

University of Wales Trinity Saint David

Master of Business Administration

Factors affecting the intention to use telemedicine services in Hong Kong – from the perspective of patients and medical professionals

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DECLARATION

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Abstract

In Hong Kong, telemedicine service has been available in the market, but the development has not been able to catch up with the rapid growth compared to other countries. The usage was obviously found to be increased during the Covid-19 pandemic, but will it sustain in long run? This research focuses on the factors affecting the intention to use and identifies the challenges for two stakeholder groups, the patients (end user group) and the medical professionals (service provider group), to adopt this services.

Several independent variables such as performance expectancy, effort expectancy, social influence, subjective norms, and privacy were identified. A total of 439 surveys were received with 214 for service provider group and 225 for the end user group. The results showed that the intention to use telemedicine service was significantly associated with all predicted independent variables, and there was no difference between the service provider and end user groups.

However, some factors such as access to medical care and the medical professional's practicing location significantly affected the performance expectancy and subjective norms, respectively.

The key barriers to adopting telemedicine services were related to perceptions on reduced clinical assessments by doctors, coverage on insurance or healthcare vouchers, and the easy access to medical care physically. Based on the results, recommendations have been made to improve the telemedicine service provision in Hong Kong, including formulation of regulation, expansion on insurance coverage or subsidy scheme; selection of service area; and support on

online to offline services. Improvement should be prioritized to gain confidence from the service provider, who will then initiate and promote the services to the public.

Keywords: Telemedicine, Patient, Medical Professionals, Service Provider, End User, Hong Kong, Intention to Use

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1. Introduction

Telemedicine has a long history back in 1879 when a telephone was used as a home-based setting for health care to reduce unnecessary patients visits to clinics. Through decades of development, telemedicine has transitioned from different stages with technology advancement and involved a broad spectrum of specialties such as teledentistry, teledermatology, teleradiology, telepathology, etc. (Board on Health Care Services and Institute of Medicine, 2012). Telemedicine usage has not been widely adopted until recent years, when the COVID-19 pandemic hit the world. It has been adopted well so well in some countries that it has brought in a new direction for the healthcare evolution, however, in some countries, it has not settled so well and not been able to utilize to benefit the medical system (Cheng, 2020). This research studies the telemedicine service in Hong Kong, identifies where we are and what determines the adoption amongst different stakeholders.

1.1 Definition of Telemedicine

World Health Organization (2010) defines telemedicine as ‘The delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for the diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities’. There are four main elements of telemedicine: to provide clinical support; to overcome the geographical area and connect users who are not physically in the same location; to involve the use of ICT; and to improve health outcomes.

In Hong Kong, telemedicine is not regulated, but the Medical Council of Hong Kong is the appointed authority to oversee the practice from the medical professionals. Telemedicine is defined as ‘The practice of medicine over a distance, in which interventions, diagnosis, therapeutic decisions, and subsequent treatment recommendations are based on patient data, documents and other information transmitted through telecommunication systems.’(The Medical Council of Hong Kong, 2019).

In concluding both definitions, it can be summarized that telemedicine is provided through a distance with the aid of communication technologies, that the medical professionals can provide diagnosis, treatment, and their care by the information or data that they have collected via the channel.

1.2 Regulations and guidelines for telemedicine

During the time of the COVID-19 pandemic, the rise of telemedicine services has urged the WHO to publish a guiding principle for implementing telemedicine services. Though it is not a worldwide regulation for the service, it outlines the basic principles for the governing officials to plan and implement telemedicine services in their states (WHO, 2021). It also highlights the importance of the legal framework to cover a wide range of areas such as practitioner’s scope of practice, quality of care, liability and medicolegal issues, privacy, and data protection, etc. For example, medicolegal uncertainty can be a significant barrier to the implementation of telemedicine. This uncertainty may include which jurisdiction would apply to the telemedicine practice if both parties were located at a distance in different countries.

According to a global guide for telemedicine (DLA piper, 2020), regulations for telemedicine vary according to different countries. Table 1 summarizes the regulations of telemedicine in the Asia Pacific Regions. Most countries have produced guidelines for the medical professionals to advise their practices on telemedicine, however, not all countries have regulations by the Government. Of all the countries, China and Singapore appeared to have the highest authority to involve in the regulation while Hong Kong and Thailand remained simply as a guideline issued by the Medical Council. Concerning the guiding principles issued by the WHO (WHO, 2021), Hong Kong's regulatory development on telemedicine service is lagging and as compared to other countries, the response by the governing body to support this service during the COVID-19 has been insufficient.

Table 1. Summary of regulations within the Asia Pacific Regions

Countries	Regulation bodies
Australia	Australian Health Practitioner Regulation Agency (AHPRA) – AHPRA Guidance
	The Medical Board of Australia – Code of conduct: Guidelines for technology based patient consultation
	Royal Australian College of General Practitioners ("RACGP"): Guide to providing telephone and video consultations in general practice
China	PRC National Health Commission and National Administration of Traditional Chinese Medicine pursuant to PRC State Council's Opinion to Promote "Internet Plus Healthcare" promulgated on April 25, 2018
	Administrative Measures for Internet Diagnosis and Treatment
	Administrative Measures for Internet Hospitals
	Good Administrative Practice for Remote Medical Services
Hong Kong SAR	The Medical Council of Hong Kong - Ethical Guidelines
Japan	Medical Practitioners' Act or various guidelines issued by the Minister of Health, Labour and Welfare
Singapore	National Telemedicine Guidelines
	Singapore Medical Council's Ethical Code and Ethical Guidelines and Handbook on Medical Ethics
	Regulatory Guidelines for Telehealth Products by the Singapore Health Sciences Authority (Medical Devices Branch)
	Health Products (Licensing of Retail Pharmacies) Regulations and Telepharmacy Guidelines
	Singapore Dental Council's Ethical Code and Ethical Guidelines
	Healthcare Services Act (to be launched in 2022)
Thailand	Notification issued by the Thai Medical Council

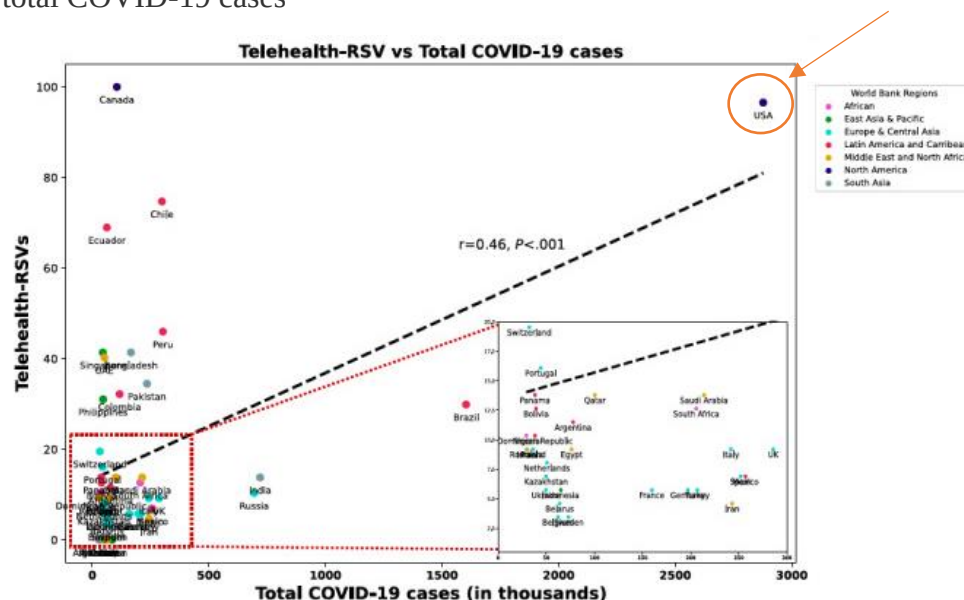
Source: DLA Piper (2020)

1.3 Worldwide telemedicine development during COVID-19

Although telemedicine service has long been existing, its utilization has not been substantial until the COVID-19 pandemic. Data presented by McKinsey & Company shows that telemedicine was 38% higher than before the pandemic and investment in virtual health in the first half of 2021 almost doubled as compared to 2019 (Bestsennyy et al., 2021).

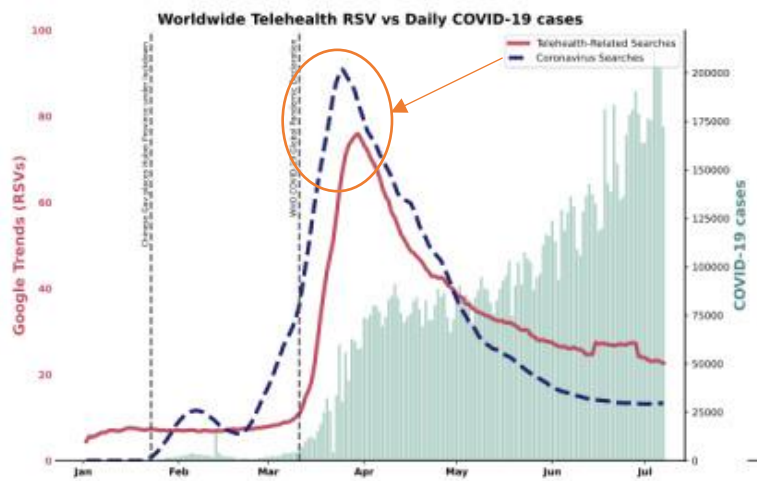
Wong et al. (2021) carried out a study to show the relative search volume (RSV) on the internet during the COVID-19 pandemic. It showed that countries with a high number of COVID-19 cases such as the USA and Brazil, resulted in a high interest in the telehealth search on the internet (Figure 1) and the pattern of telehealth related search was similar to the keyword search for coronavirus happened in the first half of 2020 (Figure 2).

Figure 1. Correlation between total telehealth-related relative search volumes (RSVs) against total COVID-19 cases



Source: Wong et al., 2021

Figure 2. Worldwide time trends for telehealth-related search volumes (RSVs) against daily COVID-19 cases



Sources: Wong et al., 2021

In China, telemedicine is part of digital health initiatives following the 5G technology development. With the aid of the 5G technology, telemedicine in China was worth RMB 255.8 billion in 2020, with a 50% growth rate (CN-Healthcare 健康界研究院, 2021). The success from China was partly due to the advanced development of its infrastructure where digital platforms played an important role in the overall telemedicine implementation (The Chinese Academy of Industry Economy Research 中商产业研究院, 2021). Platforms such as AliHealth or Ping An Good Doctors, provide O2O services to customers and support to digital health. According to Ping An Healthcare and Technology (2020), the number of virtual consultations provided in 2021 first half was 1,182 million times, which was a 17.8% increase as compared to the full year of 2020. In 2020, the total revenue from virtual consultation was RMB 1.5B (USD \$235M), recording an 82.4% increase. This shows that telemedicine service in China has successfully provided an alternative means of medical care during the pandemic.

1.4 Situation in Hong Kong

In January 2019, COVID-19 started to hit Hong Kong. The fear and worries of large crowd gathering and the exposure to high-risk venues encouraged people to find an innovative solution under the 'new normal'. Telemedicine service became a suitable alternative solution to patients and healthcare professionals to enable the provision of care at a distance (Yip, 2019). A Digital Health Survey (Cimigo, 2020) conducted by a marketing company asked 520 people about their perception of telemedicine, from a scale of 1 to 5 with 5 being 'very attractive', 49% of the sample rated 4 or above. The main reasons to use such service were categorized as convenience as there was no need to queue at the clinics and the consultations could be held at any time at home. However, most of the population would still prefer to have physical visits to hospitals or clinics (45%) given that the telemedicine service was an option (Cimigo, 2020). The results were similar to a survey done by Lingnan University for senior citizens in 2020, in which the willingness of trying telemedicine during a pandemic was carried out (Lingnan University Hong Kong, 2020). More than 60% of the senior citizens were willing to try the telemedicine service under the COVID-19 pandemic, and the education level of those senior citizens was amongst those with secondary education or above. The result also showed that the willingness to undergo online medical consultations may vary depending on the education level and living standard.

These show that the Hong Kong public is willing to try telemedicine services, however, what about the medical professionals who are the service providers of the services? Tong et al. (2021) held a webinar in 2020 with the members from the Hong Kong College of Family Physicians (HKCFP) in partnership with the Medical Protection Society (MPS). Discussions on the medicolegal implications of the use of telemedicine were carried out. Of all the attendees, 75% of the participants reported the use of telemedicine in any form. 95% of the respondents believed

that more telemedicine trainings were required and 88% wanted regulatory updates on rules and regulations. It was identified that there were numerous medicolegal pitfalls in telemedicine which required to be addressed to increase the confidence level on this service.

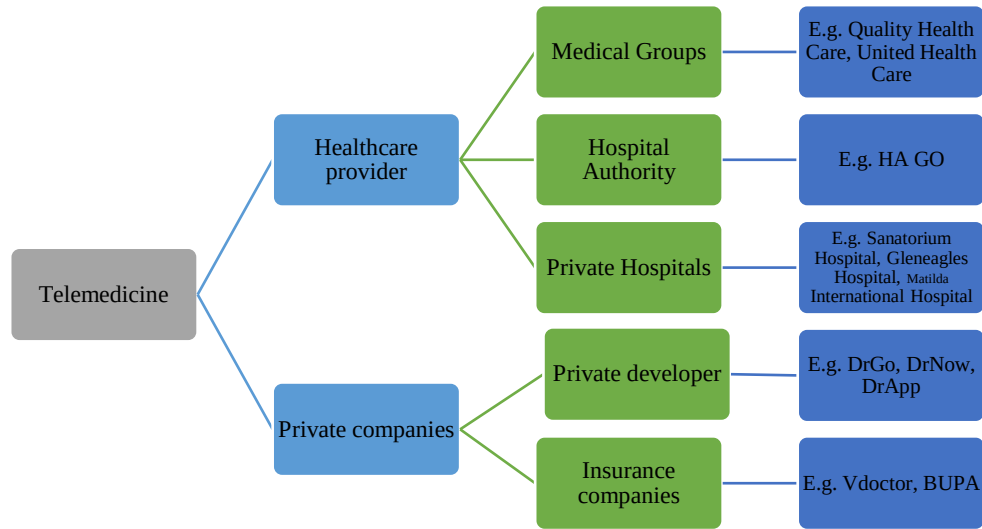
From this information, it can be concluded that the willingness to try telemedicine by the service provider and end user is positive in Hong Kong. However, the actual rate of adoption from the public has not been studied so it remains uncertain how the willingness can be pushed forward to implementation.

1.5 Sources of telemedicine in Hong Kong

The sources of telemedicine services in Hong Kong can generally be classified into two main categories: Healthcare organizations or private companies (Figure 3). Healthcare organization has a strong supply chain of medical professionals and clinical support whereas private companies are stronger at software development. They often rely on third parties to adopt the platform and provide the services.

Table 2 summarizes the telemedicine services provided by the hospitals and private companies in Hong Kong. Services provided by the private hospitals mainly focus on the existing patient where the former patient and doctor relationship has already been built, this is in line with the recommendations made by the Medical Council from Hong Kong. However, private platforms provide the channels to the public where patients can select a list of doctors virtually.

Figure 3. Sources of telemedicine service in Hong Kong



Source: Compiled by the author

Table 2. Summary of telemedicine services provided in Hong Kong

	DrGo	DoctorNow	DrApp	BowtieGo (Vdoctor)	BUPA	Sanatorium Hospital	Gleneagles Hospital	Matilda Int'l Hospital	HA Go
Website	www.drgo.com.hk/	app.doctornow.hk/	www.drapp.com.hk/	bowtiego.com/	www.bupa.com.hk	hksh.com	gleneagles.hk	www.matilda.org.hk	www.ha.org.hk
Target audience	Public	Public	Public	3Care membership	BUPA members only	Hospital's existing patient	Hospital's existing patient	Hospital's existing patient	HA's existing patient
Other Services	Health store, covid testing	Appointment booking, home care service	HA service waiting time, appointment booking, education	3Care membership	X	X	X	X	X
Service Hour	Mon- Sun: 8am-8pm	Not listed	Not listed	Not listed	Not listed	Not listed	Not listed	Not listed	Not listed
Delivery of medication	Yes	Yes	Not listed	(2 days medication)	Delivery fee: \$80	Sanatorium hospital only	Gleneagles hospital only	Matilda International Hospital only	Hospital Authority only
	(within 4 hours)			Union Medical Healthcare	(5 days medication)		Can arrange delivery		
Price	HKD 368-450	HKD 400 – 780	Not listed	Membership monthly or annual fee	Not listed	HKD 320-2500	Not listed	Not listed	Not listed
	(3 days medication)	(not mention about medication)							
Doctor network	Gleneagles Hospital; Matilda Int'l Hospital; Precious Blood Hospital;	Private doctor network	Private doctor network	Not known	BUPA network	In house doctor	In house doctor	In house doctor	In house doctor
	Quality Healthcare, etc								

Source: www.drgo.com.hk; app.doctornow.hk; www.drpp.com.hk; bowtiego.com; www.bupa.com.hk; hksh.com; Gleneagles.hk; www.matilda.org; www.ha.org.hk

1.6 Benefits of telemedicine to Hong Kong

The benefits of telemedicine have been supported by many studies that it is cost-effective; and can improve accessibility and the quality of care (Kung et al., 2016; Hailey et al., 2002; Lee and Lee, 2018; Hjelm, 2005). Besides, the telemedicine service is also regarded as the strategic solution for relieving the burden on the healthcare sector amidst the aging of the population (Cheng, 2021; Varma and Ricci, 2012; Latifi et al., 2011). The healthcare burden in Hong Kong is severe. According to the statistics published by the Food and Health Bureau (HKSAR, 2021), total health expenditure rose at an average annual rate of 5.6% and the total health expenditure as a percentage of GDP went up from 3.6% in 1989/90 to 6.8% in 2019/20. The government expenditure on social welfare and health increased 181%, from \$53.7 billion to \$151.0 billion from 1998/99 to 2018/19 (Wong and Yeung, 2019). This is the result of the increased aging population which is pressuring the healthcare system in Hong Kong (Yip, 2019; Chen, 2017). The Hong Kong Census and Statistics Department has projected that the number of elderly persons will increase from 1.32 million (18.4% of the total population) in 2019 to 2.52 million (33.3%) in 2039. In 2069, the number of elderly persons is projected to reach 2.58 million (38.4%) (Census and Statistics Department, 2020). With the evidence of an existing and projected problem in Hong Kong, Hong Kong must provide a resolution to tackle these problems and telemedicine may be one of the solutions to relieve the medical burden in long term.

1.7 Usage of telemedicine in Hong Kong

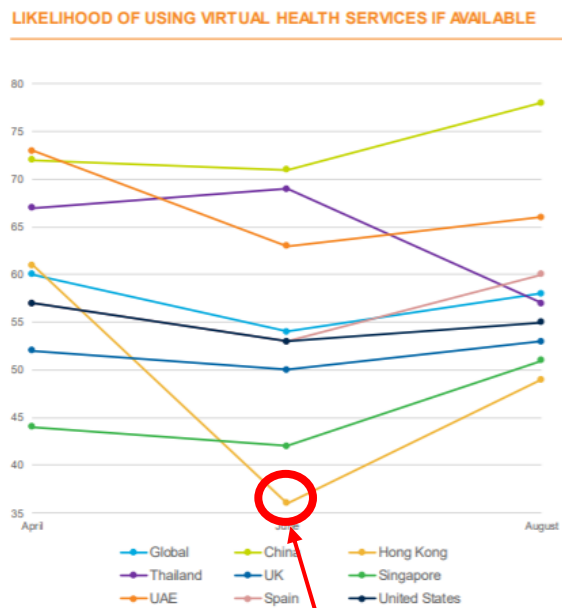
DrGo, a member of the Hong Kong Telecom group, recorded 218K registered users from launch (2020) until July 2021 (HKT, 2021). UMP Healthcare Holdings Limited, one of the largest listing medical groups in Hong Kong, provides telemedicine service as an alternative to their

patients, recorded a 10-fold increase of registered users in June 2021 as compared to the same month in 2020. The total number of virtual consultations in June 2021 was 27,000, as compared to 10,000 cases in June 2020 (UMP Healthcare Holding Limited, 2021).

Although there was a record of increased uptake, the future of telemedicine in Hong Kong remains uncertain. A study from Cigna, a worldwide insurance company, revealed that during the COVID-19 pandemic, Cigna's telehealth app downloads rose 130% and logins increased 134% between February and March 2020 as telehealth customer usage increased 514% globally during the same period. However, 63% of respondents in Hong Kong said they had no access to virtual services, as compared to 23% from the United States.

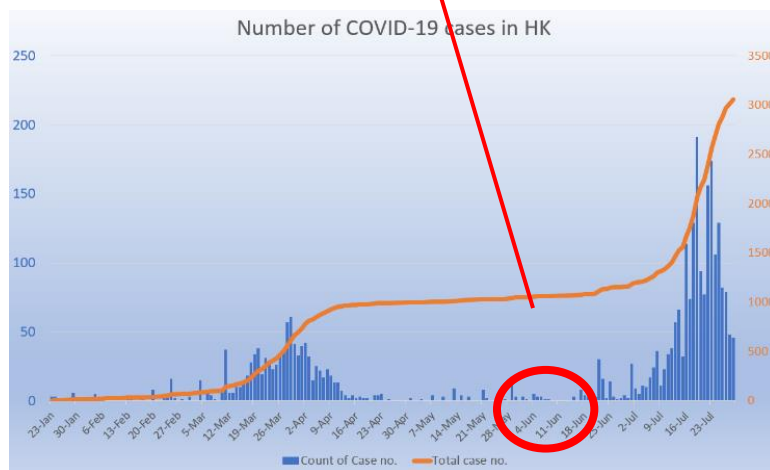
Interestingly, the uptake of telemedicine could be reflected in the severity of the pandemic. Figure 4 shows the likelihood of using such a service decreased in June 2020, which was the period when Hong Kong had the least number of confirmed cases (Figure 5). Figure 6 shows that Hong Kong resulted in the lowest in market perception and usage. It was described that Hong Kong people had used virtual services in the past, but their preference for access to healthcare was via traditional in-person visits to clinics and hospitals. In first quarter of 2022, a fifth wave of Covid-19 hit Hong Kong. This wave inserted a severe impact to the city, different healthcare sectors even the Government official (Dimsumdaily, 2022) encouraged to use telemedicine as an alternative means of care (Now 2022; MingPao, 2022; HK01, 2022; Wong et al., 2022). A private hospital, Hong Kong Sanatorium Hospital, stated that since April 2020, the hospital had provided telemedicine services to 6,000 patients and depending on the Covid situation, they were willing to double the quota (HK01,2022).

Figure 4. Likelihood of using virtual health services



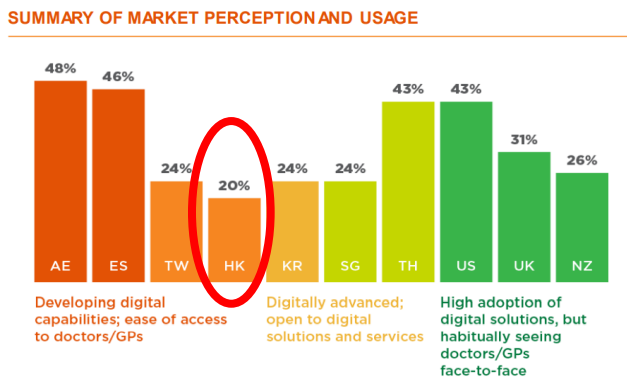
Source: Cigna (2020)

Figure 5. Number of COVID-19 cases in Hong Kong



Source: HKSAR (2020)

Figure 6. Summary of market perception and usage of telemedicine services



Source: Cigna (2020)

1.8 Research question

Various studies have highlighted that telemedicine service in Hong Kong is lagging as compared to other countries (Cheng, 2019; Cigna 2020). As per the description of all the benefits of telemedicine, it is important that Hong Kong is moving towards the development of such services to relieve the medical burden in the health care system. The success of telemedicine relies on multiple factors and the adoption from the service providers. Covid-19 has opened an opportunity for Hong Kong to take this first step and studies have shown that the public is willing to try telemedicine service. However, there are also studies showing the drop in usage when the Covid-19 was relieved (Cigna, 2020). If telemedicine is believed to be a positive tool to relief medical system, it is in the hope that telemedicine can be lasted post Covid-19 era. **As such, what are the actual factors, other than the pandemic, that can promote the uptake of telemedicine by different stakeholders? What are the key barriers between the stakeholders and how can telemedicine be sustainable in Hong Kong?**

1.9 Research objective

This study focuses on understanding factors affecting the intention to adopt telemedicine services in Hong Kong between the two stakeholder groups: the patients and the medical professionals. In this study, the former will be defined as the end user, whereas the latter will be defined as the service provider (SP). Through an in-depth interview with a reliable source, a thorough understanding of the current telemedicine service in Hong Kong will be achieved. A survey will be given out to both stakeholder groups and data collected will be discussed, analyzed, and compared. This allows an identification of the behavioral gaps which will be important to help authorities to further develop and promote the telemedicine services in Hong Kong.

2. Literature review

This study includes research into the intention to use telemedicine services for both service providers and end-users. Service provider (SP) is defined as organizations or healthcare professionals such as doctors, nurses, and allied health professionals, whereas end-user (EU) is defined as patients or people receiving telemedicine services.

2.1 Literature Search

A literature review focusing on ‘willingness’ or ‘intention’ to use was performed. Database through the University’s platform such as EBSCOhost and ProQuest, as well as internet search platform Google Scholar, were used for the search. A few keywords such as ‘telemedicine’, ‘telehealth’, ‘intention to use’, ‘willingness to use’ were used during the search. As the study focuses on the population in Hong Kong, ‘Hong Kong’ was also used in the keyword search. The

literature search focused on learning the theoretical frameworks and identifying the independent variables to affect the intention to adopt telemedicine services.

2.2 Theoretical framework

The adoption of telemedicine service can be seen in different literature reviews as using a new information technology system or planned behavior (Harst et al., 2019). Much literature studied the area using other or multiple theoretical frameworks to cover a broader spectrum of independent variables. Harst et al. (2019) carried out a systematic review to predict end-user acceptance of telemedicine. Based on this review, two theoretical models with the highest median variance: the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT), are chosen for further discussion below. In addition, Task Technology Fit (TTF) and Social Cognitive Theory (SCT), were also used several times with other models to study the related area.

2.2.1 *The Technology Acceptance Model (TAM)*

The Technology Acceptance Model (TAM) has been one of the most popular models to study technology acceptance. Developed by Davis, TAM forecasts the adoption of new technology among users and includes two significant factors, perceived ease of use and perceived usefulness (Kamal et al., 2020; Kowitlawakul, 2011). Perceived usefulness is the degree to which an individual believes that using a particular system would enhance their job performance. In contrast, perceived ease of use is the degree to which an individual believes that using a specific approach would be free of physical and mental effort (Chutter, 2009). In the systematic review

on theories predicting end-user acceptance of telemedicine use, 11 out of 24 studies used TAM to explain the acceptance in which health care providers were used seven times and patients were used three times (Harst et al. 2019). In a very early study on the physician's acceptance of telemedicine in Hong Kong (Hu et al., 1999), TAM was chosen to be the model to study and identified that perceived usefulness was a significant determinant of attitude and intention, but perceived ease of use was not. Kamal et al. (2020) used TAM to investigate the willingness of patients to utilize telemedicine services and extended the models to cover additional independent variables.

The framework was not envisioned to address the use of technology in a broader scope but mainly conceptualized for individual perception and purpose (Ajibade, 2018). There were also arguments that the framework did not consider several factors such as demographics, social influences, or subjective norms. Therefore, researchers have further modified the model to include other related factors.

2.2.2 The Unified Theory of Acceptance and Use of Technology (UTAUT)

The UTAUT model was published by Venkatesh and Davis in 2003 (Venkatesh et al., 2003). UTAUT aims to assess the likelihood of success for new technologies and understand acceptance drivers. It is an extended theory based on TAM, the Theory of Reasoned Action, and the Diffusion of Innovation Theory. There are four key variables: Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating Conditions. Originated from the TAM, performance expectancy can be described as the 'perceived usefulness', whereas effort expectancy is similar to 'perceived ease of use'. The new factor, social influence, is how users

perceive the importance of use from others. In contrast, the facilitating conditions are when an organization and technical infrastructure exist to support system use (Ammenwerth, 2019). As social influence is one of the factors in the theory, it is mainly used to study the willingness to use new technology for patients instead of health care professionals (Harst et al., 2019).

UTAUT is a relatively new model to study the intention to use technology, this has become a prevalent model to be used in recent years during the COVID 19 pandemic (Napitupulu and Kusuma, 2021; Zhai et al., 2019; Semiz and Semiz, 2021; Yamin and Alyoubi, 2020). Yamin and Alyoubi (2020) used UTAUT and Task Technology Fit (TTF) model to study the adoption of telemedicine applications among Saudi citizens during the COVID-19 pandemic. They identified that performance expectancy, effort expectancy, facilitating condition, social influence explained substantial variance R^2 79.5% in predicting user intention to adopt telemedicine services. Another study used the UTAUT and TTF model to research patients' willingness to use telemedicine services in Zhengzhou, China. It was found that performance expectancy, effort expectancy, and social influence had a significant positive relationship with patients' willingness to adopt. In contrast, task technology adaptation had no significant impact (Zhai et al., 2019).

Although the UTAUT model is widely used in the area, the link between intentions and decision-making is complex and requires more scrutiny (Moghavvemi et al., 2012). The UTAUT model does not identify the external factors to affect the actual adoption. There are uncertainties and unforeseen situations between the time the intention is formed and the actual behavior is adopted (Venkatesh et al., 2007).

2.2.3 Task Technology Fit Model (TTF)

When studying the adoption of new technology, Task Technology Fit Model (TTF) is often used (Cloutier, 2004; Michael Musyaffi and Muna, 2020; Gebauer, Shaw and Gribbins, 2010).

Goodhue and Thompson developed TTF in 1995, which believes that an information technology system is more likely to have a positive impact on individual performance and be used if the capabilities of the IT match the tasks that the user must perform (Goodhue and Thompson, 1995). Within this model, task characteristics, the totality of physical or cognitive actions processed by an individual, and technology characteristics, the tools individuals use to execute their tasks, are the determinants of technology fit. Both characteristics can be broken down into different levels of detail, depending on the complexity of the tasks performed. Considering the quality of the technology, such as data quality, data compatibility, ease of use, system reliability, it defines the task technology fit, which is the extent to which technology assists an individual in performing their tasks (Spies et al., 2010).

Several studies have used TTF to study the willingness to adopt telemedicine services. Cady and Finkelstein (2014) used TTF to investigate telehealth in a paediatric outpatient clinic by the nurses. It was found that telehealth allowed nurses to obtain more visual information from patients than a traditional telephone consultation. The TTF model analyzed work processes and identified workflows that benefit the most from technology. Yen et al. (2010) studied the determinants of users' intention to adopt wireless technology. It was found that both perceived usefulness and ease of use significantly affected users' behavior intention and the characteristics of technology and task significantly predicted the task technology fit. In combination with the TAM, the study identified that both TAM and TTF are robust models to study the adoption of new technology.

TTF focuses on user evaluation of information systems by using task and system characteristics. It has appeared to be a weaker predictor of technology adoption compared to other models. Park (2019) evaluated that the explanatory power of TTF (R^2) was generally lower (11-30%) in comparison to the TAM (30% or above), meaning that it may have a more significant variance in predicting the depending variables. TTF may not be the most suitable framework in this study as telemedicine is a relatively new development to the population. The usage by the end-users or service providers remains unknown at this stage; thus, evaluation of the task characteristics may not yet apply to stakeholders.

2.2.4 Social cognitive theory (SCT)

SCT is sometimes used alone or in combination with other frameworks in literature to learn about health behaviors adoption (Howe, 1994; Lin and Hsu, 2013). SCT is a fundamental theory of individual behavior, and it is believed that behavioral decision-making is the result of the interaction of personal and environmental factors. Self-efficacy and Trust are two essential concepts of SCT that reflect an individual's ability cognition. In contrast, Trust is one of the environmental factors reflecting Trust in the environment. The reason why SCT was used to study the adoption of telemedicine was that it postulated that behavior change was determined by three significant factors: person, behavior, and environment; and self-efficacy was the critical mediating factor between knowledge and action (Piazza et al., 2004).

Gu et al. (2021) used SCT solely to learn about an individual's motivation and social influence to adopt telemedicine in China. It was found that motivation and subjective norms could promote behavioral intentions by promoting self-efficacy and Trust. However, the author pointed out that

the study did not consider other factors such as perceived ease of use and perceived usefulness, which were also important factors affecting behavioral intention. On the other hand, Tsai (2014) integrated SCT with TAM to develop a comprehensive behavioral model for analyzing the relationships among social capital factors (social capital theory), technological factors (TAM), and system self-efficacy (social cognitive theory) in telehealth. In this study, Tsai (2014) mainly used self-efficacy from the theory and hypothesized that self-efficacy positively affected the perceived ease of use and perceived usefulness. It was found that self-efficacy was significantly associated with the perceived ease of use but not usefulness. This concluded that using SCT alone was not sufficient enough to study the behavioral intention to adopt telemedicine services and it needed to combine with other models to have a more comprehensive review.

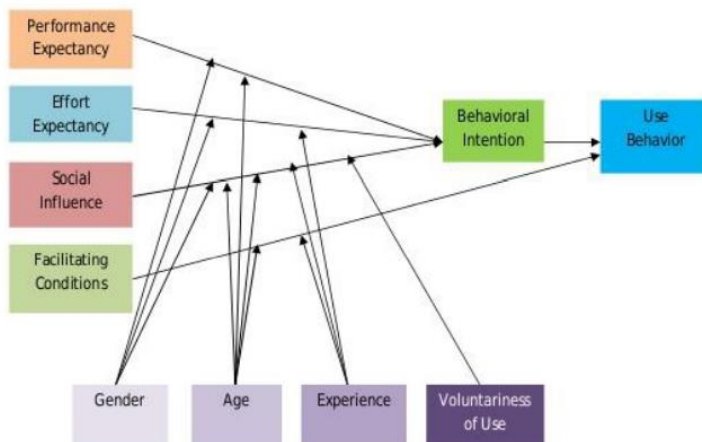
2.2.5 Summary of the theoretical framework

The intention to adopt telemedicine often involved two directions: adopting new behavior and new technology. It was found that there was no perfect theoretical framework to cover all aspects or to be used individually to study the intention to adopt telemedicine services. Studies have revealed a combination of theoretical frameworks to explore the area more comprehensively. However, recent studies have mostly chosen TAM and UTAUT as the main framework to study the related topic, with the support from literature reviews. While Harst et al. (2019) evaluated that UTAUT is more appropriate to be used for patients, this study will use UTAUT as the ground to study the factors affecting the intention to adopt telemedicine service for both end-users and service providers.

2.3 Independent variables

Figure 7 shows the basic framework of the UTAUT model, which indicates that there are four significant independent variables: Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating Conditions, to determine the behavioral intention. In addition, other variables such as user demographics, experience, or voluntaries of use also mediate between independent variables and the behavioral intention or use behavior. Together with others from the different theoretical frameworks, these independent variables will be studied in this section to recognize any discrepancies for further research.

Figure 7. Unified Theory of Acceptance and Use of Technology Model



Reference: Ammenwerth (2019)

2.3.1 Performance Expectancy

Performance Expectancy is the extent to which a user believes a system can help improve their performance (Ammenwerth, 2019). This is similar to the 'Perceived Usefulness' in the

Technology Acceptance Model. In the study of telemedicine, people identify the perceived usefulness of telemedicine as an alternative way for faster delivery of health care services with the low cost of medical inspection (Kamal et al., 2020). Many studies have identified a strong linkage between performance expectancy and user intention to adopt an e-health system (Alam et al., 2020; Hossain et al., 2019; Maillet et al., 2015; Croteau and Vieru, 2002), and these studies focused on either patients or healthcare professionals.

Thapa et al. (2021) studied the willingness to use digital health tools in patient care among health care professionals and students. It was found that the role of performance expectancy on digital health was higher amongst the professionals but not the students. This could probably be due to the students' lack of clinical practice and experience, leading to a lessened belief in digital health benefits. Perceived usefulness was also not significant in the physician's decision to adopt telemedicine. It could be because the healthcare professional may already be providing high levels of quality care to the patients. Telemedicine may only be giving efficiency of the process instead of the quality of care (Saigi-Rubio et al., 2016). In a study of telemedicine adoption in India, perceived usefulness was more significant for people who found it difficult to access their doctor due to various reasons or, in other words, dissatisfied with the current consultation system (Singh and Dev, 2021). On the contrary, performance expectancy was not a significant factor in explaining the telemedicine behavioral intention for the consumers (Koivumaki et al., 2017). This could be due to the younger age distribution in the sample as most of the respondents were aged 18-45, who did not seek medical support as often.

These variations in evidence would be interesting for this study to identify whether performance expectancy and other factors will affect the intention to adopt telemedicine in both end user and service provider groups; thus, the below hypothesis are made:

H1: The service provider's experience has a significant positive effect on performance expectancy.

H2: End users' access to medical care significantly affects the performance expectancy.

H3: End user's age has a significant effect on performance expectancy

H4: Performance expectancy significantly affects end users' intention to use telemedicine.

H5: Performance expectancy significantly affects service providers' intention to use telemedicine.

2.3.2 Effort Expectancy

Effort expectancy is the extent to which users perceive ease during telemedicine applications (Yamin and Alyoubi, 2020). It is also classified as 'Perceived Ease of Use' in the Technology Acceptance Model. The effort expectancy is an essential driver for acceptance of telemedicine services in the context of a developing country (Kamal et al., 2020), and similar evidence has been found in studies on healthcare professionals (Rho et al., 2014; Adenuga et al., 2017; (Pereyra-Rodriguez et al., 2018). Hossain et al. (2019) investigated the bilateral readiness towards telemedicine for both patients and physicians. They showed that the expected ease of using telemedicine has a significant impact amongst the stakeholders on the behavioral readiness of telemedicine. The expected easiness includes the expectation about how easy it will be to learn and use the telemedicine services. However, effort expectancy was not significant with the patient's attitude toward telemedicine. Still, it was more to be determined by computer self-efficacy, which referred to patient perception of their ability to complete the task using a

computer (Rahi et al., 2020). In addition, perceived ease of use of ICTs in clinical practice was not significant in the study of primary care physicians. It could be explained by the young age of the sampled physicians who are already familiar with ICTs. The ease of use may not be necessary a key factor affecting ICT use (Saigi-Rubio et al., 2016). This contradicted Harst et al. (2019), who mentioned that easy-to-use technology was important for health care providers. These conflicting findings would be interesting to study and investigate; thus, the below hypothesis has been made:

H6: Effort expectancy significantly affects the end users' intention to use telemedicine.

H7: Effort expectancy significantly affects the service provider's intention to use telemedicine.

2.3.3 Social influence

A person's belief in the new technology could be influenced by their acquaintances and family members. The study of social influence on the intention to use would be an important factor in understanding and planning to promote the service. In literature reviews, social influence was mainly used as an independent variable for patients than service providers thus, UTAUT was often used as the research model to study the technology adoption for patients (Harst et al., 2019). Studies have shown that social influence played an important role in affecting one's use of telemedicine (Kaium et al., 2020), but some showed insignificant relationships (Joo et al., 2014). Kamal et al. (2020) found a significant association of social influence on the intention to use telemedicine and stated that people would be more likely to use the service if their family members and acquaintances viewed these services as effective for improving health care

conditions. However, Peeters et al. (2012) found that people living alone would be more likely to use telemedicine than those living with a partner.

On the contrary, Koivumaki et al. (2017) did not find significance in social influence on the behavior intention, neither did Napitupulu et al. (2021), who found an insignificant link with behavior intention for telemedicine. One reason explained by Napitupulu et al. (2021) was that many of the consumers in the study were early adopters who are likely to develop independent evaluations and may place less weight on others' opinions. This might be similar to the condition in this study when the actual usage of telemedicine service was unknown in Hong Kong. Given the discrepancies of evidence, the below hypothesis was made in this study:

H8: End users' co-living status significantly affects social influence.

H9: Social influence significantly affects end users' intention to use telemedicine.

2.3.4 Subjective Norms

Although social influence was not a common independent variable in the models studying the behavior intention of telemedicine for healthcare professionals, some studies used subjective norms to represent the social influence on healthcare professionals (Wu et al., 2021; Saigi-Rubio et al., 2016). Subjective norms are individuals adjusting their attitudes and behavior according to those around them. In cases of doctors, this could be patients, medical staff, organizations, etc. (Robinson, 2009). Saigi-Rubio et al. (2016) studied subjective norm as one determinant of using telemedicine in primary care physicians. The results showed that patients and healthcare organizations exerted a moderating effect on the physician's decision to use telemedicine.

However, a study showed that subjective norms had no significant impact on Trust in healthcare

providers (Wu et al., 2021). In parallel with the social influence, the subjective norm has been chosen as an independent variable for the service providers in this study thus, the below hypothesis has been made:

H10: Service provider's practicing location significantly affects the intention to adopt telemedicine.

H11: Subjective norm significantly affects service providers' intention to adopt telemedicine services.

2.3.5 Privacy

Privacy can be perceived as the sense of establishing a user's faith in a system such that they will feel secure enough to share personal health information (Kamal et al., 2020). Previous studies acknowledged the importance of privacy as an important determinant for technology acceptance (Baudier et al., 2020). Hence, users with high privacy concerns regarding exchanging information within a telemedicine system might become reluctant to adopt it. However, in the investigation of telemedicine acceptance by Kamal et al. (2020), privacy was an insignificant factor in the intention to utilize telemedicine. The result was also similar to Luciano et al. (2020), where information privacy did not significantly impact the adoption of telemedicine in both the United States and Brazil. This was an exciting finding because the privacy of patient records should be of paramount concern to all involved in telemedicine adoption. Therefore, it would be interesting to raise the question in this study to understand how patients and doctors regard privacy as one factor affecting the adoption of telemedicine.

H12: Privacy significantly affects end users' intention to adopt telemedicine.

H13: Privacy significantly affects service provider's intention to adopt telemedicine.

2.3.6 Facilitating conditions

Facilitating condition is defined as the degree to which an individual believes that an organizational and technical infrastructure exists to support the use of the system (Ammenwerth, 2019). This can be related to internet connections or the use of a computer or smartphone. The successful usage of telemedicine services is significantly correlated to adequate technological infrastructure (Kamal et al., 2020). It appears that skilled users should lean towards adopting technology (Venkatesh et al., 2003), and many other studies have also resulted in the same (Napitupulu et al., 2021; Semiz and Semiz et al., 2021; Kamal et al., 2020). A systematic review evaluating the barriers to adopting telemedicine worldwide identified that technological challenge was the top barrier for staff or programmers to adapt to telemedicine. In contrast, computer literacy and bandwidth ranked third and fourth for patients (Kruse et al., 2016). Most literature reviews have shown the positive influence of facilitating conditions to the adoption of telemedicine thus, it could be concluded that the technical infrastructure and support were to be one consistent factor to encourage the intention of adoption of telemedicine service:

2.3.7 Computer anxiety (CA) / self- efficacy

Computer anxiety defines as the user's understanding of their capacity and desire to utilize telemedicine (Napitupulu et al., 2021). Several literature reviews revealed a significant relationship between computer anxiety and intention to use telehealth through effort expectancy (Sarlan et al., 2012). According to Bilgrami et al. (2020), self-efficacy was a patient's judgment

towards their capacity to how effectively they could perform the telemedicine service.

Koivumaki et al. (2017) confirmed that self-efficacy was a significant factor affecting the consumer adoption of future eHealth applications. Similarly, Thapa et al. (2021) demonstrated that self-efficacy was an important factor in adopting digital health tools, and they emphasized the need for capacity building in eHealth for professionals. The results on computer anxiety or self-efficacy seemed consistent amongst the literature review thus, it was regarded as an essential factor to support telemedicine adoption.

2.3.8 Trust

Trust is often used as an important factor in assessing the acceptance of new eHealth services (Anderson et al., 1990). Studying Trust in telemedicine service is essential as it is different from other online services where the outcome of the service often includes highly personal data, which is of particular importance to the end-user. As a result, patient trust formation in telemedicine was unique (Bansal et al., 2016; Velsen et al., 2016). Trust could be related to trust between the patient and the health care professionals; Trust in the system, treatment, health care organization, etc. Velsen et al. (2017) researched to measure patient Trust in telemedicine services. It was concluded that Trust in healthcare professionals and the treatment had a negligible effect on overall Trust in the system, whereas Trust in technology had a more significant impact. Trust was perceived as the faith in the service providers and the related diagnosis or treatment provided within this research. It was believed that when patients were provided with accurate, timely, and useful information, they were likely to think that doctors could provide high-quality services (Wu et al., 2021). Velsen et al.(2016) held a focus group study with patients and

healthcare professionals. It was found out that Trust was developed from the patient to the healthcare professionals if the patient-perceived participation, seriousness, accessibility, attention, and involvement during the consultation.

Although Trust has not been widely used as an independent variable in the study of telemedicine, the Hong Kong Medical Council's Code of Practice provides a guideline to healthcare professionals and stated that the practice of telemedicine should only be given to patients where former patients and doctors trusting relationship has already been developed (The Medical Council of Hong Kong, 2019). Thus, this is powerful support from the authority to believe that Trust is one crucial factor for a quality and trustworthy factor for telemedicine.

2.3.9 Perceived Risks

Perceived risk is defined as a person's perception if they decide to undertake an action or activity (Kamal et al., 2020). The adoption of telemedicine involved the digital collection and use of sensitive medical information among patients and medical practitioners (Shokri and Lighthall, 2020), leading to security risks. In Kamal et al.'s (2020) research, perceived risk for patients was defined as psychological, financial, and performance risk. It was regarded as a significant barrier to the acceptance of telemedicine services. In the study of intention to use telemedicine by a group of primary care physicians, security and confidentiality were regarded as the third vital determinant to use telemedicine, after the cost-benefit and staff's interest (Saigi-Rubio et al., 2016). In addition to this, a focus group studied by Velsen et al. (2016) indicated that the factors affecting the health care professional's Trust in telemedicine were secure data storage and technical reliability. In conclusion, the risks of telemedicine had widely been associated with

data security and confidentiality, and it had been one of the factors to negatively affect the use of telemedicine in the literature review.

2.3.10 Summary of independent variables

The independent variables in the UTAUT model were firstly identified to form the base of this study. The literature reviews had shown that three out of four independent variables from the UTAUT model had discrepancies and could not show consistent findings to the behavioral intention. Therefore, in this study, the three independent variables: Performance Expectancy, Effort Expectancy, and Social Influence, will be adopted to investigate further. Two additional independent variables, namely, subjective norms and privacy, were also identified for the study. Subjective norms would be used to replace Social Influence for the SP group, whereas privacy would be studied for both groups. In addition to the above independent variables, the demographics of EU and SP would also be considered to evaluate the exerting factors to the independent variables.

Table 3: Summary of hypothesis made

Hypothesis
H1: The service provider's experience has a significant positive effect on performance expectancy.
H2: End users' access to medical care significantly affects the performance expectancy.
H3: End user's age has a significant effect on performance expectancy
H4: Performance expectancy significantly affects end users' intention to use telemedicine.
H5: Performance expectancy significantly affects service providers' intention to use telemedicine.
H6: Effort expectancy significantly affects the end users' intention to use telemedicine.
H7: Effort expectancy significantly affects the service provider's intention to use telemedicine.
H8: End users' co-living status significantly affects social influence.
H9: Social influence significantly affects end users' intention to use telemedicine.
H10: Service provider's practicing location significantly affects the intention to adopt telemedicine.
H11: Subjective norm significantly affects service providers' intention to adopt telemedicine services.
H12: Privacy significantly affects end users' intention to adopt telemedicine.
H13: Privacy significantly affects service provider's intention to adopt telemedicine.

Reference: Compiled by the author

3. Methodology

The research was given a period of 6 months to conduct from November 2021. The research question specified in Section 1.8 highlighted the current problems in Hong Kong, leading to this research to study and focus on factors affecting the intention to adopt telemedicine services in Hong Kong. This section formulates the research framework and ensures all aspects are included

to produce a representable outcome. In this research, the theory of ‘research onion’ by Saunders et al. (2016) was used as the guiding principle.

3.1 Research method

Saunders et al. (2016) defined research choices concerning quantitative and qualitative research methods. Qualitative research methods involve numbers and mathematical operations, while qualitative methods imply collecting vast descriptive data (Melnikovas, 2018). Data collected will be mainly divided into primary data or secondary data. Primary data refers to the firsthand data collected from the research, whereas secondary data is collected by other people (Wagh, 2022). This research involved collecting both types of data using qualitative and quantitative methods.

3.1.1 Quantitative research method

The central part of this study involved the quantitative research method to collect primary data through a survey. This method could quickly obtain information from a sized population and be analyzed to support the hypothesis (Wagh, 2022). Based on the literature review in section 2 and the hypothesis, a survey was designed to collect feedback from both service provider and end user groups. The survey was sent to the selected population, and more details will be described in section 3.4.

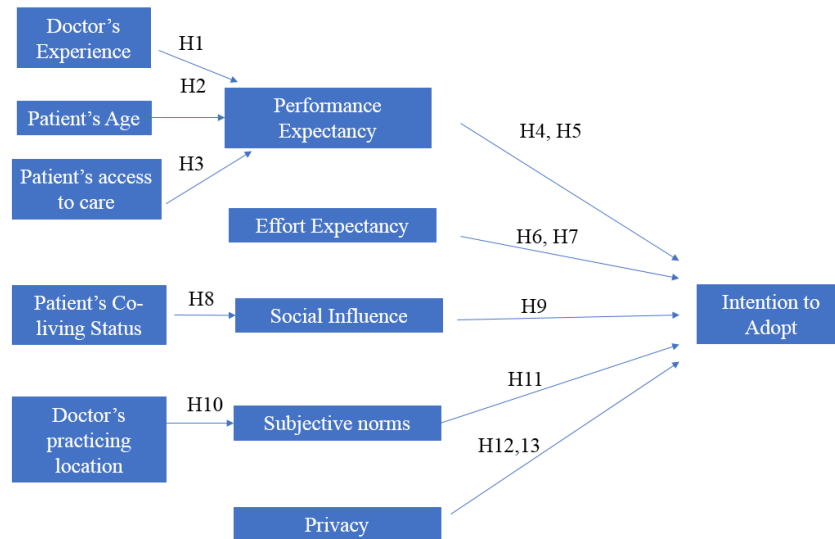
3.1.2 Qualitative research method

Apart from the quantitative method, the qualitative approach was used to understand the research topic (McGill Qualitative Health Research Group, 2012). In addition to the information collected from the literature view and website search, an in-depth interview with a representative from a healthcare organization was carried out. The representative invited was Mr. Felix Lee, the President and CEO of the UMP Healthcare Holdings Limited, , a listed healthcare group in Hong Kong (Stock code: 772.HK).. He was invited to be the interviewee as his company has been involved in setting up and developing telemedicine services in Hong Kong and China. According to the annual report, the total number of virtual consultations increased almost three folds between 2020 and 2021(UMP, 2021). This reflects that he is a representable candidate to provide his insights to the topics, and his valuable comments would be helpful to support the discussion in this study.

3.2 Research model

Section 2 discussed the literature review for the research models, and it was found that not all independent variables from the studies were applicable for further research. The hypothesis made in Table 3 were based on those with inconsistent findings and would be beneficial in this study to study further and identify a relationship with the Hong Kong population. Figure 8 shows the research model based on the theoretical framework of the UTAUT model, which has been adapted and modified to fit this studies' purpose.

Figure 8. Research model



Source: Compiled by the author

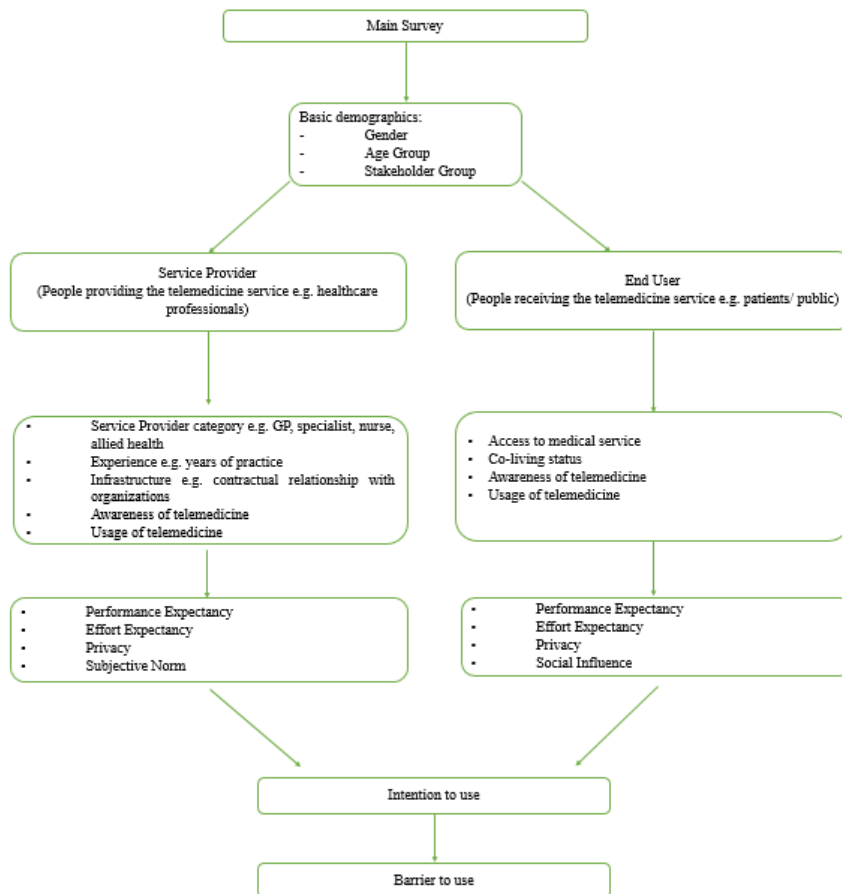
3.3 Survey Design

As the study involves two stakeholder groups, the questions in the survey were differentiated to increase the significance to each stakeholder group. There were three sections in each survey: the demographics, the independent variables, and adoption barriers. A simple structure of the survey is shown in Figure 9.

Statements relating to the dependent and independent variables were referenced from existing literature reviews, and participants were given a 5-Point Likert Scale to rank their feelings towards the view. The 5-Point Likert Scale ranged from 5 as 'Strongly Agree'; 4 as 'Agree'; 3 as 'Neutral'; 2 as 'Disagree' and one as 'Strongly Disagree'. A Likert scale was chosen as it is simple to construct and likely to produce a highly reliable scale. It is easy to read and complete

for the respondents, although participants may avoid extreme response categories, causing central tendency bias (Taherdoost, 2019).

Figure 9. Survey Design



Source: Compiled by the author

Once the questions and statements were identified, the survey tested 15 people in the service provider group and 15 people in the end user group. The data collected went through a reliability test through the SPSS software. All questions passed the Cronbach's alpha with a score of 0.7 or higher, which is the value mostly accepted by literature reviews (Taber, 2018). Once the questions passed the reliability test, the survey was compiled by Google Form which could be sent digitally. Appendix 1 and 2 highlight the questions regarding sources and the Cronbach's

alpha score after the reliability test. In the last section of the survey, a question involving the barriers to adopting telemedicine service was included. The purpose of this question was to identify the most popular reasons for non-adoption, which could help organizations recognize the roadblocks and construct strategic plans for service development.

3.4 Sample population

The sample size and population were crucial for representable results. The service provider in this study was anyone providing telemedicine services. This could be the healthcare organization, doctors, specialists, nurses, allied health professionals such as dietitians, occupational therapists, physiotherapists, etc. In Hong Kong, there are approximately 14,000 registered doctors (Department of Health, 2018), 14,000 enrolled nurses (Department of Health, 2018), and 39,000 registered nurses (Department of Health, 2016), forming an estimate of about 60,161 doctors and nurses in total. For end-users, it could be anyone in Hong Kong who needs access to medical care, in other words, defined as the public. This could be people who could independently seek medical care, so it was described as 15 years old or above. In Hong Kong, the population above 15 years old was 6.5 million in 2020 (Census and Statistics Department, 2021); thus, the population base for the end-user group would be based on this figure.

3.5 Sample size

To determine representable sample size and avoid any errors, the confidence level was set as 95%. This is an expected confidence level for management research and represents that 95 out of 100 samples will have the actual population value within the margin of error specified

(Taherdoost, 2020; Burruss and Bray, 2005). As the sample was selected randomly, a margin of error was required to estimate the error. The margin of error represents the number of errors in sampling the survey, and it measures how representative data is obtained from samples within the actual population. The greater the margin of error, the smaller the sampling size it would become (Arieska and Herdiani, 2018). Taherdoost (2020) stated that in social research, a 5% of margin of error was acceptable. Table 4 shows the suggested sampling size for the stakeholder groups in this study with a different margin of errors at a 95% confidence level.

As reaching the same sample size for consistency was required for a fair comparison, the accessibility and capability to get the suggested sample size were critical factors in deciding which margin of error to use. Ideally, a 5% margin of error at a 95% confidence level, with a sample size of around 380 for each group, would result in the most representable data. However, it would be challenging to receive responses from a total of 760 people within this research's timeframe. Alternatively, the 7% margin of error at a 95% confidence level would require 392 returned surveys in total, and this was a more realistic target for this study. Thus, a 7% margin of error, leading 196 people for each stakeholder group, would be used for this study.

Table 4. Variation of sample size based on the different margin of errors at 95% confidence level

Stakeholder	Population size	95% CL 5% MOE	95%CL 6% MOE	95%CL 7% MOE	95% CL 10% MOE
Public (>20yrs)	6,500,000	385	267	196	97
Doctor	13,993	374	262	194	96
Nurse	46,168	381	266	196	96
Doctor + Nurse	60,161	382	266	196	96

Source: www.surveymonkey.com

3.6 Data Collection

The data collection process was planned for four weeks, from 1st January 2022 to 31st January 2022, enabling sufficient time to reach the targeted sample size. The survey was compiled into two formats: Word Document and digital Google Form. The Word Document was given to people unfamiliar with filling out digital forms. In contrast, the digital Google Form was disseminated through online channels such as email, Whatsapp, Telegram, or social media. The downside of using Word Document involved further data input, but it was an effective way to get immediate responses.

For the end user group, the sample was collected through convenience, snowball, and voluntary response sampling methods (McCombes, 2019). The survey was first distributed to family members, co-workers, and friends, who were then asked to disseminate further to expand the sampling size. To reduce bias, different age groups were included at the beginning. The survey was then uploaded to social media platforms where a voluntary response from a random population would be involved.

For the service provider group, the survey was distributed to some healthcare professionals such as doctors, nurses, and allied health professionals through personal connection; thus, convenience and snowball sampling was also used. To cover a larger sampling size, an invitation to participate was sent to ten healthcare professional groups and associations. The Hong Kong College of Family Medicine responded to the invitation and assisted in disseminating it to around 1,700 doctors who specialized in Family Medicine.

3.7 Ethics

Before the research, a university ethical form was completed and approved by the research supervisor. The ethical form ensures that the study does not violate any illegal or unethical process and ensures data privacy and confidentiality. The in-depth interview and the involved an invited individual who was informed of the purpose and the use of data security.

For the survey, the aim of the research was described initially, and the participants were informed that all data collected remained anonymous. The participants were allowed to withdraw anytime and explained the data security. The Hong Kong College of Family Medicine participation involved a formal application process where an application form was completed. Their ethical committee approved the application, and the information was checked and approved before it was sent.

All data related to this research would be kept for the research period and deleted from the author's computer and online platform (google form) once the research is completed.

4. Results

A total number of 439 surveys were completed within the study timeframe. The data were extracted from Google Form, which was then validated and analyzed through the SPSS Statistics 28.0.1 Software. Of all surveys, 214 (48.7%) were from the service provider, and 225 (51.3%) were from the end user group.

4.1 Data classification

Before commencing the data analysis, it is important to identify the types of data received to decide which statistical analysis to use. The research was done to identify the types of data collected, particularly for the Likert Scale data. In this study, two major types of data were involved: nominal and ordinal. Nominal data represents categories data without numerical representation such as age and gender, whereas ordinal data represent ordering or ranking responses without measuring the distance in between.

This research involved ranking users' preferences through a 5-point Likert Scale. Definition of the Likert scale data has been controversial in some literature reviews, and identifying Likert scale data is required to decide whether non-parametric or parametric statistical analysis would be used. Some believed that Likert scale data should not be involved in parametric statistics (Allen and Seaman, 2018; Glen, 2015). However, Harpe (2015) indicated that aggregated rating scales could be treated as continuous data. Individual rating items with a numerical response with more than five categories in length could be treated as continuous data. While parametric analysis allows assumptions to be made, which is suitable for the hypothesis in this study, the Likert scale data would be treated as continuous variables in the analysis in this study.

4.2 Data demographics

Table 5 summarizes the demographics for both service provider and end user groups. Both groups consisted of more females than males with a similar distribution percentage, e.g., the female population at around 55.1-57.3% and the male population at around 42.7-44.9%. This was similar to Hong Kong's general gender distribution in the previous three years, where

female and male constitutes on average of 54% and 46% respectively(Census and Statistics Department, 2021). For the age distribution, 35-49 years dominated the population, with 81.8% and 53.3% for the service provider and end user group, respectively. The service provider group's age distribution was towards the younger population with the second-highest distribution of 20-34 years old (13.6%), whereas the end user group was towards the older generation, with 23.3% at 50-64 years old.

4.2.1 SP's and EU's characteristics

The specialty of the service provider was classified into four groups: General Practitioner, specialist; nurses; and allied health professionals. The highest number of participants was from the General Practitioner, comprising 54.2% of the sample. The next contributed groups were the nurses and specialists, with 19.6% and 18.7%, respectively. Allied health professionals were at the clinical area supporting the care cycle. In this study, the majority of the allied health professionals were dietitians, constituting 7.5% of the sample. The reason for the general practitioner's high participation rate was that the survey was disseminated to the Hong Kong College of Family Medicine, which contained around 1,700 members in their database.

In terms of working experience, over half of the service provider had more than 15 years of working experience. 33.6% of the participants had 15-19 years of experience, whereas 35.5% had over 20 years of experience. 63.1% had a contractual relationship with medical groups, while 36.9% practiced individually. In response to how quickly the end user could access medical service, over 98% of the respondent had access to medical care from home within 30 minutes. This showed that access to care in the sampling population was convenient. 44.4% of

the participants co-lived with more than three family members, and only 4.4% of the sample population lived independently.

The awareness of telemedicine service was distinctively different between the two stakeholder groups. Over 70% of the service provider was aware of telemedicine service, whereas only 35.6% of the end user were aware. The usage of telemedicine service during in both stakeholder groups remained low, although the result indicated that service provider (35.5%) had a higher usage than the end user (4.4%).

Table 5. Demographics of data

	Service Provider	End User
Total number	214	225
Gender		
- Male	96 (44.9%)	96 (42.7%)
- Female	118 (55.1%)	129 (57.3%)
Age		
- <19 years old	0 (0%)	2 (0.9%)
- 20-34 years old	29 (13.6%)	46 (20.4%)
- 35-49 years old	175 (81.8%)	120 (53.3%)
- 50-64 years old	10 (4.7%)	52 (23.1%)
- >65 years old	0 (0%)	5 (2.2%)
Specialty		
- General Practitioner	116 (54.2%)	
- Specialist	40 (18.7%)	NA
- Nurses	42 (19.6%)	
- Allied Health Professional	16 (7.5%)	
Working Experience		
- <4 years	11 (5.1%)	
- 5-9 years	7 (3.3%)	NA
- 10-14 years	48 (22.4%)	
- 15-19 years	72 (33.6%)	
- >20 years	76 (35.5%)	
Contractual relationship with medical groups	135 (63.1%)	NA
- Yes	79 (36.9%)	
- No		
Access to medical care		
- < 10 min		109 (48.4%)
- 11-30 min	NA	112 (49.8%)
- 31-60 min		0
- >60 min		4 (1.8%)
Number of Co-living family members		
- 0		10 (4.4%)
- 1	NA	56 (24.9%)
- 2		59 (26.2%)
- > 3		100 (44.4%)
Awareness of telemedicine service		
- Yes	162 (75.7%)	80 (35.6%)
- No	52 (24.3%)	145 (64.4%)
Experience with telemedicine service?		
- Yes	76 (35.5%)	10 (4.4%)
- No	138 (64.5%)	215 (95.6%)

4.3 Statistical analysis

After all the data were collected, the statements for the independent and dependent variables underwent another reliability test to make sure the questions were valid and reliable. The results are shown in Appendix 1 and 2. In general, all questions passed the reliability test with a Cronbach's Alpha of more than 0.7.

4.3.1 Independent Sample T-Test

The Independent Sample T-Test allows the comparison of two different groups on a continuous variable. This is suitable to test the hypothesis when two categories of a group exist, such as gender or questions with yes or no answers.

This study has one hypothesis that involved such characteristics, so an Independent Sample T-Test was used. In this hypothesis, the independent variable was the service provider's practicing location, whereas the dependent variable was the intention to use. The results of the test are shown in Figure 10. The T-test results, both one sided and two sided, showed the significant level of 0.017 and 0.033 respectively, representing that significant differences existed between the practicing location of the specialists on the intention to use of telemedicine services. It was shown that the number of specialists having a contractual relationship with a medical group was higher, with the mean value of intention to use of 3.91. Thus, the hypothesis that service provider's practicing location significantly influences the intention to use was supported.

Figure 10. Result of the Independent Sample T-Test

Group Statistics					
	Contract with group (1=Yes;2=No)	N	Mean	Std. Deviation	Std. Error Mean
Average Intention to use	1	135	3.91	.846	.073
SP	2	79	3.64	.949	.107

Independent Samples Test										
Levene's Test for Equality of Variances				t-test for Equality of Means						
		F	Sig.	t	df	Significance One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower Upper
Average Intention to use	Equal variances assumed	1.111	.293	2.145	212	.017	.033	.269	.125	.022 .516
SP	Equal variances not assumed			2.082	148.693	.020	.039	.269	.129	.014 .524

4.3.2 One way ANOVA test

One-way ANOVA test aims to investigate whether the means of two or more separate groups differ from each other on a continuous dependent variable. In this study, several hypotheses were suitable to carry out such a test.

i. Service provider's experience vs. performance expectancy

Figure 11 shows the results of the one-way ANOVA test for the service provider's experiences and the performance expectancy. The sample population had the highest number of experiences of more than 20 years, followed by 15-19 years. The mean value of the Likert Scale in these two groups was 3.27 and 3.31, respectively. The homogeneity test and the ANOVA test showed that the significant levels were all higher than 0.05, indicating no significant variance between the means of the groups. Therefore, it could be concluded that the service provider's experience did not significantly influence the performance expectancy.

Figure 11. Result of One way ANOVA test for service provider's experience and performance expectancy

Average Performance Expectancy SP								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean			
					Lower Bound	Upper Bound	Minimum	Maximum
<4yrs	11	3.64	.823	.248	3.08	4.19	3	5
5-9 yrs	7	3.67	.609	.230	3.10	4.23	3	4
10-14 yrs	48	3.34	.911	.131	3.08	3.60	1	5
15-19 yrs	72	3.31	1.040	.123	3.07	3.56	1	5
>20 yrs	76	3.27	.919	.105	3.06	3.48	1	5
Total	214	3.33	.945	.065	3.20	3.46	1	5

Tests of Homogeneity of Variances						
		Levene Statistic	df1	df2	Sig.	
Average Performance Expectancy SP	Based on Mean	1.418	4	209	.229	
	Based on Median	1.540	4	209	.192	
	Based on Median and with adjusted df	1.540	4	204.481	.192	
	Based on trimmed mean	1.432	4	209	.224	

ANOVA					
Average Performance Expectancy SP					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.143	4	.536	.595	.667
Within Groups	188.190	209	.900		
Total	190.333	213			

ii. End user's age vs. performance expectancy

Figure 12 shows the results of the One-way ANOVA test for the EU's age and the performance expectancy. The descriptive analysis reflected that most of the population aged 35 to 49 years, followed by 50-64 years. The mean of the two age groups was the same. The significance values of the tests of homogeneity of variances ranged from 0.279 to 0.295, indicating no significant difference between the groups' mean. The one-way ANOVA test showed a significant value of 0.792 between groups; thus, this could be concluded that there was no significant influence between the End user's age and the performance expectancy.

Figure 12. Result of One Way ANOVA test for End user's age and performance expectancy

Descriptive								
Average PEEU								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
<19 yrs	2	3.33	.943	.667	-5.14	11.80	3	4
20-34 yrs	46	3.31	.876	.129	3.05	3.57	1	5
35-49 yrs	120	3.25	.784	.072	3.11	3.39	1	5
50-64 yrs	52	3.25	.985	.137	2.98	3.52	1	5
>65 yrs	5	3.73	.955	.427	2.55	4.92	3	5
Total	225	3.27	.853	.057	3.16	3.38	1	5

Tests of Homogeneity of Variances					
		Levene Statistic	df1	df2	Sig.
Average PEEU	Based on Mean	1.279	4	220	.279
	Based on Median	1.272	4	220	.282
	Based on Median and with adjusted df	1.272	4	217.729	.282
	Based on trimmed mean	1.239	4	220	.295

ANOVA					
Average PEEU					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.243	4	.311	.422	.792
Within Groups	161.816	220	.736		
Total	163.059	224			

iii. End user's access to medical care vs. performance expectancy

The access to medical care was categorized based on the required time to access from home.

Almost all the participants reported their access time as less than 30 minutes, and 4 participants recorded the time of more than 60 minutes (Figure 13). The mean of those reported less than 10 minutes and 11-30 minutes were 3.22 and 3.28, respectively. However, a higher mean was reported to those far from medical access(4.42). The homogeneity of variances tests showed no significant difference between the means, but the one-way ANOVA test showed a significance

value of 0.021 ($p < 0.05$). This explained that the time access to medical care significantly influenced the performance expectancy.

Figure 13. Results of One Way ANOVA test for End user's access to medical care and performance expectancy

Descriptives								
Average PEEU								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
< 10 min	109	3.22	.894	.086	3.05	3.39	1	5
11-30 min	112	3.28	.797	.075	3.13	3.43	1	5
>60 min	4	4.42	.500	.250	3.62	5.21	4	5
Total	225	3.27	.853	.057	3.16	3.38	1	5

Tests of Homogeneity of Variances					
Average PEEU		Levene Statistic	df1	df2	Sig.
	Based on Mean	1.162	2	222	.315
	Based on Median	.890	2	222	.412
	Based on Median and with adjusted df	.890	2	213.801	.412
	Based on trimmed mean	1.176	2	222	.310

ANOVA					
Average PEEU					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5.547	2	2.773	3.909	.021
Within Groups	157.512	222	.710		
Total	163.059	224			

iv. End user's co-living status and social influence

The end user's co-living status was one significant factor in telemedicine adoption in some research. In this study, most of the participants co-lived with three or more family members with the Likert Scale mean of 3.07 (Figure 14). Although those living with one person recorded a higher mean of Likert scale of 3.25, further analysis of the homogeneity of variances and the one-way ANOVA test did not find any significant value between the two variables. Thus, the co-living status of the end user did not have a significant influence on the social influence.

Figure 14.Result of One Way ANOVA test for End user's co-living status and social influence

Descriptive								
Average SIEU								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
0	10	3.03	1.082	.342	2.26	3.81	1	5
1	56	3.25	.893	.119	3.01	3.49	1	5
2	59	3.08	.784	.102	2.87	3.28	1	5
3 or more	100	3.07	.928	.093	2.88	3.25	1	5
Total	225	3.11	.888	.059	3.00	3.23	1	5

Tests of Homogeneity of Variances					
		Levene Statistic	df1	df2	Sig.
Average SIEU	Based on Mean	.739	3	221	.530
	Based on Median	.784	3	221	.504
	Based on Median and with adjusted df	.784	3	218.089	.504
	Based on trimmed mean	.670	3	221	.571

ANOVA					
Average SIEU					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.397	3	.466	.587	.624
Within Groups	175.342	221	.793		
Total	176.739	224			

4.3.3 Simple Linear Regression

This section compares the distribution of the independent and dependent variables between the stakeholder groups. A scatter plot graph was drawn to visualize the relationship between independent and dependent variables. The Likert scales for all statements under the same independent variables were averaged for easy comparison.

i. Performance expectancy vs. intention to use

Performance Expectancy is the extent to which a user believes a system can help improve their performance (Ammenwerth, 2019). Figure 15 shows the relationship between the performance expectancy and the intention to use in both service provider and the end user group. Both graphs show a positive relationship with the R^2 of 0.480 and 0.353, respectively. This means that performance expectancy was positively related to the intention to use, and it could predict a 48% to the real data point for the service provider group and 35% for the end user group, in other words, the performance expectancy for the service provider can provide a better prediction to the intention to use. The relationship was statistically significant ($p < 0.01$) for both groups; thus, the hypothesis (H4 and H5) that performance expectancy had a significant effect on end user's and service provider's intention to adopt were supported.

Figure 15. Linear regression analysis for performance expectancy

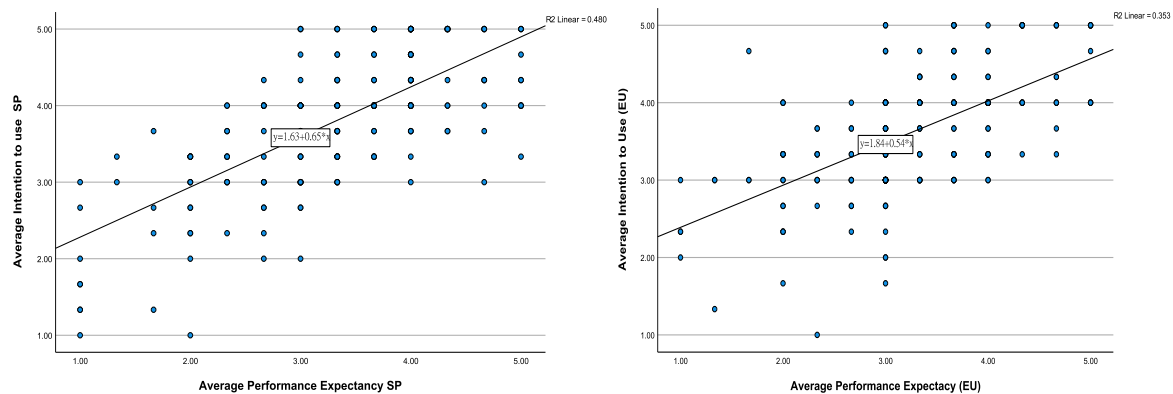


Table 6: Pearson Correlation for performance expectancy and intention to use

		Average PESP	Average ITUSP	Average PEEU	Average ITUEU
Average PESP	Pearson Correlation	1	.693**		
	Sig. (1-tailed)		<.001		
	N	214	214		
Average ITUSP	Pearson Correlation	.693**	1		
	Sig. (1-tailed)	<.001			
	N	214	214		
Average PEEU	Pearson Correlation			1	.594**
	Sig. (1-tailed)				<.001
	N			225	225
Average ITUEU	Pearson Correlation			.594**	1
	Sig. (1-tailed)			<.001	
	N			225	225
**. Correlation is significant at the 0.01 level (1-tailed).					

ii. Effort expectancy vs. intention to use

Effort expectancy is the extent to which users perceive ease when using telemedicine applications (Yamin and Alyoubi, 2020). Both scatter graphs show a positive relationship between effort expectancy and the intention to use. The R^2 was 0.387 for the service provider and 0.275 for the end user. The majority of the population found that telemedicine would be easy to use. Still, the low R^2 for the end user group also meant a harder prediction on the intention to use based on the effort expectancy. Despite this, the Pearson correlation reflected that there was a significant relationship between the effort expectancy and the intention to use, at $p < 0.01$ level for both groups, indicating that the perceived ease of the telemedicine application was significantly related to intention to use

Figure 16. Linear regression analysis for effort expectancy

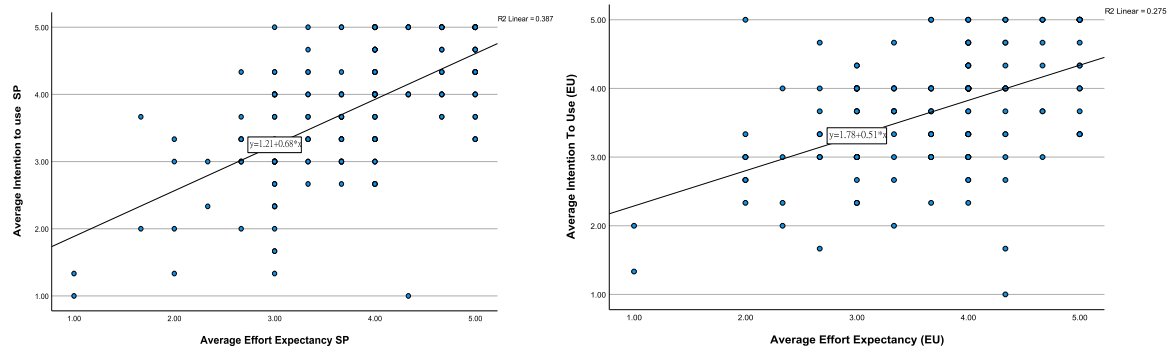


Table 7. Pearson Correlation for effort expectancy and intention to use

		Average ITUSP	Average EESP	Average EEU	Average ITUEU
Average ITUSP	Pearson Correlation	1	.622**		
	Sig. (1-tailed)		<.001		
	N	214	214		
Average EESP	Pearson Correlation	.622**	1		
	Sig. (1-tailed)	<.001			
	N	214	214		
Average EEU	Pearson Correlation			1	.524**
	Sig. (1-tailed)				<.001
	N			225	225
Average ITUEU	Pearson Correlation			.524**	1
	Sig. (1-tailed)			<.001	
	N			225	225
**. Correlation is significant at the 0.01 level (1-tailed).					

iii. Privacy vs. intention to use

Three statements were provided for the participant's views on the privacy of telemedicine service. The questions included whether they viewed telemedicine as trustworthy; everything they did during telemedicine service remained private; and their confidence in the privacy and confidentiality of telemedicine service. Figure 17 showed that privacy was positively related to the intention to use in both groups. This meant that their Trust in the telemedicine service would increase the intention to use. The service provider group resulted in R^2 of 0.384, whereas the

end user group had a R^2 of 0.245. This reflected that the end user had a more varied view on the privacy and trustworthiness of telemedicine overall. The Pearson correlation showed that privacy significantly affected the intention to use with $p < 0.01$ for both stakeholder groups.

Figure 17. Linear regression analysis for privacy

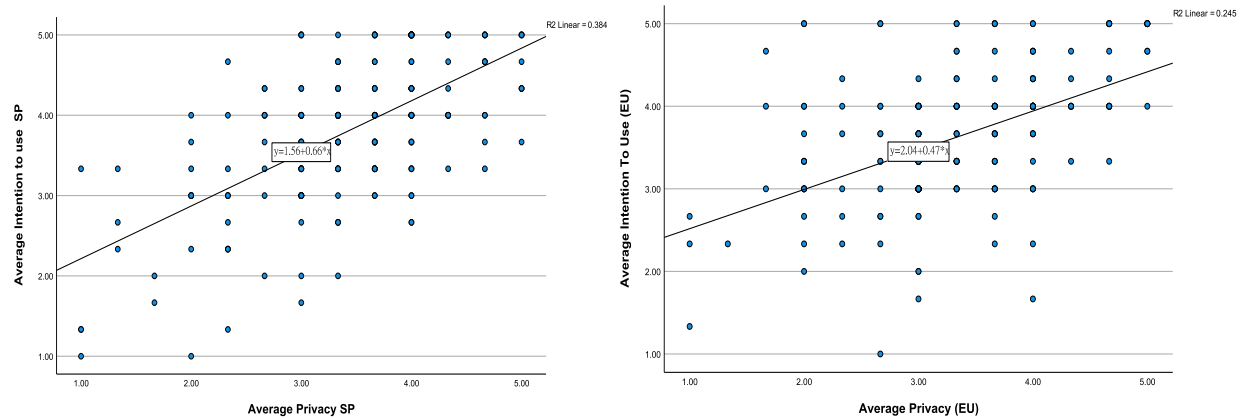


Table 8 Pearson Correlation for privacy and intention to use

		Average ITUSP	Average PSP	Average PEU	Average ITUEU
Average ITUSP	Pearson Correlation	1	.619**		
	Sig. (1-tailed)		<.001		
	N	214	214		
Average PSP	Pearson Correlation	.619**	1		
	Sig. (1-tailed)	<.001			
	N	214	214		
Average PEU	Pearson Correlation			1	.495**
	Sig. (1-tailed)				<.001
	N			225	225
Average ITUEU	Pearson Correlation			.495**	1
	Sig. (1-tailed)			<.001	
	N			225	225
**. Correlation is significant at the 0.01 level (1-tailed).					

iv. Social Influence and subjective norms vs. intention to use

The social influence and subjective norms were positively correlated with the intention to use.

Both groups resulted in a similar R^2 with 0.380 for the service provider group and 0.393 for the

end user group. The scattered graphs showed that more people chose ‘Neutral’, ‘slightly disagree’ and ‘strongly disagree’ in these two independent variables compared to the others. This reflected that the social influence or subjective norms had not played a major role in telemedicine service amongst the sampling population. This could be explained by the overall low usage of telemedicine, causing little influence to other people. Despite this, both social influence and subjective norms significantly influenced the intention to use telemedicine services with a significant level of $p < 0.01$.

Figure. 18 Linear regression analysis for social influence/subjective norm

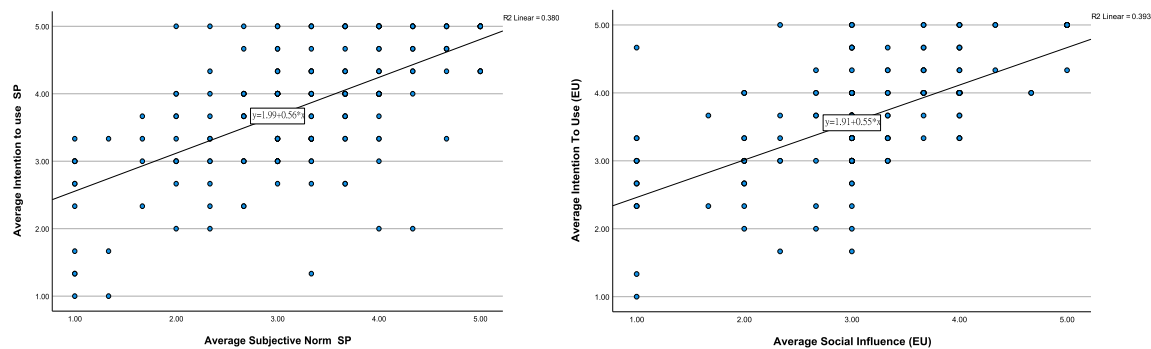


Table 9 Pearson Correlation for social influence/ subjective norm and intention to use

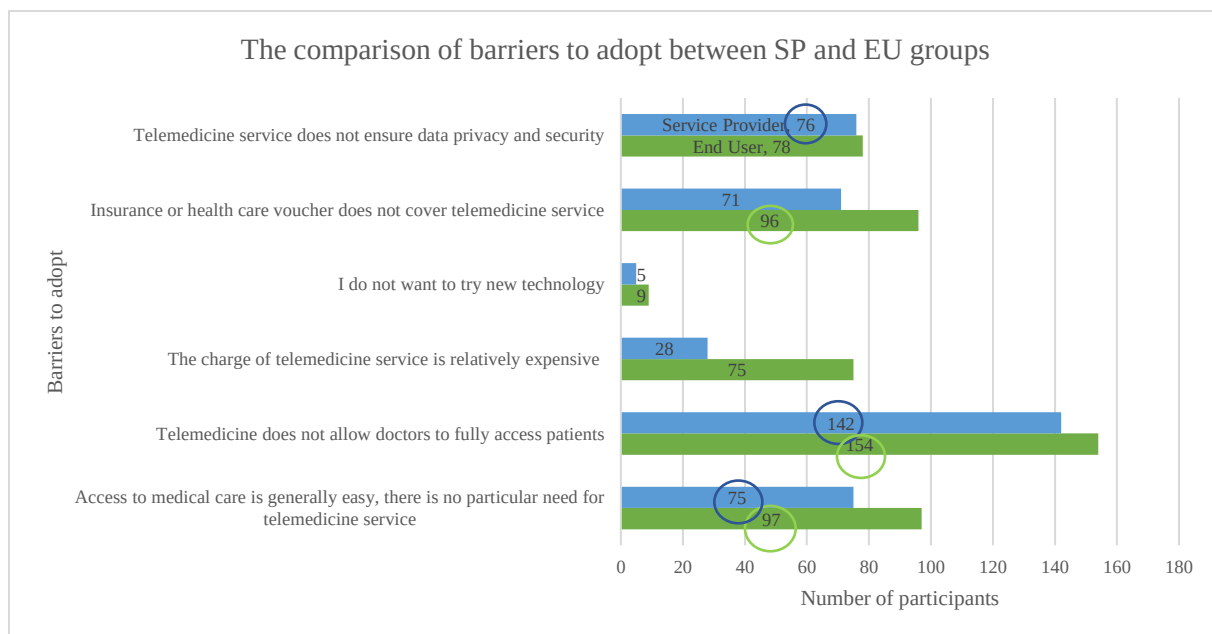
		Average ITUSP	Average SNSP	Average SIEU	Average ITUEU
Average ITUSP	Pearson Correlation	1	.616**		
	Sig. (1-tailed)		<.001		
	N	214	214		
Average SNSP	Pearson Correlation	.616**	1		
	Sig. (1-tailed)	<.001			
	N	214	214		
Average SIEU	Pearson Correlation			1	.627**
	Sig. (1-tailed)				<.001
	N			225	225
Average ITUEU	Pearson Correlation			.627**	1
	Sig. (1-tailed)			<.001	
	N			225	225

**. Correlation is significant at the 0.01 level (1-tailed).

4.4 Barriers to Adopt

The survey's final question involved a few reasons for barriers to adoption. As the barriers to adoption could be due to various reasons, each participant was allowed to choose more than one reason. Thus, the total number of results was more than the sample size. Figure 19 highlights the results from both end user and service provider groups. It is shown that the highest barriers to adoption in both groups would be due to a lack of full assessment by the doctors. For the end user group, the second-highest barrier was rated accessibility, as many felt that access to care was generally easy in Hong Kong. Similar to this rating, telemedicine service could not be covered by insurance or health care voucher then followed by privacy and security concerns. The second most popular reason for the service provider group was the data privacy and security concern followed by accessibility to care. The concern regarding insurance or health care vouchers ranked fourth with a similar frequency as the second or third reason by the service provider group.

Figure 19. The comparison of barriers to adopting between service provider and end user groups



It was noted that the number of end user choosing the cost of telemedicine was far more than the specialist, although it ranked as the second last barrier, the number was still high to make a note of. Only less than ten people chose the technology as the main barrier for both groups, indicating that it was the last concern to adopt telemedicine.

5. Discussion

The results showed all independent variables for the intention to adopt telemedicine were significantly associated, which means that the intention to use telemedicine services could be determined by the performance expectancy, effort expectancy, social influence, subjective norms, and privacy. This was standardized across service providers and end users (Table 10). Further study on both service provider and end user group characteristics gave insights to determine the independent variables. The statistical analysis results rejected three hypotheses (H1, H2 and H8) and showed an insignificant relationship with the variables being studied. These will be highlighted individually in this section.

Table 10. Result summary of statistical analysis on the hypothesis.

Hypothesis	Significance Level	Support/Reject
H1: Service provider's experience has a positive significant effect on performance expectancy.	$p = 0.667$	Rejected
H2: End-user's age has a significant effect on performance expectancy	$p = 0.792$	Rejected
H3: End-user's access to medical care has a significant effect on the performance expectancy.	$p = 0.021$	Supported
H4: Performance expectancy has a significant effect on end-user's intention to adopt telemedicine service.	$p < 0.001$	Supported
H5: Performance expectancy has a significant effect on service provider's intention to adopt telemedicine service.	$p < 0.001$	Supported
H6: Effort expectancy has a significant effect in the end-user's intention to adopt telemedicine service.	$p < 0.001$	Supported
H7: Effort expectancy has a significant effect in the service provider's intention to adopt telemedicine service.	$p < 0.001$	Supported
H8: End-user's co-living status has a significant effect on social influence.	$p = 0.624$	Rejected
H9: Social influence has a significant effect in end-user's intention to adopt telemedicine service.	$p < 0.001$	Supported
H10: Service provider's practicing location has a significant effect on the intention to adopt telemedicine service.	$p = 0.033$	Supported
H11: Subjective norm has a significant effect in service provider's intention to adopt telemedicine service.	$p < 0.01$	Supported
H12: Privacy has a significant effect on end-user's intention to adopt telemedicine service.	$p < 0.01$	Supported
H13: Privacy has a significant effect on service provider's intention to adopt telemedicine service.	$p < 0.01$	Supported

5.1 Performance Expectancy

Five hypothesis (H1 to H5) were related to Performance Expectancy. In both service provider and end user groups, performance expectancy was significantly associated with the intention to use (H4 and H5). This reflected that both groups were likely to adopt telemedicine services as they believed telemedicine was useful in their daily lives or would provide the services more quickly with improved quality. In terms of the stakeholder's characteristics to the performance expectancy, service provider's years of experience did not significantly affect performance expectancy (H1). In other words, the perception of the usefulness of telemedicine service did not differ from the healthcare professionals' experiences, which was opposing to some research. Thapa et al. (2021) found significant results that experienced healthcare professionals in Saudi Arabia were more likely to perceive digital tools which was opposite to the results from Gaggioli et al (2005) where the physicians were not convinced telemedicine could improve clinical practice. On the contrary, El-Mahalli et al. (2019) found that the adoption of telemedicine by healthcare professionals in Saudi Arabian hospitals was higher in senior consultants with more than 20 years of experience than the junior physicians.

Similarly, the end user's age did not significantly affect performance expectancy in this study (H2). However, this can probably be due to a larger sample population from 35-49 years old (81.8%), which dominated the results. In terms of the access to medical care on performance expectancy (H3), the statistical analysis showed a significant positive relationship between the two. Data collected showed that over 98% of the sample population could access medical care within 30 minutes, and those who rated over one hour of access had a larger Likert scale mean (4.42) as compared to 0-14 minutes (3.22) or 15-30 minutes (3.28). This reflected that access to

medical care in Hong Kong is generally easy, and the perception of the usefulness of telemedicine service was higher for those living far away. This is also one of the beliefs why telemedicine could not settle well in Hong Kong. Cheng (2020) identified Hong Kong's telemedicine market as conservative. It was stated that there might have been an uptake during the pandemic, but the lasting adoption was unlikely. Because Hong Kong is a high-density city, people are easily accessible to the public; thus, the demand for remote solutions is less. 'Hong Kong is very different from other places. Mainly because it is geographically very small, and the private medical market is very competitive, it is rather easy in Hong Kong to see doctors. As a result, the kickoff of telemedicine was not very impactful. However, in an extreme situation like COVID-19, there was an obvious demand for the benefit of convenience.' mentioned by Mr. Lee (Appendix 3).

5.2 Effort Expectancy

Effort expectancy were shown to be significantly related to the intention to use telemedicine in both service provider and end user group (H6 and H7). This result is supported in a number of studies on the healthcare professionals (Adenuga et al., 2017; Houwelingen et al. 2014) as well as end users (Cimperman et al., 2016; Quaasar et al., 2018). Cimperman et al. (2016) found that amongst the old users' group, computer anxiety was positioned as an antecedent of effort expectancy with a strong negative influence. Supported by the Singapore Eye Research Institute who did a survey and found that 55% of the people aged 60 and above were unlikely to use digital medical devices during the pandemic, though the higher income and education group would be more likely to adopt (Begum, 2021). Despite this, studies in Hong Kong have shown the intention to adopt telemedicine services is positive in the advanced age group. The study

carried out by Lingnan University Hong Kong (2020) showed that more than 60% of the senior citizens were willing to try the telemedicine service under the COVID-19 pandemic. Zhou et al. (2019) studied the factors influencing behavior intentions to telehealth by Chinese elderly and found medical service satisfaction, ease of use, and information quality had a significant influence on the elderly patients' acceptance of telehealth. Mr. Lee commented that telemedicine was not necessarily unpopular for the older generation. 'Sometimes these old people do not want to bother their children to take them to the doctors, as long as the platform's user interface was user-friendly, many of them would like to try' (Appendix 3).

5.3 Social Influence and Subjective Norm

Social influence was a significant factor affecting telemedicine in the end-user group (H9). This is in line with many studies (Kijasanayotin et al., 2009; Aggelidis and Chatzoglou, 2009).

However, Napitupulu and Kusuma (2021) found a weak impact on behavioral intention to use and social influence. An explanation was that most of the respondents in their study were early adopters who were considered reluctant to other people's opinions. On the contrary to our finding, the end-user population had a low usage of telemedicine (95.6%). Yet, social influence was still one of the significant factors to use telemedicine in this group.

This study also investigated the relationship between co-living status and social influence (H9). It was believed that family members' co-living status would influence one's belief (Karmal et al., 2020; Peeters et al., 2012). Studies have shown inconsistent social influence results on the intention to use telemedicine. In this study, 95% of the population lived with one or more persons, and regardless of the number of co-living members, the average mean of the Likert Scale ranged from 3.03-3.25. There was a little variance of mean between groups, and the relationship between the intention to use and the co-living status was insignificant; thus, the

hypothesis (H8) was rejected. This means that the co-living status of the end-users does not insert a significant effect on the social influence.

Subjective norm was found to be a significant factor to the intention to use telemedicine services in the service provider group (H11) thus, the service provider tended to adapt to the service when their patients, peers, or influencer in the company encouraged them to use. Some studies insisted on using Social Influence in the study for healthcare professionals and found a positive relationship between social influence and the intention to use telemedicine services. Marcelo et al. (2021) confirmed that social influence was a significant factor in using telemedicine devices amongst health professionals and found that the professionals tended to use it because their co-workers or colleagues endorsed it.

The service provider was asked if they had any contractual relationships with any medical groups in this study. This was believed that if the service provider was part of the infrastructure, the telemedicine services might become a part of strategic directions that the service provider had to follow. 63.1% of the service provider answered they had contractual obligations with medical groups, and they had a higher mean of Likert Scale (3.91) compared to the service provider working individually (3.64). The Independent Sample T-test showed the significance level at 0.033 (two-sided), indicating that the practicing location was significantly associated with the intention to use (H10).

5.4 Privacy

In this study, people were asked if they believed telemedicine was trustworthy and whether they believed the service would remain in a private manner. The result showed that privacy was

significantly associated with the intention to use telemedicine in both stakeholder groups (H11 and H12). A strong security tools can increase the number of users in telemedicine (Zaidan et al., 2011) and many studies showed that patient confidentiality and privacy issues were barriers to telemedicine services (Paul et al., 1999; Mansouri-Rad et al., 2013). Olanrewaju et al. (2013) recognised that the potential for protected health information to be leaked during telemedicine services was higher than face-to-face interaction. During the time when the demand for telemedicine is high, the benefit of telemedicine might outweigh the potential risks of privacy. Yet the risks can still not be neglected by the healthcare organisations who need to increase their cybersecurity infrastructure by developing stronger prevention and detection protocols (Jalali et al., 2021); and compliance during telemedicine regardless on medicolegal concern or data privacy concern is critical for healthcare professionals if telemedicine enters to the sustainability phase (Bonderud, 2022)

5.5 Moving forward to sustainability

When the Covid-19 fifth wave hit Hong Kong in the first quarter of 2022, the telemedicine services returned to the market again, proving that demand was higher when physical interaction was prohibited (Bastille, 2022; RTHK, 2022; HK01, 2022). The current situation of telemedicine services in a non-Covid era in Hong Kong has contradicted this study's findings. The findings have shown that people are intended to use telemedicine services, but the usage remained low when the Covid situation was settled in Hong Kong. Why was that?

The study identified that both end user and service provider found telemedicine did not allow doctors to access patients fully. The end user group felt strongly that insurance coverage or the

ability to use health care vouchers is one of the top three important indicators and accessibility (Suri et al., 2005). At the same time, data security ranked the third most important for the service provider group (Saigi-Roubio et al., 2016). Both groups did not show any difficulties in their willingness to use new technology, which is positive to see that the Hong Kong population is generally open to technology use. One interesting point to note is there was a huge discrepancy on the perception on cost of telemedicine where almost 2.5 folds more of the end user group felt telemedicine was expensive as compared to the service provider group. This would be worth studying more on the reason behind in order to set for a reasonable market rate satisfied for both stakeholders.

These findings have given a clearer idea of the main reasons for non-adoption, which is important for setting directions in the future. It seems that telemedicine services should be narrowed down to target a few specialties where physical assessment on the patient is not required. ‘We often say telemedicine is a triage channel to access the healthcare system. This triage system should benefit both doctor and patient, so telemedicine is best to be used as a method to decide if a physical assessment is required.’ Mr. Lee said (Appendix 3). From a health care organization’s perspective, Mr. Lee mentioned that the top barrier of telemedicine adoption is a regulatory concern. Without a clear guideline on what the doctor can or cannot do, it worries the medical professionals and the organization about the medical claims liability they must bear. Tong et al. (2019) held a webinar with Family Physicians in Hong Kong; they identified a few areas of concern, including the difficulty in establishing a trustful doctor-patient relationship, a less comprehensive physical examination, and possible inherent problems with technology relating to storage and privacy of data.

As many countries are moving towards the post-Covid era, they are ready to sustain telemedicine and improve healthcare through digital transformation (Hospital Management Asia, 2022).

However, it is felt that Hong Kong needs to solve the barriers raised by the service provider as a preliminary step to enhance the confidence level amongst the stakeholder groups. It is more important to have a trustworthy and endorsed system by the medical professionals who will feel confident to initiate the launch of such service. Of course, the concerns on medicolegal liability cannot be neglected and must be put forward to discuss amongst the healthcare professionals and the designated authorities.

6. Recommendations

The telemedicine service development in Hong Kong requires a clear direction from the authorities. It is important for the service to succeed to determine the services being provided and their feasibility. Minimal physical assessment for clinical diagnosis is best for such an area of service. As medical service is easily accessible in Hong Kong and the private medical system is well established, telemedicine development should not follow the path from the other countries. Instead, it is better to identify the key service area which can benefit from it. Below are some recommendations for the authorities to consider for the future development of telemedicine services in Hong Kong:

i. Formulation of Regulations

The current guideline from the Medical Council gives a basic principle, but it is not robust to give reassurance to service providers in terms of medicolegal liabilities. The topic was brought up to the Legislation Council in early 2021 where recommendations on setting up a clearer

regulatory framework and guidelines on the applications of technology in the healthcare sector were made (Cheng, 2021). However, there has not been any updates since then. As telemedicine has been encouraged to use more frequently in the fifth wave of COVID pandemic in Hong Kong (Tin, 2022; Headline Daly, 2022), the urge to formalize the regulations and clarification on the guideline is crucial for the service to sustain.

ii. Expand insurance or healthcare voucher coverage

If the motivation to adopt telemedicine is to formulate regulation for the service provider, then expanding insurance coverage or healthcare voucher would be one important factor for the end-users (Kumar, 2021). It is a two-way process that requires negotiation between the service provider, the insurance companies, and the subsidy scheme. During the 5th wave of Covid many insurance companies have partnered with service providers to launch telemedicine service for their members, and the Government and some organizations even provided free telemedicine services to support the community (HKSAR Government, 2022; am730, 2022; Hong Kong Business Times, 2022; UMP Healthcare Holdings Limited; 2022). This was one positive step that Hong Kong had moved and with the increased adoptions from the end user, the insurance companies and authority should consider expanding telemedicine as a routine item covered by the insurance or subsidy plan in long term.

iii.Focus on key service area

Telemedicine service is not suitable for all medical services. Service providers should evaluate the most suitable service area and invest in support resources. For instance, long-term health

monitoring, rehabilitation service, mental health, and nutrition counseling are examples of services requiring the least physical assessment, which will be appropriate for doing remotely. In public sectors where there are usually many patients daily, they could consider using a virtual platform for the initial triage supported by prescription of medication or to focus on a particular disease management. This can reduce the number of patients in the outpatient or emergency unit, and the hospitals can better utilize their onsite resources to support other patients in need (Poon et al., 2005; Po, 2000; So et al., 2021)

iv. Online to Offline support

If telemedicine service is to be provided, organizations must find ways to support offline services such as medication delivery. It does not serve its purpose if the patient is required to pick up medication remotely. In Hong Kong, medicine prescription is provided by the doctor's clinic. Unlike other countries, it is uncommon to ask the patient to bring the prescription and pick up the medication from the pharmacy. Thus one way to provide an online to offline support is to partner with a logistic solution where medication can be delivered to the patient within a period.

7. Limitations

The research methodology had some limitations which influenced the credibility of the results. Firstly, the population of the EU group was too large, making the sampling size too small to represent the whole population. In addition, the service provider group could have been narrowed down to a specific specialty as telemedicine might not apply to all healthcare professionals. For example, it might be more easily adapted by specialties that do not require physical assessment by the doctors.

Secondly, the convenience sampling method might have provided some biased information as the population would be around similar demographics such as education, age or living area, etc. It would have been more representable based on other sampling methods, such as the stratified sampling method, where representatives from a particular geographical location were selected.

As the usage of telemedicine in Hong Kong was not high at the time of data collection, some of the questions may not be understood by those who have not had any experiences with telemedicine services. Focus groups with a demonstration of the telemedicine service for both stakeholder groups, particularly those who have not experienced such service, would be beneficial in helping them to understand the service. The data collection was done prior to the 5th wave in Hong Kong and the situation and the acceptability of telemedicine services might have changed during this time. However, even though the adoption might have increased during the 5th wave, the core problem of telemedicine services in Hong Kong remained unresolved.

There are other aspects which could have included in the survey and listed as one of the possible barriers to adopt. For example, regulatory concern was not included as a barrier to use which could have been one critical factor to support the recommendation. Secondly, whether the education or career background for the EU group would exert any difference on the independent variables. These would be some additional factors to look at in future research.

8. Conclusion

The use of telemedicine has shown great benefits in many countries. During the COVID-19 pandemic, this has shown to be an excellent alternative to access to medical services and relieving the burden of the medical system. However, Hong Kong has not been shown to have

benefitted from it during the 'normal time' due to its convenience and well-established private medical system. This study evaluated the factors affecting the adoption of telemedicine services for both service providers and end-users. It was found that the intention to use was based on the performance expectancy, effort expectancy, social influence, subjective norms, and privacy, and the results were consistent amongst the two groups. Despite this, the accessibility to medical service from home was a significant factor in the performance expectancy. Service providers were more willing to use it if they were backed up with infrastructure support. There are still several issues with telemedicine in Hong Kong, causing barriers to adoption. Those are the factors that cannot be neglected if telemedicine needs to take part in Hong Kong to reduce the burden from the medical system. In that case, it will be the most important to gain full confidence from the medical professionals on the telemedicine services as they will put the service forward to the end-users.

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Appendix 1

Survey Questions for Service Providers		Reference	Post Survey Cronbach's alpha score
Performance Expectancy			
PESP1: I find telemedicine service useful in my daily practice		Yamin and Alyoubi, 2020	0.938
PESP2: Using telemedicine service helps me provides healthcare service more quickly			0.938
PESP3: Using telemedicine service improves the quality of my care			0.941
Effort Expectancy			
EESP1: I should find telemedicine service easy to use		Senuz and Senuz, 2021	0.940
EESP2: Learning how to use telemedicine service is easy for me		Yamin and Alyoubi, 2020	0.942
EESP3: It is easy for me to become skilful at using telemedicine service			0.941
Privacy			
PSP1: The telemedicine service is trustworthy		Hossain et al., 2019	0.939
PSP2: Everything that I do during the telemedicine service remains private		Velsen et al., 2017	0.943
PSP3: I am confident that the information I provide during the telemedicine service will be kept in a private and confidential manner			0.942
Subjective norms			
SNSP1: Patients think that we should try telemedicine service.		Wu et al., 2021	0.940
SNSP2: My organization or clinic thinks that we should try telemedicine service			0.940
SNSP3: The owner/ board of directors of my organization think that we must try telemedicine service			0.940
Intention to use			
ITUUSP 1: Assuming that I was given a chance to access telemedicine, I intend to use telemedicine services		Kamal et al., 2020	0.937
ITUUSP 2: I want to learn more about telemedicine service		Olivia et al., 2014	0.942
ITUUSP 3: I intend to use telemedicine service in near future			0.938

Appendix 2

Survey Questions for End Users		Reference	Post Survey Cronbach's alpha score
Performance Expectancy			
PEEU1: I find telemedicine service useful in my daily life		Yamin and Alyoubi, 2020	0.928
PEEU2: Using telemedicine service helps me seek healthcare service more quickly			0.929
PEEU3: Using telemedicine service improves the quality of my healthcare seeking			0.931
Effort Expectancy			
EEEU1: I should find telemedicine service easy to use		Semiz and Semiz, 2021	0.932
EEEU2: Learning how to use telemedicine service is easy for me		Yamin and Alyoubi, 2020	0.932
EEEU3: It is easy for me to become skillful at using telemedicine service			0.930
Privacy			
PEU1: The telemedicine service is trustworthy		Hossain et al., 2019	0.929
PEU2: Everything that I do during the telemedicine service remains private		Velsen et al., 2017	0.932
PEU3: I am confident that the information I provide during the telemedicine service will be kept in a private and confidential manner			0.932
Social Influence			
SIEU1: People that are important to me think that I should try telemedicine service		Wu et al., 2021	0.929
SIEU2: In my social circle people who influence me think that I must try telemedicine service			0.929
SIEU3: In my social circle people whose opinions are valued prefer that I should try telemedicine service			0.929
Intention to use			
ITUUEU 1: Assuming that I was given a chance to access telemedicine, I intend to use telemedicine services		Kamal et al., 2020	0.929
ITUUEU 2: I want to learn more about telemedicine service		Olivira et al., 2014	0.932
ITUUEU 3: I intend to use telemedicine service in near future			0.929

Appendix 3

Interview with Felix Lee, President and CEO, UMP Healthcare China

Date: 15 January 2022

Time: 9:30am

D= The Author ; L= Mr. Lee

D: The telemedicine development in China is very mature and based on the annual report from UMP, it was shown that the telemedicine usage in the past year increased in many folds. Did you observe the same increased demand in Hong Kong during the Covid-19?

L: I think Hong Kong is very different from other places. Mainly because Hong Kong is geographically very small, and the private medical market is very competitive, so it is rather easy in Hong Kong to see doctors, as a result the kickoff of telemedicine was not very impactful. However, during the extreme situation such as COVID-19, there is some sort of demand for the benefit of convenience. But I think the telemedicine service in Hong Kong should not be focusing on the convenience, it is rather a method of digitalizing the communication to bring efficiency and effectiveness for a particular group of chronic patients within the healthcare organizations. For example, using telemedicine can help nurses sorting out the communications in preparation before the consultation so within one hour, the doctor can see 8 patients instead of 3. So, telemedicine is not as simple as just an online consultation but the whole infrastructure can help the organization increase the efficiency and business.

D: So as according to what you said, it is more workable for long term disease management and rehabilitation service?

L: Yes absolutely. Acute care is not suitable for telemedicine.

D: But this seems that it is also working for acute care in China, is it because of the COVID-19 or will this also work in long term?

L: Acute care can be divided to pre- or post-acute care. If it is a post-surgery acute care, I think telemedicine can still be used. But the pre-acute care shouldn't involve telemedicine. We often say telemedicine is a triage channel to access the healthcare system, and this triage system should benefit both doctor and patient, so telemedicine is best to be used as a method to decide if a physical assessment is required.

D: During your development of telemedicine in Hong Kong, what are the main barriers for the healthcare professionals?

L: In Hong Kong, the top barrier is regulatory concern. The doctors think that the Medical Council do not have a clear guideline on what they can or cannot do; the second barrier is that medical claims liability, whether the insurance coverage will cover for what they do during the online consultation; the third barrier is that they will think telemedicine in Hong Kong is not a huge market, so they concern that there is no business volume after all their efforts. Therefore, I think telemedicine services needs to be very specific, as not all specialties are suitable for telemedicine. Even in China, the acute care will not involve telemedicine. In fact, the recent

regulation in China mandates all internet hospitals to have an all-rounded offline support for their telemedicine service operations.

D: What about the barriers from patients? Have you observed that it is more receptive to the younger generation than the old population?

L: To a tech savvy generation, broadly classified as 20-45 years old smart phone users, they are very receptive. They go rock in the digital era, they don't like going offline to the clinic and wait for the appointment. If it is something not serious, they don't want to waste time.

Telemedicine can provide them with digital communication so they can make use of their time more efficiently. This also greatly reduces the crowd to the outpatient setting and the cross-contamination risks. So, from this perspective, the young generation is receptive to telemedicine service.

However, it doesn't mean that the older generation or the non-tech-savvy group cannot use telemedicine. We just need to simplify the whole portal to make it easier. For example, you don't expect the old population knowing how to navigate HKTV mall, Taobao, Amazon. We just need to find a new user interface for them, and they will engage. A lot of them don't want to bother their family members to bring them to the doctors so as long as they know how to access, they should also benefit from it. I am currently seeing that happening in China.

D: I want to understand more about the infrastructure. As you said it is one important factor for the service development, during COVID-19, there are many private apps developed for telemedicine such as DrGo, DrNow; but at the same time some hospitals such as Gleneagles also have their own platforms as well as being part of the service

provider of the app. For you as a healthcare organization, do you think building your own platform is more suitable or is it better to partner with some private companies?

L: That's a very good question. I think this is a business decision. If it is a small organization and you don't have resources, it is better for you to do partnership. It is also a good way to test the effectiveness and enabling decision making of investment on development. For a bigger organization, sometimes you do not have a choice not to do it then you will start thinking for the future development. Our company also started with some simple channel such as zoom but within the clinical setting, it is quite complicated and using zoom alone does not enable efficiency of the whole process. One good example is that the doctor may need to access your medical report during the virtual consultation, the doctor cannot rely on two different computers.

It is a tradeoff process, but the decision can only be made once you can prove there is revenue potential, otherwise I will rely on third party's platform from the start. Having said that, as a large health care organization, it might be inevitable for further development and make customization to suit our needs.

D: But I think it is hard to measure the outcome for further investment, particularly in Hong Kong.

L: Yes, it is very difficult. I would not make such investment in Hong Kong as I cannot see the market demand. As I mentioned before, it is too convenient to see a doctor in Hong Kong. I

think COVID-19 was a trigger point but in Hong Kong telemedicine is more a service extension but it is not a business lead with competitive advantage

D: I think it is a pity that Hong Kong cannot benefit from the telemedicine service when many research has proved that telemedicine can be used to improve the medical system.

L: This is because Hong Kong people do not struggle to get access to medical care. But from the business strategic prospect, telemedicine may be the way to go when there is further development within the Greater Bay Area.

D: How important is the Government's role on the development of telemedicine in Hong Kong?

L: It is very important since it is a regulatory industry after all. There needs to be a clear guidance what can be done and there should also be an encouragement on the application of telemedicine on some specialties. It is too broad to conclude telemedicine for the overall healthcare industry, it may not work of orthopedic, but it may work perfectly for some other disease management.

D: Does this mean that the Government will need to lead the development of telemedicine in Hong Kong?

L: Well, not exactly. Corporate innovation can often start to test the regulatory water, then we can make an impact to the Government for regulation set up. It has been done for other industries too. It is just the private sector does not see the potential of telemedicine fundamentally so there is little force to push the Government forward.

D: Do you agree that the demand from the pandemic did not help Hong Kong moving towards telemedicine development, but instead it has made us realized that telemedicine does not work in Hong Kong?

L: I agree. I think there is no difference. The Hong Kong market is not big. A very good example is the Octopus and Alipay. Octopus has been used widely in Hong Kong for so long that it is difficult for Alipay to enter to the market; applying to our case, as it is too convenient to see doctors in Hong Kong, it is hard for telemedicine to land to the market. Even with the push from the government, it will be difficult to sustain given the environment and demographic factor.

D: If comparing to China, is the success due to the large service gap within the medical system? And when the government supported the idea, it exerted a huge impact to the development?

F: Exactly.

D: Do the Mainland public like this idea?

L: Yes they do because they struggled to access. Imaging you had to queue for 4 hours and now this can be solved by telemedicine? Their offline support is also a key factor. In China, they separate the service provider from the pharmaceutical supply, so the doctors do not benefit from the medicine whereas in Hong Kong, it is a linked factor making the service convenient seamlessly, and it is also a profitable source for the service providers.

D: Thank you for your time, that were all the questions I had and the information from you is very relevant and useful.