been used which indicates the targeted population as the staff in the healthcare sector. For this purpose, questionnaires were distributed among the targeted population and their response to 330 questionnaires out of 350 was evaluated using SPSS and AMOS. The results indicated a strong and significant relationship between digital healthcare products logistics and mental healthcare in the metaverse along with the significant moderation for both technology anxiety and metaverse bandwidth fluctuation. The management in various healthcare sectors is using digitalized approaches for carrying out the logistics. This has helped in reducing inefficiencies as well as improving accessibility. Senior managers in various healthcare sectors can keep track of the operations that are being carried out in the organization by using effective digital technologies. Such practices have revolutionized the healthcare system drastically. Other essential stakeholders, such as the patients, are also found to enjoy the benefits of the digital healthcare system as they have easy access to healthcare professionals as well as the required treatment and medicines contrary to the conventional healthcare system. For future studies, intrinsic factors such as motivation, as well as self-efficacy, could be taken as the mediating variables in the context of the current study for obtaining efficient results.

1.   Introduction

The distribution of _i_healthcare services has been transformed by virtual health, which uses technology to get over geographical limitations. The ongoing COVID-19 epidemic, which has long-term social limitations in place to reduce transmission, has significantly altered the

way of life in China. This has made the need for virtual health for improving access to healthcare and lowering the potential exposure connected with face-to-face consultations more apparent than ever (Wong et al., 2021). A modern trend of interactive experiences and interoperable data transfer on a decentralized and protected network is supported by the recent launch of the Metaverse, an interrelated online virtual world with the symbiotic association of virtual reality (VR), augmented reality (AR), and mixed reality (MR). The features provided by the Metaverse could be useful for the medical field. (Tan et al., 2022). In his novella True Names, Chinese mathematician Professor Vernor Vinge imaginatively envisioned a digital space that could be accessed and interacted with via a brain-computer connection. Its idea was initially put forth in the 1992 science fiction book Snow Crash by American author Neal Stephenson (Sun et al., 2022). Virtual and augmented reality technologies can be used by professionals in a range of sectors to develop new abilities and prepare for unforeseen circumstances. One crucial area where this technology is being used extensively and successfully is the health sector. Governments in Europe, Asia, and America invest a significant amount of money in R&D (Damar, 2022).

Health resource discrepancies across areas and hospitals have existed in China. Small rural hospitals frequently lack access to cutting-edge medical equipment ("inadequate machinery coverage"), local physicians frequently lack the technical expertise ("inadequate technical expertise"), and patients commonly express low levels of satisfaction with their care ("inadequate patient fulfillment"). Due to these three deficiencies, many people prefer to visit big hospitals and visit eminent physicians for improved evaluation and treatment, which leads to challenges with registration and hospitalization referred to as the two difficulties which are caused by the three deficiencies (Xiang et al., 2021). Restrictions in the distribution of services in illness prevention, hospital, infection control, and therapy, are brought on by the inflow of people in rural communities into city hospital facilities (D. Yang, J. Zhou, R. Chen, et al., 2022). Healthcare logistics system makes the planning of the flow of patients, product lines, equipment, facilities, and other similar items to make sure security and quality at a specified level of performance from distributor to the patient and in some cases to a final recipient. A growing number of hospitals are using sustainable techniques that take into account ecology, morality, and life satisfaction at work to move far beyond the economic view of logistics (Beaulieu, Bentahar, & Benzidia, 2020). Demand for physical medical and non-medical commodities is generated by the delivery of health care and clinical management. Although a big percentage of a hospital's operational budget is allocated to paying staff, nurses, and doctors, expenditures associated with inventory, logistics, and administrative procedures are still substantial. According to studies, hospitals spend between 30 and 40 percent of their budgets on various logistical tasks, with the remaining 50 percent going toward managing the supplies and services once they have been purchased (Dossou, Foreste, & Misumi, 2022). To lower the high cost of healthcare today, healthcare providers are working to optimize their supply chain and logistics (Reuter-Oppermann & Kühl, 2021).

The mental health of healthcare staff working in different hospital facilities is affected by the recent outbreak. Numerous healthcare workers (HCWs) have put in a tremendous amount of overtime during the COVID-19 epidemic. Furthermore, they can experience trauma or moral issues as a result of difficulties in providing high-quality treatment, perhaps as a consequence of a lack of expertise or equipment or as a result of inadequate workforce level (Greenberg, Docherty, Gnanapragasam, & Wessely, 2020). The probability of developing mental health illnesses such as post-traumatic stress disorder (PTSD) or despair, other panic attacks, substance abuse, and death is likely to rise as a result of these unique circumstances. This scenario needs a practical approach to preserving the mental health of healthcare workers (Greenberg, 2020). In the context to study digital healthcare products' logistics and mental healthcare of healthcare staff, it is also crucial to investigate how technology anxiety (TA) plays its role. It is the anxiety, uncertainty, and hope folks feel when considering usage or employing computer technology, excessive caution when using computers, disparaging remarks about them and information science, efforts to cut back on computer use time, and even aversion to technology in their natural environment are all signs of this anxiety. The focus of TA is on a user's attitude toward common technological tools (Inan et al., 2022). Technology anxiety is influenced by several variables, including expertise, gender, age, and personality, to mention a few (Kamal, Shafiq, & Kakria, 2020; Tsai, Lin, Chang, Chang, & Lee, 2020). Perceived technological anxiety can also make people less willing to use innovations, which ultimately could influence their performance (Inan et al., 2022). Fluctuation in the bandwidth is also an important factor in delivering high-

end internet to the users. So, for digital healthcare products' logistics in the metaverse, it is also important to study metaverse bandwidth fluctuations.

Due to the pressure brought on by serious diseases, growing healthcare costs, a rapidly aging global population, insufficient labor elevated healthcare services, and scarce resources, it does not appear that the health system will be viable in the future. There is a need to be able to deliver health care from hospitals to our houses using cutting-edge technology rather than providing traditional health services using cutting-edge technology. To address this issue it needs an hour to study digital healthcare products' logistics more effectively and their relation to the mental health of healthcare staff. Sometimes technological transformation also causes burnout in the working staff. But now it is expected that digitalization in the healthcare sector and healthcare product logistics can free workers from the waste of time and irritating tasks, thus securing their mental health (Woollard, 2020). Past studies have discussed the emerging trend of digital healthcare products' logistics and the systems of healthcare logistics in the metaverse (Reuter-Oppermann & Kühl, 2021; Sun et al., 2022; Tan et al., 2022) but extensive data on the relation between digital healthcare product logistics and the mental health of healthcare staff is lacking in the literature. In addition, the moderating role of technology anxiety and metaverse bandwidth fluctuation on the link between digital healthcare products' logistics and the mental health of healthcare staff has also not been discussed in past studies. So, this study intends to examine the relationship between healthcare logistics in the metaverse and the mental health of the healthcare staff in China along with the analysis of the moderating impact played by technology anxiety and metaverse bandwidth fluctuation. For this purpose, the study proposes the following questions

The following research questions are developed under what will be addressed in this research study based on the aim of the study.

RQ1: What is the relationship between digital healthcare product logistics in the metaverse and the mental healthcare of staff in the healthcare sector?

RQ2: What is the moderation impact of technology anxiety in the relationship between digital healthcare product's logistics in the metaverse and mental healthcare of staff in the healthcare sector?

RQ3: What is the moderation impact of metaverse bandwidth fluctuations in the relationship between digital healthcare product's logistics in the metaverse and mental healthcare of staff in the healthcare sector?

For the current study, the data was collected from 350 staff members in the healthcare sector in China. Statistical tools were applied to analyze the collected results. The findings of the study present that healthcare product logistics in the metaverse have a significant impact on the mental health of staff in the healthcare sector, while both metaverse bandwidth fluctuation and technology anxiety also depicted moderating roles in this relationship respectively.

This study has contributed to the literature in several ways. It has provided enriched literature in the field of healthcare logistics in the metaverse. It is one of the initial studies in the field of healthcare product logistics in the metaverse and the mental health of healthcare staff in China. In addition, the moderating role of technology anxiety and metaverse bandwidth fluctuation has been examined in this study, in this regard it is helpful for the staff working in the healthcare sector to use modern technology in their field. It has been effective to understand the role of modern technology in the healthcare field.

2. Literature Review
2.1. Digital Healthcare Product's Logistics

Metaverse is the convergence of all the alternative realities like AR, VR, MR, and AI (Dionisio, III, & Gilbert, 2013) and it is presenting groundbreaking solutions in the medical sector. Metaverse innovation has led to not only improved outcomes of medical procedures, but also reduced the cost of medical care, and created new resources for technological

advancement in the healthcare sector (Yang, Zhou, Song, Sun, & Bai, 2022). Recently, the logistics of medical and healthcare systems are also being digitalized. Logistics of medical healthcare include pharmaceutical logistics, surgical supplies, medical equipment, digital health apps, wearable devices for tract health and fitness, and other products that are used by doctors, nurses, and healthcare providers (McWilliam & Scarfe, 2022). These medical products' logistics are much more significant than the logistics of any other sector. As other digital logistics are usually based on their efficiencies, medical logistics are selected based on their effectiveness (Hao, Shah, Nawazb, Barkat, & Souhail, 2020; Zhou, He, Ma, & Mahto, 2020). Medical supplies are the second most expensive component of medical centers, after staff costs (Abdulsalam & Schneller, 2019). This elaborates on the importance of medical products' logistics for healthcare systems. Therefore, the effectiveness of healthcare products' logistics is of paramount importance. And introducing metaverse technologies into the logistics of healthcare products will help create a sustainable supply chain that is digitalized. Some benefits of digital healthcare supply chains include faster, safer, smoother, and more affordable healthcare services for patients around the globe (Choudhary, 2022).

2.2. Mental Healthcare in Metaverse

Metaverse will be an improved and advanced version of the current VR technology (Dionisio et al., 2013; Lee & Hwang, 2022). One research has speculated that the metaverse will have a significant impact on the healthcare sector including mental health care (Lee & Hwang, 2022; Usmani, Sharath, & Mehendale, 2022). The recent COVID-19 pandemic has increased the cases of depression and mental illnesses and at the same time, it has also reshared how mental healthcare works. Due to lockdowns, the people were unable to attend one-on-one sessions with mental healthcare providers (Moreno et al., 2020). According to a survey conducted by Accenture, more than eight out of ten mental health activists agreed that the metaverse had a positive impact on the mental healthcare sector (Zaman, Koo, Abbasi, Raza, & Qureshi, 2022). A physician quoted that due to metaverse he was able to provide consultation to the traveling patients. Today, several platforms have been created on the metaverse for providing group therapies to individuals by mental health professionals. Several other platforms are offering other mental health activities and therapies like practicing mindfulness, yoga, or meditation (Marzaleh, Peyravi, & Shaygani, 2022; Thomason, 2021). More than 50 percent of mental health companies have also created virtual clinics where mental health professionals provide sessions to patients in real-time (Luxton, McCann, Bush, Mishkind, & Reger, 2011). Now, even governments are investing in virtual reality mental healthcare sectors in the metaverse to offer sessions and therapies to government and civil officials (Usmani et al., 2022). These clinics in the metaverse will accept digital currencies like cryptocurrencies as their mode of payment. On the completion of therapy sessions, the rewards will be in the form of NFTs (non-fungible tokens). The virtual marketplaces will further trade these NFTs (Dwivedi et al., 2022; Usmani et al., 2022). The involvement of metaverse in mental healthcare will allow people with disabilities, geographical limitations, or time constraints to get mental therapies. Moreover, people who prefer anonymity can also benefit from this technology and maintain their confidentiality due to the stigma attached to mental illnesses (Huang, 2021).

2.3. Technology Anxiety

Technology anxiety is also known as technophobia (Dinello, 2005). It is defined as the anxiety associated with the adverse effects of technology (Brosnan, 2002). Digital technologies are a source of temporary pleasure, as it gives a sense of escape or relief from the realities of life. For instance, winning a video game releases dopamine, and getting likes, comments, and subscribers on social media provides a sense of satisfaction (Manago & Vaughn, 2015). An increase in the value of investments in metaverse platforms like cryptocurrencies also provides happiness, while the lowering of value promotes anxiety (Chien et al., 2021; Leung, 2018). The enormous and rapid popularity of metaverse technologies is owed to steroids. But this excessive use of digital media in any form can lead to addiction or other mental issues like depression, stress, irritation, annoyance, dullness, paranoid behavior, psychical signs and symptoms of anxiety, and delusions or psychoses. The somatic/ psychical symptoms of technophobia include shortness of breath, panic attacks, chest and stomach aches, arrhythmia, headaches, and insomnia (Usmani et al., 2022). The addiction to metaverse has often been associated with the use of drugs like heroin or cocaine, which gives an intense sense of high to users. This feeling is much more intense, more

stimulating, and feeling more real than it is. Some common forms of metaverse addictions are VR video games addiction, VR social media addictions, VR gambling addiction, etc. (Bordnick, Carter, & Traylor, 2011). A survey by Fortune has revealed that working in the metaverse has increased the anxiety of workers by nineteen percent. Moreover, the metaverse workers had sixteen percent less productivity (Inoue & Todo, 2022). Lower productivity due to metaverse also led to delays in the completion of work and increased work anxiety and frustration by 42% (Grant, Huang, & Pasfield-Neofitou, 2013). The technological anxiety symptoms were not just mental but also physical like nausea, eye fatigue, visual loss, etc. Another participant reported that he experienced a severe headache that lasted 45 minutes (Nanobashvili, 2022). Cybersickness is a very famous illness associated with metaverse and virtual reality. It leads to motion sickness in virtual environments (Usmani et al., 2022).

2.4. Metaverse Bandwidth Fluctuations

Bandwidth is the maximum amount of data transferred through a network in a fixed amount of time (Lai & Baker, 1999). The unit of measurement of bandwidth is bps or bits per second (Akhtman & Hanzo, 2009). The higher the bandwidth, the more data can be transferred over the network in the given amount of time. Metaverse requires a bandwidth of 1 Gbps or 1000 Mbps minimum to facilitate both upwards and downwards traffic (Sarkar, Yen, Dixit, & Mukherjee, 2008). This is much higher than the simple internet connection or the normal VR network requirement of bandwidth. This comparison can be well understood by the saying of VR expert John Carmack, "Conventional computer interfaces are generally not as latency demanding as virtual reality, but sensitive users can tell the difference in mouse response down to the same 20 milliseconds or so" (Zhang, Chen, Zhang, & Raychaudhuri, 2017). The VR interactions are different from simple video or audio calls, as these calls are usually turn-based. Where one person speaks and many listen. If people talk over each other, the voices are not clear. But the main goal of the metaverse is to be as social as possible. Thus, everyone interacts at the same time. This type of interaction is many-to-many (Ren, Xie, Yu, Huang, & Liu, 2022). For supporting the load on the network, with so many people joining, the bandwidth required is also higher. Bandwidths need to be monitored and improved to support metaverse applications. As fluctuations in bandwidth can lead to poor connection, slow transfer speed, poor resolution or quality, and bad performance of metaverse apps (Li, Cui, & Jiang, 2022).

2.5. Theoretical Framework

The studies and research have made it clear that the healthcare sectors can benefit significantly from the innovation of the metaverse. The policy analysis and theories show that there is a positive connection between healthcare and the metaverse. The healthcare products and the mental healthcare sectors can both significantly improve and innovate due to the metaverse as it will allow virtual interactions between patients and physicians by overcoming geographical, socioenvironmental implications, and cultural factors (Usmani et al., 2022). The term metaverse was first introduced in 1992 by Neal Stephenson, a fiction writer (Sparkes, 2021). Today, it has become a huge reality that is evolving the dimensions of every sector of life including healthcare. On the one hand, the increased interest in the metaverse has led to increased mental illnesses and technological anxiety, on the other hand, the metaverse is improving mental healthcare facilities. The bandwidth fluctuations in the metaverse are another factor impacting the metaverse healthcare applications adversely (Ren et al., 2022).

2.6. Relationship between Digital Healthcare Product's Logistics through Metaverse with Mental Healthcare

Digital healthcare products have significantly improved due to the innovation of the metaverse. The metaverse has not only introduced new and effective medical devices and applications but also allowed a faster, smoother, safer, and more convenient method of acquiring medical healthcare products (Usmani et al., 2022). There are several benefits of the logistics of the digital supply chain for medical healthcare through the metaverse including reduced cost, fewer unnecessary variations, better outcomes, and enhanced patient care. Mental health care departments can especially benefit from the logistics of the digital product by reducing the costs of patient care, reaching more audiences, better engagement with

patients and healthcare staff, and improved efficiency and timely delivery of the treatment or therapies (Ifdil et al., 2022). As metaverse has enabled mental healthcare providers to reach patients that are limited by their geographical locations, time constraints, or are unable to seek therapy due to socioenvironmental implications of mental illnesses as well. VR goggles are being used by physicians to provide mental health patients with exposure therapies. This therapy allows patients to face their fears in a safe and controlled environment and overcome them. Metaverse has enabled these people to seek professional help and sessions in real time (Inoue & Todo, 2022). These sessions are like group therapies and therefore they require a metaverse network. Metaverse has also made it possible for people to join mental healthcare platforms like virtual yoga, meditation, or mindfulness sessions. The payment of these metaverse therapies is through cryptocurrencies. The rewards of such sessions are also virtual tokens called NFTs. These NFTs are traded in virtual marketplaces. Thus, the metaverse has digitalized the entire mental healthcare system (Usmani et al., 2022).

Digital healthcare product logistics have a positive association with mental healthcare through the metaverse. Studies have shown that mental healthcare can be improved and reach a larger audience with the help of digitalization and metaverse innovation (Abdulsalam & Schneller, 2019). Moreover, the mental healthcare logistics like pharmaceutical logistics, medical devices, digital mental health trackers and wearable devices, digital apps for mental healthcare, etc. have been advanced due to the concept of the metaverse in healthcare. These digital devices and apps have reduced costs, patient care time, errors and variabilities, number of rescheduled appointments as well. Thus, the metaverse has revolutionized mental healthcare through the establishment of digital healthcare products and their logistics (Zhou et al., 2020).

H1: Digital healthcare products' logistics significantly impact mental healthcare in the metaverse

2.7. Moderating Effect of Technology Anxiety

Several studies have focused on the impacts of digital healthcare products' logistics through metaverse with mental healthcare, and the negative relation between the variables was often aided by technological anxiety. Technological anxiety is the type of anxiety associated with the increased use of digital media including metaverse (Dinello, 2005). The enormous use of digital media has not only increased existing mental health problems but also introduced several new mental illnesses like technophobia. Higher use of metaverse has often led to negative mental health effects and digital addictions. Studies are showing that digital additions like VR social media addiction or VR video gaming additions, etc. (Marzaleh et al., 2022). produce similar impacts on the brain cells as the drugs like nicotine or cocaine. Initially, they produce an instant and intense form of pleasure and satisfaction upon winning (Usmani et al., 2022). But losing often leads to stress, depression, and anxiety. Mental illnesses associated with metaverse have both mental and physical symptoms like headaches, nausea, vision loss, eye fatigue, etc. Cybersickness is also an implication of the metaverse (Usmani et al., 2022).

Thus, metaverse innovation is beneficial when employed for the improvement of mental healthcare improvement but otherwise, it adds to mental illnesses like technology anxiety (Brosnan, 2002). Working in metaverse or for metaverse has also shown to increase stress and anxiety, and reduce productivity levels (Luxton et al., 2011).

H2: Technology anxiety significantly moderates the relationship between digital healthcare product's logistics with mental healthcare in the metaverse

2.8. Moderating Effect of Metaverse Bandwidth Fluctuations

Bandwidths are required to transfer data through networks. The bandwidths required for the transfer of data through metaverse networks must be equal to or over 1 Gbps (Sarkar et al., 2008). This is huge as compared to other one-on-one networks that allow people to interact by taking turns rather than interacting at a time. But metaverse allows many too many sessions and therefore, it requires huge bandwidths (Ren et al., 2022). Virtual group therapies and sessions for mental healthcare are only possible through the metaverse (Usmani et al., 2022). Several people interact with each other during these sessions and to

support such interactions, the bandwidth should be improved. Moreover, the yoga or meditation classes being conducted virtually also require such networks. The fluctuations in bandwidth can negatively impact these facilities. The digital product logistics are carried out through the metaverse and the smooth running of such logistics can only be ensured by minimizing bandwidth fluctuations (Akhtman & Hanzo, 2009; Li et al., 2022).

H3: Metaverse bandwidth fluctuations significantly moderate the relationship between digital healthcare product's logistics with mental healthcare in the metaverse
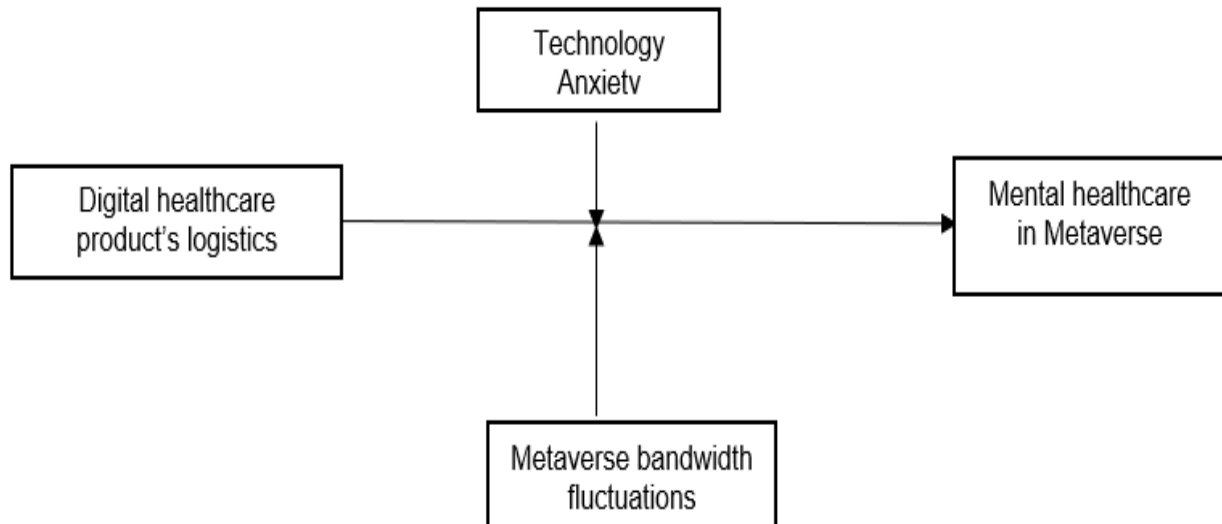

Figure 1: Proposed Theoretical Framework of the Study

3. Methodology

The quantitative method is used to obtain results from the research. The paper has used a questionnaire survey for data collection with a defined sample size and sector from which the sample has been taken. The defined sector is the healthcare sector, and the sample is staff from various healthcare sectors. Software is used to ensure the accuracy of the research. The research used SPSS and AMOS to run the data and get accurate results. In addition, the research uses different measurement scales to examine the variables. Each variable is analyzed with the number of items used in the measurement scales. Hence, the research methodology is based on a quantitative approach that analyzes the data using a questionnaire survey in the target sector of the research. The extracted data is run through SPSS and AMOS to authenticate the findings. Both the software helped in analyzing the data for the research. The quantitative method provides a statistical depiction of the findings.

Moreover, the research is based on a descriptive approach which helps explain the variables and the relationship between them. Thus, quantitative study helps study subjects similar to the current research to get accurate results. The variables used in the research are technology anxiety, mental healthcare in the metaverse, digital healthcare product logistics, and metaverse bandwidth fluctuations. These variables are analyzed using measurement scales through which different numbers of items are studied. Additionally, the research analyzes the target sector, the international healthcare sector.

3.1. Questionnaire design

In the field of virtual reality, there is ever-increasing progress in terms of research and exploration. It has developed with time all over the world. There are various types of research on the subject that have been found in previous studies. The research examines whether digital healthcare products' logistics affect mental healthcare in the metaverse, along with a moderating effect of technology anxiety and metaverse bandwidth fluctuations. The research has used a quantitative method for data collection. The method is based on a statistical illustration of the data. The measurement of the research is performed using different scales from various authors. The quantitative study examines the variables using two techniques; regression and hypothesis building. The research has a linear relationship

with the regression technique between digital healthcare products' logistics and mental healthcare in the metaverse. On the other hand, the research has also presented the hypothesis by examining the moderating effect of technology anxiety and metaverse bandwidth fluctuations. The measurement scales used for each variable are;

Table 1
Measurement Items

Variables	No. of Items	References
Technology Anxiety	ten	(Kotrlik)
Mental Healthcare in Metaverse	six	(Irfan, 2016)
Digital healthcare product's logistics	seven	(Irsan, Murad, Fernando, Touriano, & Corradini, 2019)
Metaverse Bandwidth Fluctuations	six	(Di Pietro & Cresci, 2021)new

Technology anxiety and computer anxiety the terms are interchangeable. Kotalik adopts the scale used for the measurement of technology anxiety. The scale is known as Oetting's computer anxiety scale. There are ten items used in the research. The items are submitted into different categories. The score of the items is examined with a Likert-type scale. The scale can be used in data entry, business operations, and computer science. The value is found using the score of each variable.

Moreover, the research findings on computer anxiety are mixed. The research will eventually support the experience with computers to decrease anxiety. The rapid growth in technology and the internet has created ease for human life. Along with that ease, the internet negatively impacts human life. Metaverse has developed a new virtual reality but has negatively affected people's lives. The mental health of people is being affected by metaverse. To find the impact of the metaverse, the measurement scale is used. The scale is adopted by Irfan (2016). The scale has six items: demographic information, father's warmth, Rosenberg self-esteem scale, mental health continuum, extraversion vs. introversion scale, and peer relationship scale. These items are identified and examined to measure mental health, specifically in the metaverse. The scale Irsan et al. (2019) has helped measure digital healthcare products' logistics. The scale is based on seven items: type of business, gender, age, position, no. of employees, region, and medical records program. All the mentioned items are further classified and measured with frequency and percentage. The business can be expanded into different fields, i.e., pharmaceutical, medical device manufacturing, medical institute, logistics, and service sector. The analysis of the items can be performed using confirmatory factor analysis, as discussed in the referred study.

Moreover, the value can be formed using the structural equation model in the research. Di Pietro and Cresci (2021) developed the measurement scale for metaverse bandwidth fluctuations. The measurement scale uses two main headings, i.e., privacy and security in the domain of metaverse bandwidth fluctuations. These two are further divided into six items, three in each main heading. These items are used in the field of the metaverse, specifically in gaming. The items may include user profit, privacy, countermeasures, human in and out of the loop, integrity/authentication, polarization, and radicalization. All these items are studied separately and combined with the statistical approach to attain the outcomes.

3.2. Data collection process

Data analysis plays an essential part in the research. The analysis of the current research is based on the quantitative method. The sample is taken from the population, i.e., staff in the healthcare sector. The research has a defined sample of 350 questionnaires. Out of 350, only 330 questionnaires helped in analyzing the data. For data collection, the research has used a questionnaire survey technique. There were 350 questionnaires, out of which 330 helped interpret the results. The questionnaire is established using different measurement scales for each variable. The measurement scales are based on several items. The current research has attempted to use the highest possible number of items since more items ensure the results' accuracy. The questionnaires were distributed among the target population. The target population for the research is the staff from the healthcare sector. Therefore, the research has used the quantitative technique for data collection, extraction, and analysis, to study the relationship between the research variables and their impact on each other.

In contrast to all the measures and data analysis techniques, the researcher has also faced some issues during research, which were tackled using preventive measures. The foremost issue is the sample size, which could affect the findings and overall research. The sample size for research is standard to prevent the issues related to the results. The researcher has also left some gaps in the unfilled questionnaires. The second issue relates to the time horizon. The study could have used the longitudinal time method for data collection, but the time horizon selected by the researcher is cross-sectional as it favors the questionnaire survey technique. All the researchers and authors of past studies and measurement scales are recognized and provided with credits for their contributions. Lastly, the software for data authentication is used carefully to examine the accurate results. The variables and their relationship is identified, and the collected data is extracted and analyzed carefully in the research. Thus, the hurdles in the research are overcome using different techniques that favor the research.

4.   Findings
4.1.   Demographic Characteristics of Respondents

The staff of the healthcare sector in China has been targeted to gain the required response. For this purpose, there were 350 total questionnaires, out of which 330 helped interpret the results. The received questionnaires were 330 from the staff of the healthcare sector. The demographic features indicated that 70% were male and 30% were female in the total of 330 respondents which means that the Chinese healthcare sector recruits mostly male individuals as compared to females. The work experience also varied because there were 30% of employees whose work experience was between 2-4 years, 37% of employees had work experience of 5-7 years whereas 33% of employees had work experience of 8-10 years. The response rate was observed to fluctuate regarding digital healthcare products' logistics and mental healthcare in the metaverse.

4.2.   Descriptive Results

Descriptive statistics are meant to explain the main characteristics of the data used in the research.

Table 2
Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
TA	330	1.00	5.00	3.2776	.97211	-.293	.119
MHM	330	1.00	5.00	3.2212	.89062	-.492	.119
DHL	330	1.00	5.00	3.4494	.90917	-.502	.119
MBF	330	1.00	5.00	3.3588	.97763	-.361	.119
Valid N (listwise)	330						

In other words, it can be said the main features of the investigation can be gained through the tabular representation of the data which is the mean, medium, and skewness detail. The normality of the data can thus be illustrated through the results meeting the criteria of threshold ranges. The values that meet the criteria of the threshold range fit perfectly in the data and indicate there is no outlier present in the data that disturbs it.

The standard value of the mean lies near 3 and the minimum values explained in the table above are 1. Therefore it indicates there is no disruption in the data. The two other important reporting indicators are standard deviation and skewness values. The table explains that all the values such as technological anxiety, digital healthcare product's logistics, the metaverse bandwidth fluctuations, and mental healthcare in the metaverse have skewness values that fall in the cut-off threshold range along with the numerical figures of the standard deviation which reports the normality of the data.

4.3.   Rotated Component Results

The rotated component analysis is mainly done to assess and confirm the cross-loading appearance in the items of the questionnaire. In other words, it can be said that the

authenticity of items chosen for the questionnaire is determined through the rotated component matrix.

Table 3
Rotated Component Matrix

	Component			
	1	**2**	**3**	**4**
TA1	.769			
TA2	.716			
TA3	.640			
TA4	.733			
TA5	.804			
TA6	.761			
TA7	.776			
TA8	.604			
TA9	.704			
TA10	.818			
MHM1		.763		
MHM2		.768		
MHM3		.779		
MHM4		.729		
MHM5		.652		
MHM6		.710		
DHL1				.782
DHL2				.804
DHL3				.829
DHL4				.818
DHL5				.558
DHL6				.524
DHL7				.503
MBF1			.706	
MBF2			.665	
MBF3			.705	
MBF4			.634	
MBF5			.763	
MBF6			.725	

The items in above table 3 explained that there is no cross-loading in the data as the items of respective studied variables such as technological anxiety, digital healthcare product's logistics, the metaverse bandwidth fluctuations and mental healthcare in the metaverse have items appearing in their respective column so there is no cross-appearance of items and the rotated component results are authentic and trustworthy.

4.4. Validity Results

The validity results are significant to assess the reliability of the data and its accuracy. In the quantitative study, where cause and effect relationships of variables are to be determined, then the two types of validities such as discriminant and convergent have to be reported. These two validities indicate the authenticity and fitness of results regarding data collected through surveys.

Table 4
Convergent and Discriminant Results

	CR	AVE	MSV	TA	MHM	DHL	MBF
TA	0.817	0.617	0.302	**0.851**			
MHM	0.900	0.710	0.301	0.875	**0.893**		
DHL	0.971	0.855	0.388	0.681	0.501	**0.921**	
MBF	0.801	0.631	0.346	0.563	0.575	0.894	**0.866**

The above table illustrates the results of discriminant validities and the most crucial convergent one. The reported figures explain that the convergent validities are normally measured through composite reliability and average variance extract having threshold values greater than 0.05. The average variance extracted values for TA, MHM, DHL and MBF are 0.617, 0.710, 0.855, and 0.631 respectively, these values explain the study of these variables is valid, as the CR and AVE have all the values greater than 0.05. Composite reliability reports the authenticity of scales concerning each item. The CR values for TA, MHM, DHL and MBF

are 0.817, 0.900, 0.971 and 0.801 respectively.The variables such as technological anxiety, digital healthcare product logistics, the metaverse bandwidth fluctuations, and mental healthcare in the metaverse have discriminant validity indicating these to be distinct from the preceding variables indicating the value in bold figures. The discriminant validity results confirm, that the variables which are not theoretically correlated are found not to be linked in actuality too. As the discriminant validity values for technological anxiety have been reported in bold to be 0.851 which varies with 0.875 from MHM, 0.681 from DHL, and 0.563 from MBF. Similarly, the values of discriminant validities for mental healthcare in the metaverse, Digital healthcare products' logistics, and metaverse bandwidth fluctuation are 0.893, 0.921, and 0.866 respectively. This type of reporting confirms the basic validity of results through CV and DV.

4.5. Model Fitness Results

In the quantitative model-based research, the confirmatory factor analysis through the model fitness explores the discrepancies of measures among the seen/observed and the model application covariance or correlation matrices. Whereas, the indices of model fit explain or represent fluctuations or variations between the models implied and the data observed. It can be assessed through model fit measures whether the formulated or hypothesized model fits with the model fitness results indicating its supremacy and accuracy.
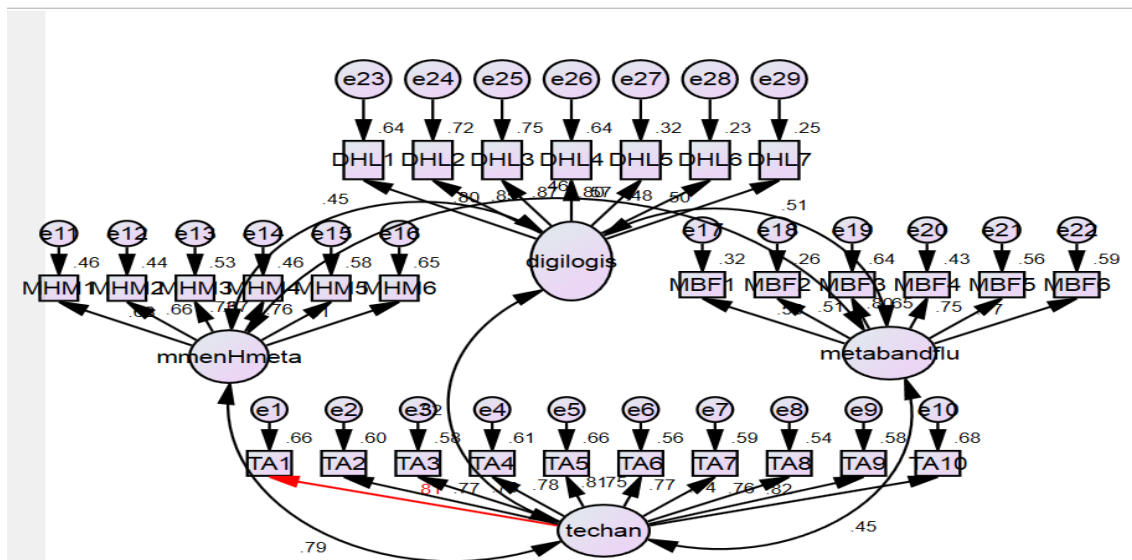

Figure 2: Model fitness
Table 5
Confirmatory Factor Results

CFA Indicators	CMIN/DF	GFI	IFI	CFI	RMSEA
Threshold Value	≤ 3	≥ 0.80	≥ 0.90	≥ 0.90	≤ 0.08
Observed Value	1.583	0.871	0.903	0.988	0.089

The confirmatory factor analysis explains the data through various measures of IFI, GFI, CFI, and RMSEA. The values explain the results whether fit with the data hypothesized model or not. The threshold or standard values defined for the measures are in the case for IFI the values must be less than 0.90 and this model explained the value to be 0.903 which is at the edge to meet the criteria defined for IFI. Similarly, the values for RMSEA, GFI, and CFI also fall in the defined range of the measures. The values of GFI, IFI, CFI, and RMSEA are 0.871, 0.903, 0.988, and 0.089 respectively So, to report the results of the confirmatory factor, it can be concluded that the model is fit and structural equation modeling can be performed.

4.6. Structural Equation Modelling

Structural equational modeling is the core analysis indicating the finalized decisions regarding the status of the hypothesis. These can be analyzed through the reporting of direct effects and indirect effects as well. The indirect standardized effects are often reported through the mediation and moderation present in the data. Table 5 explains the results of

structural equation modeling, and the impacts of digital healthcare products logistics on mental healthcare in metaverse indicates the acceptance of this hypothesis.

Table 6
SEM Results

Effects	Hypothesized Path	B	S.E	P value	Conclusion
Direct Effects					
Hypothesis 1	DHPL-→ MHM	.143	.053	0.00	Accepted
Restraint Effects					
Hypothesis 2	DHPL*MBF→ MHM	.172	.055	0.01	Accepted
Hypothesis 2	DHPL*TA→ MHM	.164	.051	0.00	Accepted

Hypothesis 1 is accepted as illustrated through a probability value which is less than 0.05 and is accepted, furthermore the review of literature has also indicated a strong bonding among the two variables and reported the acceptance of this hypothesis. Therefore, results indicated that digital healthcare products' logistics significantly impact mental healthcare in the metaverse i.e. (DHPL→MHM, β=0.143 and p=0.00). The graphical figures below elaborate on the indirect moderation effects of the hypothesis. Figure 2 illustrates that the moderating role of technology anxiety between digital healthcare products logistics and mental healthcare in the metaverse is significant having a p-value of 0.01 i.e. (DHPL*TA→MHM, β=0.172 and p=0.01). The results of figure 3 explain that the two red or blue lines intersect each other reporting the significant moderation of technology anxiety.
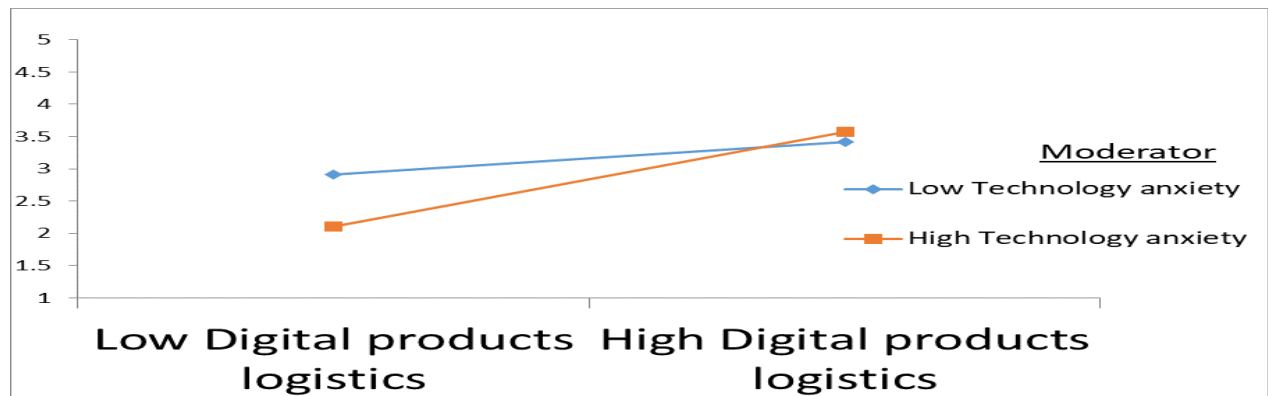

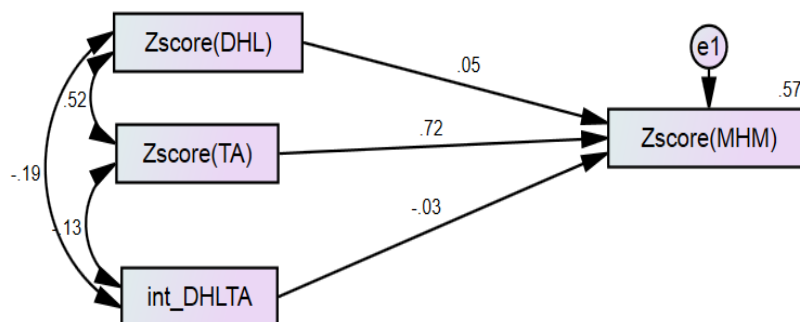*Figure 3: Graphical Moderation of Technology Anxiety*

Figure 4: SEM Moderation of Technology Anxiety

Figure 5 below explains the results of the fourth and the last hypothesis which is the moderating impact of the metaverse bandwidth fluctuations between the digital healthcare product's logistics and mental healthcare in the metaverse. The results reported the significant moderation of metaverse bandwidth fluctuations among the DHL and MHM. (DHPL*MBF→MHM, β=0.164 and p=0.01). So, the review of literature also assisted the idea of strong moderation among digital healthcare products logistics and mental healthcare in the metaverse. The two lines again intersect each other and present strong moderation between the dependent and the independent variables.
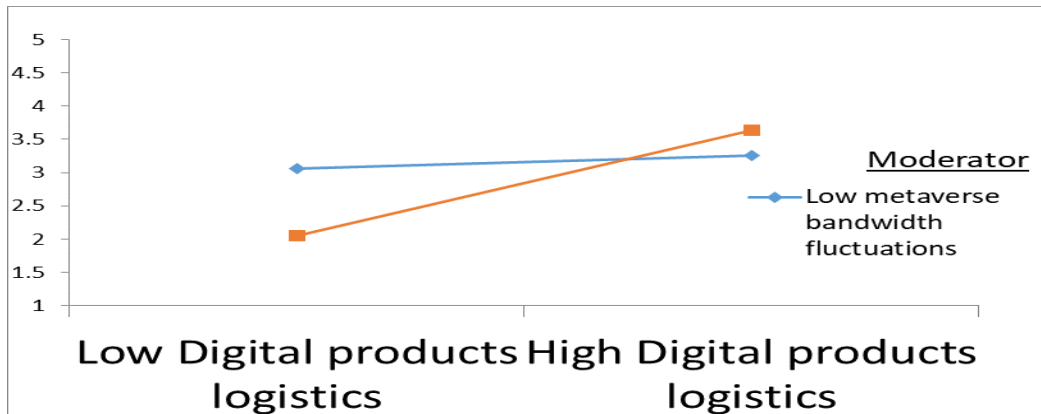
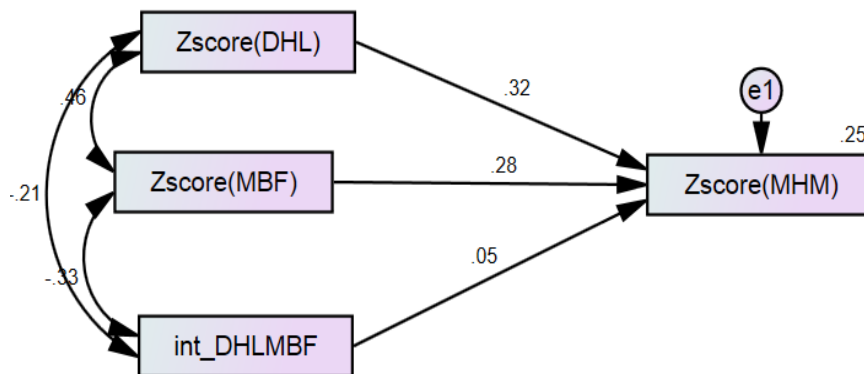**Figure 5: Graphical Moderation of Metaverse Bandwidth Fluctuations**

Figure 6: SEM Moderation of Metaverse Bandwidth Fluctuation

The results of structural equation modeling thus report the strong moderation through the indication of probability values less than 0.05 and its perfectly significant relation can be determined.

5. Discussion

The number of hospitals is found to be increasing day by day worldwide due to extensive care requirements. This has made things quite difficult for the healthcare sector as a large number of staff is required to carry out different processes. This has increased the costs on the healthcare staff. However, to deal with such issues, many healthcare sectors have taken the initiative of introducing digital technologies to carry out various operations cost-effectively as well as within the provided time. Therefore, healthcare logistics have always been a point of consideration, but very limited studies have focused on digital healthcare products' logistics. So the present study is efficient in this regard as its objectives mainly focused on digital healthcare product's logistics in the metaverse as well as mental healthcare of staff in the healthcare sector of China. Three important findings were attained from the tested hypotheses of the present study.

The first hypothesis of the present study was found to be accepted, and it stated that digital healthcare products' logistics through metaverse positively impact mental healthcare. This result was also supported by many past conducted studies (Jeffree et al., 2020). (Malhotra, Chakrabarti, & Shah, 2019) observed that the innovative measures taken by the healthcare systems have improved the digital supply chain of healthcare products. This is found to be effective in improving overall patient care as well as in providing better services to various associated stakeholders. Digital technologies have also helped in reducing the excessive burden on the healthcare staff, improving their mental health by decreasing the stress of work and other related anxieties (Liang, Zheng, & Zeng, 2019). However, the digitalized healthcare system also offers essential therapies for improving the mental health of not only patients but also healthcare professionals (Zhang, Grandits, Härenstam, Hauge, & Meijer, 2018). These studies align with the findings of the present research study showing the positive relationship between digital healthcare logistics and mental healthcare.

The second hypothesis of the current study was also found to be tested positive as per the findings and it was stated that technology anxiety significantly moderates the relationship between digital healthcare products' logistics through metaverse with mental healthcare. This finding was supported by previous studies which showed that excessive use of technology might lead to various issues such as technostress, technophobia, and many others (Venkatesan, Rahimi, Kaur, & Mosunic, 2020). All these factors contribute to technology anxiety. It has also been noted that the excessive use of technology not only impacts the mental health of the user but it also negatively influences the physical health of the user as it might lead to fatigue, nausea, headache, and other such symptoms. Proper measures are needed to be taken by healthcare professionals to prevent technology anxiety (Silverman et al., 2022). It has been recommended that a proper management system should be introduced for managing digital technologies for carrying out various operations in healthcare systems. Shifts should be arranged in this case as it prevents one individual from doing all of the technological work (Hornstein, Forman-Hoffman, Nazander, Ranta, & Hilbert, 2021). This helps in reducing the stress of the workers resulting in decreased mental health issues due to excessive utilization of technology. Contrary to this (Mrklas et al., 2020) supported digital technologies for improving the mental health of workers during the times of covid-19 pandemic as these technologies have helped in reducing the overall burden by optimizing various operations effectively.

The third hypothesis of the current was also found to be accepted, and thus it was concluded that metaverse bandwidth fluctuations significantly moderate the relationship between digital healthcare products' logistics through metaverse with mental healthcare . Previous studies helped in understanding the importance of metaverse bandwidths for transferring required information to provide mental healthcare therapies effectively (Bhattacharya et al., 2022). However, it has been observed that the fluctuations in metaverse bandwidths distort transferring such information. As digital technology is advancing continuously, the metaverse bandwidths have become an essential part of the healthcare systems in carrying out the necessary medical procedures (Yang, Siau, Xie, & Sun, 2022). The present research study has also supported these claims and has helped in determining the influence of metaverse bandwidth fluctuations in this context for attaining better and more effective implications in the healthcare systems.

The present study has helped in understanding the need for the transformation of the healthcare system to a digitalized healthcare system to improve the overall performance of the hospitals. Many researchers have encouraged digital supply chains in this context as they are found to be beneficial for the optimization of various operations which are carried out in hospitals (Y. Yang et al., 2022). Digital healthcare systems are effective in improving the basic healthcare services for the patients as well to achieve patient satisfaction.

6. Conclusion

The healthcare system is found to be pressurized due to the increasing number of serious diseases. This is negatively influencing the costs of healthcare treatments as they are found to be rising rapidly. The traditional healthcare product's logistics have also been found to be contributing to the increased costs. This has encouraged many healthcare sectors to opt for new as well as advanced digital technologies for carrying out various processes to cut down some costs. These days digital healthcare products' logistics are being used for this purpose. They are effective in providing better as well as cost-effective services as compared to conventional approaches. However, the excessive use of technology might also lead to technology anxiety in the professionals, and special care is needed to be taken while carrying out such processes. Proper arrangement of data is needed to be done in this case. Even though many past studies have focused on healthcare logistics in determining its influence on the mental health of the healthcare staff but almost none of the previous studies focused on the digital healthcare product's logistics in this context. So the present study is found to be beneficial in this case.

The current quantitative study was conducted to determine the relationship between digital healthcare products' logistics in the metaverse and mental healthcare of staff in the healthcare sector of China. The moderating roles of technology anxiety, as well as metaverse bandwidth fluctuations, were also determined in this context. The results attained from the current study show that digital healthcare product's logistics in the metaverse have a

significant impact on the staff in the healthcare sector, while both technology anxiety, as well as metaverse bandwidth fluctuations, have significant mediating roles in the relationship between digital healthcare product's logistics in the metaverse and mental healthcare of staff in the healthcare sector of China.

6.1. Research Implications
6.1.1. Theoretical Implications

The present research study is considered to be effective in providing detailed knowledge regarding the impact of technology anxiety as well as metaverse bandwidth fluctuations in the context of digital healthcare products' logistics. Technology is found to be advancing these days rapidly, so the logistics in the healthcare system are also becoming digitalized greatly. So the present study contributes to specifying the significance of digital healthcare logistics in the present scenario to encourage various healthcare professionals to utilize digital technologies to obtain required outcomes in minimum time. Digital logistics are cost-effective as well as less time-consuming, which have helped in improving the health-related issues faced by healthcare professionals as they are found to be more prone to various mental disorders such as depression, anxiety, and others. The theoretical framework of the current research has been effective in investigating the relationships between the variables of the present study.

The literature has helped in understanding the importance of digital healthcare logistics for improving the mental health of the associated stakeholders. Literature has also encouraged various policies for promoting the digital healthcare system in order to provide better healthcare products as well as services in contrary to the traditional healthcare system. The current study coule also be beneficial in comparing the traditional healthcare system and digital healthcare system for promoting effective operations to improve the overall healthcare system.

6.1.2. Practical Implications

Digital technologies are found to help maintain health records which can be used later for performing various clinical trials. The management in various healthcare sectors is using digitalized approaches for carrying out the logistics. This has helped in reducing inefficiencies as well as improving accessibility. The senior managers in various healthcare sectors can keep track of the operations that are being carried out in the organization by using effective digital technologies. Such practices have revolutionized the healthcare system drastically. Other essential stakeholders, such as the patients, are also found to enjoy the benefits of the digital healthcare system as they have easy access to healthcare professionals as well as the required treatment and medicines in contrary to the conventional healthcare system. The continuous implementation of digital healthcare products' logistics in the hospitals has also helped in improving the mental conditions of staff by preventing them from work overload. Digital technologies are being updated continuously according to the changing requirements of the healthcare system.

6.1.3. Limitations and Future Research

Every research study possesses its own merits as well as demerits. So is the case for the present research study. Various gaps are observed in the current study, which is considered to be effective in providing a way for future research. One of the most prominent gaps observed in the study is the lack of qualitative analysis due to limited time. The present study solely carried out quantitative analysis by using the survey method. This leaves a space for utilizing the mixed approach for future studies. Similarly, as the researcher did not have any organizational support, so the resources were limited, which explains the cross-sectional nature of the study. However, for future research studies, the longitudinal approach could be focused on. Additionally, the present study was only limited to digital healthcare logistics, and no attention was paid to the conventional methods of logistics due to the conservation of the researcher. This has prevented an opportunity of comparing digital non-conventional and conventional healthcare logistics. However, this limitation could be overcome in future studies. Another gap observed in the current study is the limited literature in the context of metaverse bandwidth fluctuations; the current study, therefore, will be effective for future

studies in this regard. No mediating variable is introduced in the conceptual framework for the present study due to the double moderation effect. This limited the effectiveness of the current study. For future studies, intrinsic factors such as motivation as well as self-efficacy could be taken as the mediating variables in the context of the current study for obtaining efficient results.

Authors Contribution
Pham Hoang An: Contributed to the conceptualization, data sorting, editing, referencing, analysis and write up of the paper.

Conflict of Interests/Disclosures
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