Exploring the Perspective of Service Quality in mHealth Services during the COVID-19 Pandemic

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Abstract—The impact of COVID-19 has a significant effect on all sectors of society globally. Health information technology (HIT) has become an effective health strategy in this age of distancing. In this regard, Mobile Health (mHealth) plays a critical role in managing patient and provider workflows during the COVID-19 pandemic. Therefore, the users' perception of service quality about mHealth services plays a significant role in shaping confidence and subsequent behaviors regarding the mHealth users' intention of use. This study's objective was to explore levels of user attributes analyzed by a qualitative method of how health practitioners and patients are satisfied or dissatisfied with using mHealth services; and analyzed the users' intention in the context of Taiwan during the COVID-19 pandemic. This research explores the experienced usability of a mHealth services during the Covid-19 pandemic. This study uses qualitative methods that include in-depth and semi-structured interviews that investigate participants' perceptions and experiences and the meanings they attribute to them. The five cases consisted of health practitioners, clinic staff, and patients' experiences using mHealth services. This study encourages participants to discuss issues related to the research question by asking open-ended questions, usually in one-to-one interviews. The findings show the positive and negative attributes of mHealth service quality. Hence, the significant importance of patients' and health practitioners' issues on several dimensions of perceived service quality is system quality, information quality, and interaction quality. A concept map for perceptions regards to emergency uses' intention of mHealth services process is depicted. The findings revealed that users pay more attention to "Medical care", "ease of use" and "utilitarian benefits" and have less importance for "Admissions and Convenience" and "Social influence". To improve mHealth services, the mHealth providers and health practitioners should better manage users' experiences to enhance mHealth services. This research contributes to the understanding of service quality issues in mHealth services during the COVID-19 pandemic.

Keywords—COVID-19, mobile health, mHealth, service quality, use intention.

I. INTRODUCTION

THE COVID-19 pandemic has received a worldwide attention. On February 1, 2021, more than 102.8 million cases were infected with COVID-19 worldwide [1]. Consequently, governments of several countries worldwide implement different methods to slow or stop the virus' spread,

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including border controls, quarantine, and social distancing protocols. According to the Taiwan Centers for Disease Control, as of February 2021, there were only 913 confirmed cases, 798 were imported in Taiwan [2]. Additionally, international travelers were required to complete a 14-day mandatory quarantine to curb the spread of the COVID-19 virus. Consequently, wearing a medical mask was mandatory in public areas [2].

Currently, the COVID-19 pandemic generates changes in healthcare. Thus, HIT is one of the essential tools in communication, patient care, medical appointment, and medical information linked to this dire situation worldwide. Mobile technology plays a vital role for improving healthcare because it leverages a technology incorporating smart phones and their applications (technology that most people already use around the globe) in times of crisis, such as the current COVID-19 pandemic [3]. Mobile health has been a tool in closing the gap in access to healthcare. In this context, mHealth is essential because it allows health practitioners to deliver necessary healthcare services through mobile communication technologies in various ways (e.g., observing quarantine patients, providing healthcare information, distribution of medical masks, etc.) [3]-[5]. The mHealth offers portability, mobility, personalization, and ubiquity. These advantages affect patient, health practitioners, and essentially to public health [6].

The use of mobile phones and its applications plays a vital role in healthcare in Taiwan; applications for medical appointments, distribution of masks, and mobile health consultations during quarantine are fundamental tools in crisis times, such as the current COVID-19 pandemic. However, challenges lie in the perceived quality of the mHealth services because of the lack of efficiency, reliability, privacy, and security for these information services. Service quality in mHealth is defined as the patients' (or users') judgment of the overall excellence or superiority of the mHealth service [7]. The recognition of service quality is currently critical because it is considered a means to increase user adoption of mHealth and to enhance better healthcare outcomes for patients [7]. It is noteworthy that quality perceptions influence users' inclination to take advantage of health services because health concerns are among the most prominent of human concerns [8]. The success of mHealth services depends on the users' (patients') perceptions of service quality because this is an essential element that significantly affects the users' satisfaction regards the use intention behavior [9], [10]. Preliminary work on service quality found that patients' behaviors are affected by the healthcare received quality, such as trust [11].

World Academy of Science, Engineering and Technology
International Journal of Economics and Management Engineering
Vol:15, No:5, 2021

This study aims to examine health practitioners, clinic staff, and patients' experiences using mHealth services. The research uses the collection and analysis of qualitative data. The purpose of the research was to develop and evaluate mHealth service quality during the COVID-19 pandemic in Taiwan. The collaboration involved in-depth interviews and discussion with health practitioners, clinic staff, and patients about the mHealth services and the performance in times of crisis, such as the current COVID-19 pandemic.

II. LITERATURE REVIEW

A. Mobile Health (mHealth)

Mobile health (mHealth) service may be defined as health care practice (e.g., storing, retrieving, and transmitting data) supported by mobile devices (e.g., smartphones), and real-time healthcare data transmission for remote users (or patients) enhancing users' safety and quality care [12]. mHealth service is an essential determinant of HIT, enhancing health care quality and promoting good health [12]. Therefore, this research focuses on the mHealth service in the COVID-19 pandemic in Taiwan. The mHealth service this study includes apps that users (or patients) use for mask distribution, medical appointments, provide consultation to quarantine patients and provide information to users about the disease COVID-19 [13].

Nowadays, the comprehensive mobile network coverage and the accessibility of low-cost smartphones are increasing mobile internet adoption. Thus, most people worldwide have access to communication and information services [14]. Therefore, different countries worldwide are using mobile communications (e.g., smartphones) to enhance different healthcare needs, such as data collection, remote monitoring, communication and information, outbreak tracking, diagnostic, and treatment support. Additionally, mHealth is faster, simpler, and cheaper than other platforms to establish in any environment that can expand healthcare strengths. In this context, mHealth facilitates ease of access to health care with straightforward medical advice through mobile phones at a low cost [14]. Thus, mHealth is experiencing higher adoption, and this technology can be seductive and intuitively feels useful by the easy access and low cost [14]. Thus, it is necessary to analyze the service quality in mHealth to develop a broad scale for health service outcomes [14].

B. Service Quality in mHealth

Quality is an essential factor for any service. The purpose of this paper is to evaluate and validate the perceived service quality of the mHealth services, which is defined as users' (or patients') judgment of service expectation related to the overall excellence or superiority of the mHealth service performance [15].

In the context of health care, several studies have explored service quality from the theoretical lens of two factors model based on technical quality, functional quality [16], and SERVQUAL model based on assurance, tangibles, reliability, empathy, and responsiveness [17]. Although many kinds of research have merged to contribute the mHealth service quality, it remains essential to understand the concerns about the service quality of mHealth and study the significant factors that enhance service quality delivery in mobile health in the context of the COVID-19 pandemic.

In another significant study, the researchers identify three critical dimensions of mHealth service quality that influence user satisfaction and use behavior (e.g., information quality, interaction quality, and system quality) [18].

System quality measures the service delivery systems and is defined as the users' (or patients) perception regarding patients' medical level of communication and system reliability, system efficiency, system availability, and system flexibility [19]. According to [20], the efficiency and the data processing of a system to integrate remote data can significantly affect the users' behavior and the users' satisfaction. Akter [18] identified three essential factors that can enhance system quality (e.g., system privacy, system reliability, system efficiency). System reliability refers to the capability to perform a reliable and accurate service. Privacy refers to the capability to which users believe the system is safe and can be trusted. Thus, system efficiency refers to how a system is easy to use and meets the user's different needs. Thus, system quality can be measured by the degree of easy use, reliability, adaptability, and real-time response [19].

Interaction quality is the direct communication and the interaction between the user and the service provider. Human communication is an essential tool that impacts users' satisfaction and uses the behavior of a mobile health care technology service [21]. Wu [22] argued that communication with service providers' personnel significantly influences service quality. Akter [18] identified three critical factors that define interaction quality and enhance system quality (e.g., cooperation, confidence, care). Cooperation refers to the service provider's capability to deliver and provide technical or information service to users. Confidence refers to the capability to which a system is considered reliable and safe to use. Care refers to customized attention from service providers to users. In the context of mHealth, interaction quality is when users (or patients) interact with a health practitioner over mobile health platform, providing solutions and attention to the users' needs.

Information quality is defined as the capability to which a service helps achieve a task [23]. DeLone [19] argued that the data information's content should be complete, easy to understand, and secured. Akter [18] identified two essential factors that can enhance system quality (e.g., utilitarian, hedonic). A practical benefit is 'the degree to which the mHealth information serves its actual purpose,' and a hedonic benefit is 'the degree to which the mHealth information service arouses positive feelings' [18]. In mobile health, users perceive service quality by the degree of the benefits derived from the mHealth service. Thus, the provided information should be complete and accurate to their medical problems to satisfy the users' needs.

World Academy of Science, Engineering and Technology
International Journal of Economics and Management Engineering
Vol:15, No:5, 2021

III. METHODOLOGY

To ensure the research's validity, the authors investigated the critical factors of service quality in previous studies based on marketing literature, as described in the literature review section. Following this procedure, the authors recognized three key dimensions (e.g., Information quality, Interaction quality, System quality) that reflect mHealth service quality perceptions. Thus, this research conducted a qualitative analysis to explore mHealth service quality and analyze the suitability of the critical dimensions regarding intention during the COVID-19 pandemic in Taiwan.

This study applied in-depth interviews to explore mHealth service quality to acquire more accurate information about the success factors development of mHealth services. In-depth interviews were conducted to collect the qualitative data with health practitioners, clinic staff, and patients' (or users) experience using mHealth services. There were five volunteer participants, divided into two focus groups, the first group integrated health practitioners and clinic staff and the second focus group integrated patients' (or users) experiences using mHealth services. Interview questionnaires were prepared ahead of time the interviews took place. All the interviews were carried out in the participant's preferred language for approximately 30 minutes with each respondent, and the interviews were digitally recorded and transcribed. Participants were recruited from one clinic's local population at a municipal private hospital in Kaohsiung, Taiwan. The criteria established by the researchers required potential participants to be over 18 years of age and have experience and knowledge about mHealth services. The in-depth interviews include participants aged between 18 and 60 years. Both males and females were represented. The method performed to form the focus groups involved two procedures. Firstly, the possible participants were provided with a description of mHealth services. Additionally, some examples of mHealth applications were provided (e.g., mask distribution, medical appointments, information about COVID-19) to ensure that they accurately understood the term's intended meaning. At the same time, the selected participants were contacted via telephone to confirm their participation and to decide the dates and times for the interview session.

Trained researchers conducted the interviews to recognize mHealth service quality dimensions. The researchers developed semi-structured interview guides with open-ended questions to explore the participants' perceived mHealth service quality. Participants were asked about their perception using mHealth services. Example questions included "In your opinion, what makes a great mHealth service?" "What are mHealth's major strengths or weaknesses?" and "Can you tell me about any positive or negative experiences you have had using mHealth services?". All the in-depth interviews were digitally recorded and transcribed then the research team members developed a codebook. The codebook was applied to all the data transcripts and was then analyzed by doing a manual content analysis system, and the content analysis was used for coding. It allowed the researchers to create categories,

group codes, and organize data into thematic categories. Different steps were involved. The first analytic step taken was to highlight the critical responses on the transcripts. The analysis identified important feedback associated with the dimensions of service quality and behavioral intentions. The second analytic step taken was to create categories of the responses, used to reflect the critical factors of service quality and the relationship between variables to blueprint a better description of the research. The third step taken was to create thematic categories by searching for patterns in the data and then reviewing, defining, and naming them by the authors. The final step was to select and analyze the themes based on attributes related to each research question and literature by rechecking the primary data and confirming the interpretation. The quality analysis aimed not to perform representativeness but rather to recognize significant patterns and variations [24].

IV. QUALITATIVE RESULTS

The research aimed to evaluate mHealth service quality during the COVID-19 pandemic in Taiwan. Three sections present our main findings. The first section discusses the perceptions regarding the technical competence of mHealth communication (System quality). The second section introduces the relationship developed between mHealth service and a user (Interaction quality). The third section focuses on the benefits of mHealth services or the users' perception as a result of users' (patients) interactions with mHealth services (Information quality).

The level of experience with mHealth services among the participants is variable. Thus, thematic analysis throughout the mHealth service qualitative study was involved in different levels of abstraction. Participants expressed their comments about primary service-level attributes, e.g., "The mHealth service is helpful," or "The interaction with mHealth is excellent," or "The professional show's interest to attend my needs," or "I prefer consulting with a professional face-to-face," or "It is worthwhile to use the service of mHealth," or "I can use mHealth services anywhere and anytime." Furthermore, this study found necessary support for service quality three factors (e.g., information quality, interaction quality, and system quality) despite the mHealth service qualitative study involved and indifferent abstractions.

A. System Quality

At this process, the study found three themes that constitute the users' perception of system quality (e.g., Convenience, easy use, and privacy). Convenience was referred to as a vital measure of system quality in mHealth services. Thus, Convenience was referred to the following comments: "I can use mHealth services anywhere and anytime," "I can make medical appointments right away," and "I have access to important information about the COVID-19 pandemic anytime". In contrast, a participant comment: "I prefer consulting with a professional face-to-face than by a mobile phone." Additionally, a participant with quarantine experience comments: "mHealth is a convenient platform, provided me confidence during quarantine." The second theme, easy use

World Academy of Science, Engineering and Technology
International Journal of Economics and Management Engineering
Vol:15, No:5, 2021

describes how easily users can use mHealth services to meet their needs [25]. The following comments reflect this: "The interaction with mHealth is easy" and "It can provide the information that I need." The third theme, privacy describes the degree of users' health information security and protection [25]. The following comments referred to privacy: "mHealth service protects my personal data information" and "mHealth keeps confidential my personal information."

B. Interaction Quality

At this process, the study found three critical themes that constitute the users' perceptions of interaction quality (e.g., care, confidence, and cooperation) [26]. The following comments referred to cooperation: "Professional shows interest to solve my health care needs." The second theme, confidence, describes the degree of trust and confidence among users using mHealth services [26]. The following comments referred to confidence: "I feel confident while consulting with the professional" and "I trust the professional during online consulting about my problem." Additionally, a participant with quarantine experience comments: "I feel confident to have a professional anytime." The last theme, care, describes the professional's caring and personal attention to the users (or patients) [26]. The following comments reflected care: "The professional understands my health problem" or "The professional give me personal care" and "The professional cares to solve my needs." This research believes that these three themes are essential indicators of interaction quality in the context of mHealth service quality.

C. Information Quality

At this process, the research found two important themes that constitute the customers' perceptions of interaction quality (e.g., practical, hedonic benefits) [26]. Utilitarian benefits measure the degree of all those benefits derived from the utility of mHealth that serves its actual purpose. The following comments referred to the practical benefit: "It is useful for my medical appointments" and "It is beneficial for keeping important up-to-date information about the COVID-19 pandemic." Utilitarian benefits of mHealth (i.e., usefulness) play an essential role in developing a positive attitude toward the behavioral intention of mHealth services [26]. Hedonic benefits measure the degree of positive feelings towards mHealth services [27]. The following comments referred to the hedonic benefit: "I consider my health will improve having the online consultation using mHealth services during quarantine" and "I feel hopeful having mHealth service to improving my health checking during my quarantine." Hedonic benefits have received much attention in recent years to stimulate users' beliefs regarding their perception of service quality [27].

V. DISCUSSION AND CONCLUSION

The research aimed to develop and evaluate mHealth service quality during the COVID-19 pandemic in Taiwan. The collaboration involved in-depth interviews and discussion with health practitioners, clinic staff, and patients about the mHealth services and the performance in times of crisis, such as the current COVID-19 pandemic. Thus, mHealth service quality in times of crisis, such as the current COVID-19 pandemic, makes an essential contribution to theory, method and practice. The qualitative results found several important themes, including significant perceived benefits of mHealth services, and mHealth care acceptability for users (or patients) during quarantine. Potential inhibiting factors were also identified. Additionally, the results show how mHealth service quality affects users' (or patients) emergency use intention for health activities during the COVID-19 pandemic.

In the system quality dimension, the qualitative data analysis results show a difference of perspective for the most influential dimensions; therefore, the sequencing of the existing criteria varies. However, the highest weight in the system quality dimension is convenience, which was chosen by four of the five interviewees. In contrast, one participant believes that mHealth service is convenient for basic health services (e.g., mask distribution, medical appointment, information about COVID-19) but is not significant for personal medical consultation due to mHealth medical consultation is shorter and includes less presentation and discussion of problems than face-to-face consultation. A possible explanation for this is that COVID-19 pandemic has had a smaller impact in Taiwan than in most other countries. Thus, the general population has never had to go into lockdown and people had a normal routine access to health care services in hospitals. Additionally, this research found that easy use and privacy emerged as important indicators that influence positively mHealth service quality. In the interaction quality dimension, the qualitative analysis results show a positive perspective for the influential factors. These findings seem to indicate that a positive cooperation behavior by professional, caring of the professional to the users and the degree of trust and confidence among users using mHealth services were associated with the intervention of the mHealth service quality. In other words, doctors and mHealth providers must be encouraged to make special efforts to improve their skills in communication in the mHealth service situation. Thus, this study found that care, confidence and cooperation emerged as important indicators of interaction quality in the context of mHealth service quality. According to the information quality dimensions, the results determine a significant perspective for the influential factors. These findings reflect that the usefulness and the users' positive feelings are key determinants of mHealth service quality. Thus, mHealth service providers must improve customers' perceptions of mHealth platforms by offering customers information of the benefits of mHealth services in the context of the COVID-19 pandemic. On the other hand, a health practitioner must improve different actions in order to deliver a beneficial medical consultation such as, encouraging users (or patients) in their treatment or empowering patients with information of the treatment. Thus, utilitarian and hedonic benefits are vital indicators of information quality and have a positive influence on mHealth service quality.

This paper evaluates the critical factors of mHealth service

World Academy of Science, Engineering and Technology
International Journal of Economics and Management Engineering
Vol:15, No:5, 2021

quality during the COVID-19 pandemic in Taiwan. Findings indicate that improving system quality, interaction quality, and information quality is essential to enhance mHealth services. Additionally, these dimensions are driven by six sub-dimensions. The sub-dimensions include convenience, easy use, privacy, care, confidence, cooperation, utilitarian, and hedonic benefits are essential to enhance the use of mHealth services. Moreover, the findings of this study provide health practitioners and mHealth providers with valuable insights into the factors that affect customers' health service quality perceptions, improving Taiwan's response to the COVID-19 pandemic.

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