SUCCESSFUL FACTORS OF SERVICES AND FUNCTIONS OF TELEMEDICINE APPLICATION IN OPHTHALMOLOGY IN THAILAND

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ABSTRACT

The COVID-19 pandemic and growing healthcare inequality have resulted in reduced access to basic healthcare, both globally and in Thailand. Fear of contracting COVID-19 has made patients more hesitant to visit hospitals, especially the elderly, who may even avoid emergency care. In addition, studies have found that healthcare inequality in Thailand is worsening, as many doctors are opting to work in larger, more affluent cities like Bangkok. This has created a healthcare crisis and a shortage of medical personnel in rural areas. This trend is also evident in ophthalmology, where the number of patients far outweighs the number of available doctors.

This study aims to investigate to identify the critical success factors and barriers to implementation of telemedicine for ophthalmology consultations. Specifically, the study will focus exclusively on telemedicine in ophthalmology and its application within this specialty. The study employed qualitative method via in-depth interviews with 30 people from both service providers and patients.

Our findings demonstrated that the opinions and viewpoints towards ophthalmology and telemedicine varied significantly depending on factors such as the participant's demographics, educational level, and gender. In general, those aged 50 years and above expressed lower interest in using telemedicine for their consultations with underlying reasons categorized as unfamiliarity, lack of trust, and the perceived absence of personal touch. However, those younger than 50 years were more inclined to using telemedicine mainly due to convenience, and time-saving measure. One of the main barriers identified included the lack of a developed infrastructure and technological advancement currently available to provide a fully in-depth ophthalmological examination and investigation. Another main barrier was the issue of patient confidentiality in regard to patient-related information and images. Additionally, the need for complex investigations and technical machine was also another identified barrier for teleopthalmology implementation and use. Critical success factors identified included convenience, cost, usability of the application as well as the availability of high quality of digital infrastructure coupled with high digital literacy and training.

This study is the first of its kind to investigate the utilization of telemedicine applications in ophthalmology in Thailand, taking into account the perspectives of both service providers and users. The research has significant implications, as it has provided ground-breaking insights into the attitudes of patients and clinicians, key success factors, and barriers to the adoption of teleophthalmology in Thailand. These findings hold great potential for practical application, with the ultimate aim of improving healthcare availability and equality, as well as preventing the transmission of diseases during future pandemics.

KEYWORDS: Challenges and Opportunities / Ophthalmology / Telemedicine/ Thailand Expatriates
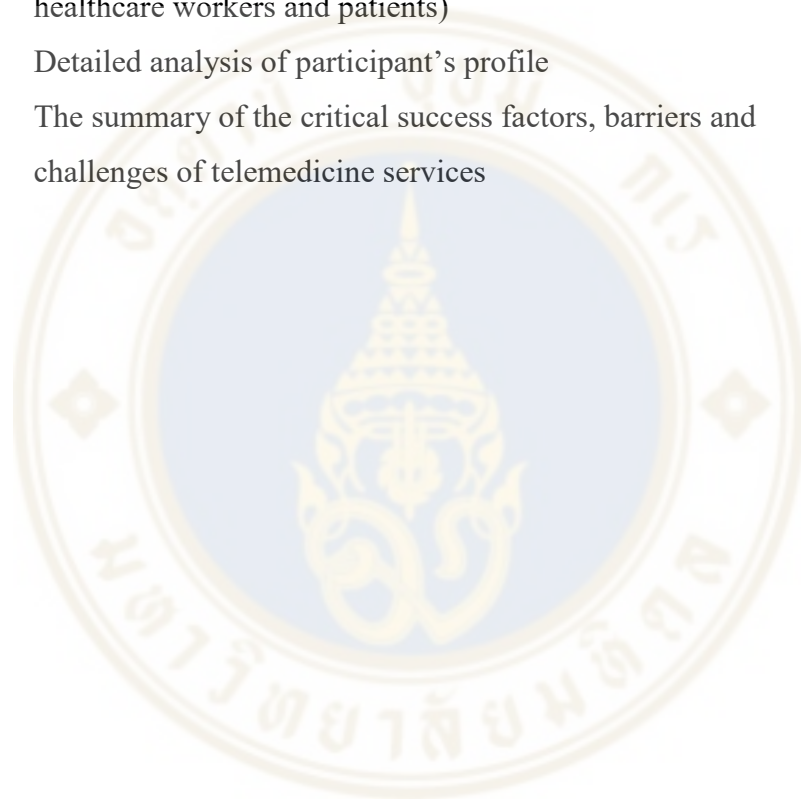
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CHAPTER I
INTRODUCTION

1.1 Background

The advancement of telemedicine has revolutionized healthcare delivery in recent years, and teleophthalmology is one such branch of telemedicine that has shown great potential in improving access to eye care services. In Thailand, telemedicine services have been in development for several decades, and the use of teleophthalmology has expanded to include a wide range of medical specialties. Limited access to medical care, especially in remote areas, poses a significant challenge to the population's health, and the COVID-19 pandemic has further highlighted the need for remote medical care. However, there is limited research on the implementation and effectiveness of teleophthalmology services in Thailand. This thesis aims to study the current state of teleophthalmology services in Thailand, assess their effectiveness in improving access to eye care, and identify barriers to their implementation and use. The findings of this study could provide valuable insights into the potential benefits of teleophthalmology services in Thailand and inform policymakers and healthcare providers in developing strategies to overcome barriers and enhance the provision of teleophthalmology services in the country.

1.2 Problem Statement

The COVID-19 pandemic and growing healthcare inequality have had a detrimental impact on access to essential healthcare, both on a global scale and in Thailand. Patients have exhibited an increased apprehension towards seeking medical care, as the fear of contracting COVID-19 looms large. This apprehension is especially pronounced in the elderly population, who may even refrain from seeking emergency medical services. In addition, several studies have indicated that the healthcare

inequality in Thailand is worsening, owing to an increasing number of medical professionals opting to work in more affluent regions such as Bangkok. This shift has contributed to a healthcare crisis and a dearth of medical personnel in rural areas. This trend has also manifested in the field of ophthalmology, where there exists a disproportionate ratio of patients to available medical practitioners. Thus, teleophthalmology can potentially offer an effective and innovative solution to improve eye care services in Thailand, especially for the elderly and in resource-poor settings, while also helping to prevent the spread of diseases like COVID-19.

1.3 Research Question

What function and services does the telemedicine platform for ophthalmology need to become successful in Thailand to cater towards both Thai and international patients?

1.4 Research Objectives

The scope of the research will include:

- To understand and identify Thai and expat's attitudes and perception towards telemedicine service both in general and to ophthalmology

- To identify the barriers to accessing telemedicine and ophthalmological services

- To identify the critical success factors for telemedicine services in Thailand

1.5 Research Scope

The scope of this research is to explore and understand the critical services and functions of telemedicine for ophthalmology in Thailand in order to understand the necessary components for success in this consultation delivery. Further, it hoped that the research will provide novel insight and raise points that can be explored further for

real-life application to enhance healthcare service delivery in Thailand. This research will thus focus specifically on the application of telemedicine in the ophthalmology speciality setting only.

CHAPTER II
LITERATURE REVIEW

2.1 Telemedicine services and definition

According to the World Health Organization (WHO), telemedicine or telehealth is defined as "the provision of health services, where distance is a critical factor, by all health professionals who use information and communication technologies for the exchange of valid information for the diagnosis, treatment and prevention of diseases and injuries, research and evaluation, and for the continuous training of health workers, all in the interest of advancing the health of individuals and their communities" [1].

Telehealth pertains to the delivery of healthcare over distance and time via electronic communication technologies. It can be divided into four main categories including:

- Audio-video (synchronous) telemedicine, which involves real-time, two-way communication between a healthcare provider and a patient using audiovisual telecommunications and data collection technology.

- Store-and-forward (asynchronous) telemedicine, which involves the electronic transmission of healthcare data, such as images, text, or other digital data, to a healthcare provider for evaluation and treatment using methods other than real-time interaction with the patient.

- Remote patient monitoring (RPM), which involves the collection of health data directly from the patient, usually during their daily activities, which is then transmitted to a healthcare provider for analysis and appropriate action.

- Mobile Health (mHealth), which involves healthcare, patient communication, and education based on mobile communication platforms, such as fitness trackers, cell phones, tablet computers, and other mobile devices.

These fields utilize various technologies to enhance healthcare outcomes, tailored to specific clinical processes, conditions, and settings. Telehealth tools should

be used in conjunction with established clinical practices and evidence-based standards of care. Integrating telehealth with traditional methods can improve current practices (sustaining innovation) and create new workflows and clinical settings to enable novel approaches (transformational innovation). To ensure safe and effective patient care, the efficacy and safety of telehealth practices must be supported by evidence, including the technology utilized to develop new standards of care. The implementation of these strategies will require new risk management practices, reimbursement models, and regulatory oversight. The secure exchange and storage of telehealth data between devices, systems, and providers is necessary to safeguard patient privacy while ensuring the availability of data for appropriate patient care [2].

With these various functions, telehealth can be used to increase accessibility to healthcare, promote convenience and relieve the burden on healthcare personnel in hospital settings. Particularly amidst the COVID-19 outbreak, the utilization of mobile health or m-health solutions, such as smartphone apps, became increasingly popular. These apps, particularly those used for digital contact tracing, gathered data on people's health status, location, movement, and proximity. When integrated with artificial intelligence-based technologies and employed on a large scale, they proved effective in limiting the spread of the virus and mitigating its impact on public health. Other m-health apps were also used for remote monitoring, symptom checking, and video consultations, and were utilized as valuable tools for disseminating health information and raising awareness among the general population. A systematic review conducted during the early stages of the pandemic found that contact tracing and symptom checking apps were more widespread in Asia, whereas apps developed in Europe and North America focused more on information dissemination. As such overall, there was an increase in the number of telemedicine services with a reported 23-fold increase from January to June 2020 in various specialities of medicine [2]. However, despite this increasing trend, the application of telemedicine in ophthalmology appears to be lagging, with an increase in uptake of only 9.3% of ophthalmologists applying telemedicine in daily use at least once [3].

2.2 Ophthalmology outpatient services definition

Ophthalmology is the surgical subspeciality that concerns the diagnosis and treatment of eye disorders. It involves a subspeciality of training in medical and surgical eye care. Common ophthalmological diseases include diabetic retinopathy, cataract, glaucoma and uveitis, as well as many others. To treat diseases, ophthalmologists can prescribe medications, administer medical injections, perform laser therapy or surgery. Many of the diagnosis in ophthalmology pertains to pattern recognition and pertinent symptoms and signs on fundoscopy, angiography and various other imaging techniques mainly in an outpatient setting. However, the application of telemedicine has been increasing in the field of ophthalmology to increase access to healthcare, convenience and cost-effectiveness of consultations. For example, the use of telemedicine in diabetic retinopathy (DR) and retinopathy of prematurity (ROP) has demonstrated benefits for patients, healthcare providers, and healthcare systems. Telemedicine has been effectively used for remote surveillance of DR, which has resulted in clinical, public health, and economic benefits. Despite effective treatments for high-risk DR over many decades, DR remains a leading cause of blindness among working-age adults due to half the population being unable to access retinal examinations in a timely manner. Telemedicine programs can improve patient access to annual DR screening through patient imaging in a primary care setting, leading to improved clinical outcomes. The expansion of telemedicine programs for ophthalmology can result in earlier provision of eye care for DR and non-DR eye conditions, which is necessary given the high proportion of patients who currently cannot obtain a retinal screening or eye examination at the appropriate frequency [2].

Additionally, previous studies have reported that patients who live in the vicinity of further from medical centers are less likely to receive eye examinations, in critical diseases that require constant follow up such as glaucoma. In fact, more than 30% of patients do not return for follow up, resulting in further disease progression and poor disease prognosis [2]. Thus, the use of telemedicine via video conferencing can help increase patient monitoring, and remote testing to help enhance care, resource utility and increase cost-effectiveness. Many previous studies have outlined the advantages of employing telemedicine in ophthalmology such as in triaging and diagnosis of urgent eye conditions, as well as regular follow-up for stable patients.

Currently, ophthalmological applications are on the rise, with at least 121 apps with application in ophthalmology and can be used to help test vision such as the Snellen visual acuity test as well as applications for evaluating paediatric and illiterate patients. Examples of this includes "All in One Ophthalmology", which is a mobile based application and includes a Snellen chart, pupil size chart and interpretation of basic slit lamp findings. Another example is the "Healthy Vision" application which allows for paediatric ophthalmology examination [4]. While such platforms and functions are available, the full extent in terms of usability, cost-effectiveness, accuracy and long-term implications on disease management and treatment have yet to be fully evaluated. Similarly, the integration of such applications into daily practice and use at patient's homes are still to be further studied.

2.3 Telemedicine services in Thailand

Currently, Thailand lags behind many countries in terms of telemedicine's infrastructure and use. While various hospitals have been increasing the use of online, Line or Google meet for clinicians to diagnose and manage patients, there is a lack of existing platform to store medical records, process payment and use usability. Since, there have been several hospitals on the forefront in utilizing telemedicine services. An example is Siriraj hospital which was the first hospital to provide telemedicine services, along with King Chulalongkorn Memorial Hospital with both hospitals accounting for the majority of telemedicine services in Thailand. Currently, most telemedicine services are offered in Bangkok, outnumbering other areas by at least 14 times. Since these institutions and many others have also been offering teleophthalmology services into their overall telemedicine services, including patient triage, post-operative follow-up and detection of eye complications. The use of teleophthalmology have also penetrated into government-wide diabetic retinopathy screening campaigns where physicians are able to review fundus images remotely and give advice to patients via online platforms. Further the use of telemedicine and tele-ophthalmology have also been increasingly offered by many private hospitals, such as Bumrungrad, Samitivej and Praram 9 Hospital, and is a testament to a growing need in the adaptation of remote medical management in both the private and public sectors in Thailand [5].

In addition to this, there have been a rise in telemedicine start-up platforms in Thailand, including CHiiwii, Ooca, See Doctor Now, Doctor A to Z, Doctor Anywhere Thailand and Raksa, which have been providing both generalized telemedicine and teleophthalmology services since the year 2017 [5].

2.4 Barriers and challenges

According to Kotler, the buying process consists of three main methods: purchase, consumption, and post purchase stages. These processes are the fundamental stages in consumer behaviour and decision making and is also applicable to telemedicine and tele-ophthalmology. There are many various factors governing the consumer behaviour and decision making in telemedicine. However, in general terms, the attitude of telemedicine varies between demographics, age, education attainment. For example, many elderly patients or those lacking access to technology will still prefer face-to-face consultation. Previous studies have also reported a level of disinterest in telemedicine due to mistrust, lack of familiarity and fear of technological use. However, those in the younger population with a relatively busy lifestyle and those careers oriented might be more inclined to attend telemedicine consultation due to convenience, ease of technological use, and familiarity with online platforms. Various challenges exist in implementing and adopting telehealth, including acceptance, adoption, functionality, understanding, quality, and legislation. According to literature, some patients, particularly older patients, may not be comfortable with telehealth due to a lack of familiarity with technology. Patients with low technical skills, such as uneducated and elderly patients, may face challenges in using telehealth. The lack of medico-legal considerations in different countries can also impede the implementation and adoption of telehealth. Technological and technical issues are also major barriers to implementing and adopting telehealth. These include lack of Internet access, slow Internet connection, and difficulty accessing telehealth technology. Lack of additional technological equipment and large-scale telehealth solutions are also challenging. Telehealth functionality, specifically its effectiveness for patient screening, remains limited, and there are significant gaps in assessing its effectiveness. The lack of accurate monitoring

systems is also a challenge, and some examinations, such as blood taking and physical examination, require face-to-face interaction and cannot be performed via telehealth.

Another identified barrier was that the use of telehealth raised significant concerns about data privacy and security. Safeguarding patients' data and privacy were considered major concerns in telehealth, with the risk of exposure to fraud or data breach increasing due to the rapid rise in digital health records. The vulnerability of some telehealth applications also heightened concerns over privacy and security issues. Telehealth apps' safety and the use of telecommunication directly affected patients' data privacy.

There are several additional obstacles to using or implementing telehealth. For example, payment-related challenges exist for patients and healthcare services. Some examinations and screenings require specific equipment, like imaging equipment, to be installed in patients' homes before telehealth can be performed, but few vendors or companies provide such services. Additionally, loading and viewing patient images during telehealth visits can be difficult. Some patients do not have the necessary devices in their homes to access telehealth, and guiding them to set up their devices properly for effective examination can be challenging.

Thus, in summary, previously identified barriers to telemedicine include lack of patient readiness (such as technological skills or technological equipment available), lack of technical and regulatory readiness of health care system, digital inequality as well as medico-legal implications and patient confidentiality, as previously stated [6].

2.5 Medico-legal implications for telemedicine in Thailand

Teleophthalmology has various medico-legal implications that necessitate consideration. One of the primary concerns is the potential for misdiagnosis or overlooked diagnoses, which could result in harm to the patient and legal responsibility for the healthcare provider. This is especially critical because laws and regulations governing telemedicine in Thailand have only recently been created, and future legislative reviews will be necessary. Another concern is safeguarding patient privacy since teleophthalmology necessitates the transmission and storage of confidential

medical information. Sufficient precautions should be implemented to ensure the security and privacy of patient data. Medico-legal implications also arise due to data security issues, emphasizing the importance of patient confidentiality. Additionally, teleophthalmology may influence the standard of care and clinical guidelines for ophthalmic care, as well as the physician-patient relationship. Healthcare providers must ensure that teleophthalmology is employed within established clinical practices and evidence-based standards of care, and that patients are fully informed and consent to its use as part of their care. Reimbursement strategies for teleophthalmology services must also be addressed to ensure that insurance providers adequately cover them. Regulatory oversight of teleophthalmology should also be carefully considered, including issues related to licensure, credentialing, and privileging of healthcare providers who provide teleophthalmology services. National laws must be evaluated to ensure compliance with telemedicine practice regulations, as well as a lack of standard set of telemedicine laws that hinders global implementation. Additionally, in Thailand, medical insurance reimbursement presents a significant challenge for many insurance companies. Only certain telemedicine services are covered for medical reimbursement by specific insurance companies, depending on various factors. This situation raises medico-legal concerns about how treatment coverage can be provided and could potentially exacerbate healthcare coverage disparities. These medico-legal concerns must be addressed and resolved to maximize the benefits of teleophthalmology while minimizing the potential risks and liabilities [7].

2.6 Reported critical success factors for telemedicine

Reported critical success factors for implementation of telemedicine include strong fundamental knowledge and infrastructure, planning and management of health information and technology, fulfilment of legal and ethical issues, and adaptability of services. In terms of fundamental knowledge and infrastructure, both the healthcare workers, technological staff will need to be experienced with the implementation of various telemedicine platforms as well as trouble shooting measures, and strategies for offline failsafe measures. Similarly, a well-equipped set of infrastructures will need to be invested to help complement and allow for the delivery of telemedicine services. The

planning and management of health information and technology remains important as patient confidentiality remains a key medico-legal issue and barrier to implementation. Most notably, the safe storage of data and encryption are critical to achieve this. This is very relevant to Thailand, as the infrastructure for telemedicine is not as developed in comparison to other countries. Adaptability is also a key critical success factor as a trial and error method will be needed to constantly modify the service model according to the needs of the patients as well as remain responsive to requirements of all stakeholders. This is also relevant to the needs of the Thai population, as patient education has increased, and patients are now more aware and health-conscious, leading to a wider demand in telemedicine [6,8].
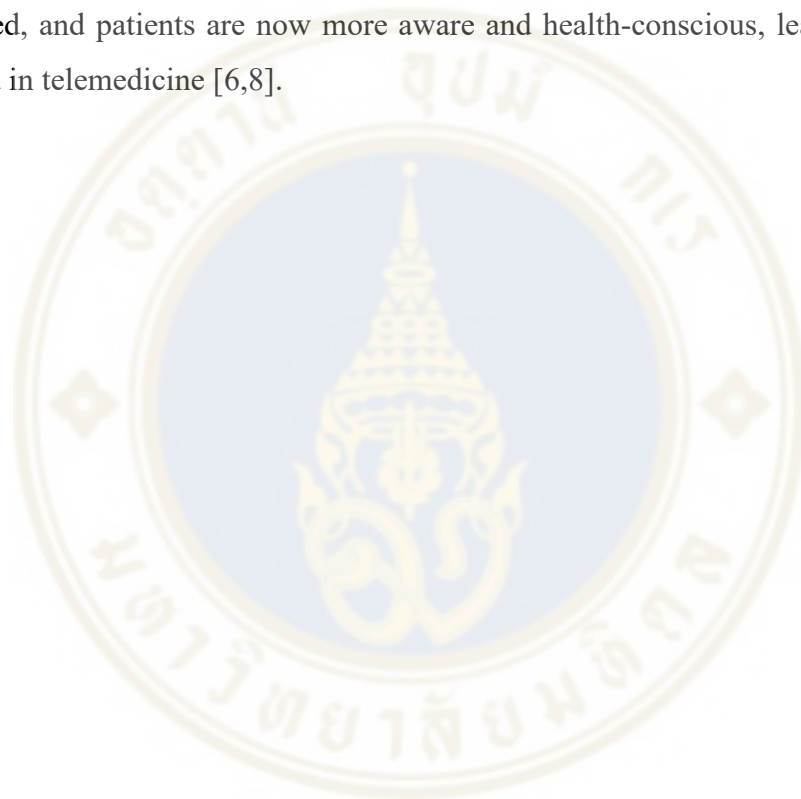
CHAPTER III
DATA COLLECTION

3.1 Research Design

The research design will include qualitative data collection from focused interview to receive information on previous telemedicine services and offerings, identified problems and solutions as well as give fresh new perspective and have local relevance via conducting interview survey. The researcher will conduct relevant literature review and in depth interviews to supplement the answers obtained from the interview.

3.1.1 Primary Data

A semi-structured interview will be conducted with a sample size of at least 30 participants. These participants will be from the healthcare sector, including clinicians and nurses, as well as service user i.e. patients. The respondents will be different in demographics, education background and medical needs. This will help the researcher gather a wide range of information and hopefully obtain an unbiased perspective. The questions used in the interview will be based on previously published literature and research conducted. A brief literature review will also be conducted to increase the insights obtained from the interview, and also to help analyse the results from the interview and determine any differences found.

3.1.2 Secondary Data

The secondary data will be in the form of a literature review on previous telemedicine services, especially in the field of ophthalmology, globally. The data will be collected from a variety of source, including PubMed and Cochrane journal searches.

3.2 Sampling Plan

The research will be conducted via convenience sampling method due to convenience and appropriateness.

3.3 Data Collection

The semi-structure interview involved at 30 respondents, 15 from the healthcare industry and 15 from the service users. Data collection was in the form of interviews that conducted both face-to-face or via online channels such as Google Meet, Skype, Line Meeting or Zoom and telephone conversations. The choice of platform was dependent on what was suggested by the interviewees. The interviewees included those from different demographics, medical needs and social backgrounds, as well as those in the healthcare profession. Each interview had a duration of around 30 minutes. Further relevant literature review was also searched with relevant keywords to help supplement the answers received from the interview and create a more comprehensive summary [6,8].

Sample selection and inclusion criteria:

- Thai and expatriate citizens
- Male and female respondents
- Age above 18 years old and able to give informed consent
- Medical healthcare workers including, but not limited to doctors, nurses, health technicians
- Ophthalmology patients in an inpatient setting, regardless of whether they have used telemedicine services before

3.4 Interview Question

The questions was divided into both general, screening and specific questions. Open-ended interview question was also preferred where interviewees can give their opinion on certain aspects, which will help provided a more thorough insight.

Table 3.1 Qualitative Interview questions used to conduct the research

Topics	Questions
Screening Questions	1. Have you ever used telemedicine services before? And for what? 2. How do you feel about the use of telemedicine services?
General questions	1. Can you tell me your current occupation, education level and interest in healthcare? 2. What kind of telemedicine services have you previously used? 3. How frequently do you use telemedicine services? 4. Do you have any medical conditions, ophthalmology or otherwise? 5. Are you willing to use telemedicine for the stated conditions?
Situation factors influencing telemedicine use	1. What would influence you in using telemedicine service for ophthalmology? 2. Would you use telemedicine services for ophthalmology if it is cheaper than the traditional ways of consultation? Why or why not? 3. How important is convenience in helping you decide to use telemedicine? Why?
Attitude and perception towards telemedicine	1. What are the important features of an effective telemedicine service, in ophthalmology? 2. Do you think that telemedicine service for ophthalmology is reliable and trustworthy? Why or why not? 3. Do you believe that not seeing an ophthalmology in person will change treatment? 4. Do you think opthalmologists are able to give the same accuracy of diagnosis as in conventional consultations? 5. Do you think that telemedicine is just as confidential as face-to-face consultation?
Perceived barriers of using telemedicine	1. What are some factors that will deter your use of telemedicine for ophthalmology?

	2. What are some challenges you identified with using telemedicine for ophthalmology?

Table 3.1 Qualitative Interview questions used to conduct the research (cont.)

Topics	Questions
Critical success factors	1. What is your opinion of a good ophthalmology telemedicine platform? 2. What is the ideal price for an ophthalmology telemedicine consultation? 3. What features would make telemedicine consultation for eye problems trustworthy and safe for you?

3.5 Data analysis

Data collected from the questionnaire was analysed using thematic analysis. However, due to the time constrains and limited study size, the data obtained might not present the entire population, not might not be applicable for other countries.

3.6 Limitations

This study was limited by time constrains, as well as the limited population size and lack of variation in hospital sites or clinical facilities. As such, the data might not be representative of the entire Thai and expatriate population. Thus, further studies with a larger population size might help create a more generalizable conclusion.

3.7 Data analysis Method

The researcher examined the outcomes of 30 interviews conducted, using the aforementioned table as a reference for each question. Additionally, the data provided by the participants was assessed through coding techniques (e.g. labeling them as A1, B2, C3, etc.) to determine the successful factors and barriers to providing

telemedicine in ophthalmology in Thailand. The subsequent chapter will provide a thorough explanation of these findings.

CHAPTER IV
RESULTS AND DISCUSSION

4.1 Interview respondent's profile

A total of 30 interviewees participated in the study using various platforms such as Zoom, Google Meet, Line meeting, or face-to-face interviews. These individuals were either healthcare workers (which included ophthalmologists, ophthalmic nurses and technicians) or patients. The interviews lasted approximately 30 minutes each. Of the participants, 15 were female and 15 were male, with 10 of them being Thai and 10 being expatriates.

Table 4.1 Brief outline of participant's demographics (including both healthcare workers and patients)

Demographics		Count
Gender	Male	15
	Female	15
Age	19-30	5
	31-50	20
	51-60	3
	61-70	2
Educational level	Lower than bachelor	3
	Bachelor	20
	Higher than bachelor	7
Monthly income	Lower than 10,000	2
	10,001-30,000	2
	30,001-50,000	10
	50,001-70,000	5
	70,0001-100,000	1
Nationality	Thai	26
	British	1
	Chinese	1
	Indian	2

Table 4.2 Detailed analysis of participant's profile

Participant Code & NO.	Gender	Nationality	Position	Education level	Monthly income
A1	Female	Thai	Patient	Bachelor	30,001-50,000
B2	Female	Thai	Patient	Bachelor	10,001-30,000
C3	Female	Thai	Doctor	Bachelor	30,001-50,000
D4	Female	Thai	Patient	Bachelor	10,001-30,000
E5	Female	Thai	Nurse	Bachelor	10,001-30,000
F6	Female	Thai	Doctor	Higher than bachelor	70,0001-100,000
G7	Female	Thai	Health technician	Bachelor	10,001-30,000
H8	Female	British	Patient	Bachelor	50,001-70,000
I9	Female	Thai	Doctor	Higher than bachelor	10,001-30,000
J10	Female	Thai	Patient	Lower than bachelor	Lower than 10,000
K11	Female	Chinese	Patient	Bachelor	10,001-30,000
L12	Female	Thai	Doctor	Higher than bachelor	10,001-30,000
M13	Female	Thai	Doctor	Higher than bachelor	50,001-70,000
O14	Female	Indian	Patient	Bachelor	30,001-50,000
P15	Female	Indian	Patient	Bachelor	50,001-70,000
Q16	Male	Thai	Doctor	Higher than bachelor	50,001-70,000
R17	Male	Thai	Doctor	Higher than bachelor	50,001-70,000
S18	Male	Thai	Doctor	Higher than bachelor	50,001-70,000
T20	Male	Thai	Patient	Lower than bachelor	Lower than 10,000
U21	Male	Thai	Patient	Bachelor	10,001-30,000
V22	Male	Thai	Patient	Bachelor	50,001-70,000
W23	Male	Thai	Nurse	Bachelor	30,001-50,000
X24	Male	Thai	Patient	Bachelor	10,001-30,000
Y25	Male	Thai	Patient	Bachelor	10,001-30,000
Z26	Male	Thai	Nurse	Bachelor	30,001-50,000
A2	Male	Thai	Nurse	Bachelor	30,001-50,000
B2	Male	Thai	Nurse	Bachelor	30,001-50,000
C2	Male	Thai	Nurse	Bachelor	30,001-50,000
D2	Male	Thai	Nurse	Bachelor	10,001-30,000

4.2 Research findings

4.2.1 Identifying Thai and expat's attitudes and perceptions towards telemedicine service both in general and to ophthalmology

The attitudes and perceptions towards both in general and to ophthalmology varied greatly depending on the participant's demographics, gender, and educational level. For example, the older studied subjects (categorized as over 50 years of age) were less inclined to use telemedicine services. Notably, 5 respondents (16%) who were of ages 50 years old and over were less interested in using telemedicine for their consultations due to the reasons categorised as unfamiliarity (60%), lack of trust (20%), and lack of perceived personal touch (20%).

Unfamiliarity

The main attitude towards telemedicine and teleophthalmology the geriatric population (60%) was due to unfamiliarity with the use of online platform. For example, many subjects reported that they are less interested to using telemedicine for ophthalmology as they are not familiar with the use of mobile devices such as smartphone, iPad or computers in conducting telemedicine on conventionally used applications such as Zoom, line, Skype, Microsoft teams or google meets. Due to this, they reported that the use of telemedicine for ophthalmology and in general to be perceived as "difficult", "complicated" or even "overwhelming" and feel deterred to adopting it. One respondent, patient I9 reported a negative perception towards employing telemedicine as his place of resident does not have the digital infrastructure (i.e. lack of internet and digital appliance) to conduct telemedicine consultations. Thus, he believes that the use of telemedicine might not be applicable and accessible for some patient subgroup. The concept of unfamiliarity to the delivery of care through telemedicine, online platforms or remote healthcare monitoring has also been an identified barrier previously cited in published literature [9].

Lack of trust

Many of these patients described how unfamiliarity with using telemedicine for consultations, whether for general medical conditions or for ophthalmology can cause doubt and a lack of trust. The geriatric patient groups patients reported to believe that physical contact and a thorough physical examination was necessary for accurate

diagnosis and disease management and believed that the quality of care and management would be far more inferior if it was provided exclusively via telemedicine. Specifically, they believed that a misdiagnosis could easily be made during the consultation, leading to compromised patient safety and care. This perceived lack of trust especially in the geriatric population has also been reported in previous literature [9].

<u>Lack of perceived personal touch</u>

Further, a lack of perceived personal touch was also of concern to some of the more senior patients have a good relationship with the ophthalmologist and patient A noted to have miss the personal touch of face-to-face interactions with their healthcare providers and report that she perceives that she will feel less connected to her healthcare team when using telemedicine. Thus, the patient, a widow, saw the consultation as a means of social interaction and these specific, but perceived important needs of some of the geriatric population might not be met via telemedicine consultations. In fact, a previous study have reported that up to 40% of the studied population were less inclined to adopt telemedicine due to a loss of doctor/patient personal touch, and have cited this to be an important factor in improving patient outcomes [10].

<u>Perceptions in the younger demographic subjects</u>

However, the younger demographic patients (defined in this study as 50 years old or younger), amounting to a total of 25 people, were more interested in using telemedicine. The most commonly cited reasons were due to convenience (65%), time-saving (30%), and reduced risk of infection (5%). This age disparity and higher adaptation and willingness to use telemedicine in the younger population has also been observed and reported in previously published literature [11].

<u>Convenience factor</u>

Convenience was the main identified perception of telemedicine in the younger demographics. The majority of the younger subjects reported that telemedicine and teleophthalmology can offer the main advantage of convenience and practicality. For example, patient D4, who works from home has described how telemedicine consultations would fit well with his lifestyle as he can acquire medical check ups without having it interfere his meeting schedules. Several patients also reported that telemedicine can also conveniently be used to help reduce stigma associated with certain

mental health conditions such as anxiety, depression or schizophrenia and younger patients feel more comfortable discussing their concerns with a healthcare provider virtually. This notion was also common to ophthalmology where a younger patient (patient D4), reported that he felt more at ease to consult an ophthalmologist regarding his herpes eye disease as he felt that he could assume privacy without having to interact with other patients or healthcare providers in the hospital. Further the importance of convenience was also reflected in the expatriate patients. For example, O14 who recently moved to the country reported that telemedicine especially for her ophthalmology problem could as an 'important bridge' for her to conveniently access consultation services without the need to navigate the complex Thai healthcare system, especially compounded due to the fact that she was unable to understand the language or read the signs in the outpatient clinic. She proposed that the tele-ophthalmology service could allow her to fully access doctors at her fingertips without having to wait in queues or face language and communication issues.

Time-saving aspect

Similar positive attitudes and perceptions towards telemedicine was reflected in all of the expatriate patients. For example, a patient P15, who is an expatriate described how telemedicine responds to his needs as he does not have to undergo the logistical issues of commuting, queuing up and language barriers that is associated with attending a large public hospital. Thus, he has a positive perception of telemedicine, as being effective, convenient and most suitable for his needs. Another Thai patient B2 perceive telemedicine to be highly positive as it could allow him continuity of care and follow up despite having to commute countries from time to time. He believes that it can offer seamless consultations and allow for better patient care and improved safety. Previous reviews have also cited the time-saving aspect of telemedicine and teleophthalmology to be an important critical success factor. In fact, an economic review has presented proof of the cost efficiency of tele-ophthalmology in the treatment of diabetic retinopathy and glaucoma [12].

Reduced infection rates

Some participants also reported that one of the benefits of teleophthalmology is that it can help reduce the risk of close contact and infection. For example, participants have described how having remote consultations from the hospital can help ensure that patients are less likely to be exposed to airborne infections such as the COVID-19 infection, as well as contact with infection and bacteria on the medical equipment or in the hospital. Due to this, they reported that in certain situations such as during the outbreak, telemedicine services might be a safer alternative to conventional examination methods and hospital visits.

Thus, it can be seen that the perceptions and attitudes of patients towards using telemedicine for ophthalmology varies greatly depending on demographics, race and digital literacy. These findings are significant as it highlights the nuances towards willingness and interest in adopting telemedicine for treatment.

Perceived barriers to teleophthalmology by the participants

The main perceived barriers identified included lack of high quality and capable infrastructure to provide a comprehensive teleophthalmology service. Specifically, the common underlying theme was that certain ophthalmic investigations, such as retinal examinations or visual field tests, may be challenging to perform remotely, and may require specialized equipment that is not available to patients at home. Some ophthalmic conditions may require a physical exam or in-person diagnostic testing to make a definitive diagnosis.

This lack of appropriate infrastructure has influenced the perception of both patients and healthcare workers, with an overall mixed findings (60% having a positive perception, and 40% as negative). For example, Doctor F6 noted that "*it is still very difficult to have various imaging features on a software, as in general clinicians will require specialised machines and equipment to visualise the eye, some of these features might be able to offer remotely due to technological constraints.*" For such reasons, healthcare providers might be sceptical of the use of telemedicine to provide for such consultations. Further Doctor L12 also mentioned that "*There are some conditions in which remote monitoring and examination might not be possible. For example, in cases such as suspected retinal detachment or a suspected intraocular tumor, an ophthalmologist may need to perform a dilated fundus exam or a specialized imaging*

test to accurately diagnose and treat the condition. Similarly, if a patient has a suspected corneal ulcer or an injury to the eye, an ophthalmologist may need to perform a slit-lamp exam to assess the extent of the damage." As discussed, the health providers surveyed have identified some shortcomings and thus, might have a relatively sceptical viewpoint on using telemedicine to provide entire ophthalmology consultations and it may not always provide sufficient information to make an accurate diagnosis. On the other hand, a subset of healthcare providers had a relatively more positive perception towards telemedicine. For example, they believe that telemedicine could make ophthalmology consultations more efficiency as it can allow providers to see more patients in less time and at a faster pace. By being able to conduct remote consultations and exams, they believe that this could improve the quality of life for certain patients such as the geriatric or those who live in further areas where commute can pose a huge obstacle. Further, they also believe that it could improve access to care as telemedicine can help expand the reach of ophthalmology services especially in rural and underserved areas which might lack ophthalmologists. Thus, it is perceived that telemedicine could help equalize disparity of care in the field of ophthalmology. Some healthcare providers also reported that it could be time and cost saving for patients especially in the logistical sense, and thus have an overall positive perception of ophthalmology for their patients.

Overall, it can be seen that the perception of telemedicine from the healthcare providers' point of view can also vary, but is in general, positive. Thus, it is important to address concerns raised which can compromise examination, investigation, and patient care and ensure that the use of telemedicine in ophthalmology is appropriate, tailormade and effective for each patient.

4.2.2 To identify the barriers to accessing telemedicine and ophthalmological services

As previously touched upon, one main barrier identified is the lack of a developed infrastructure and technological advancement currently available to provide a fully in-depth ophthalmological examination and investigation. From the interview, it was identified that infrastructure, and technological advancement plays a critical role in ensuring reliability and trustworthiness. For example, Patient U21 has described his negative experience with tele-ophthalmology due to the lack of available technology at

his house. He described how the lack of a stable internet connection in his rural area of residence prevented the consultation from being conducted successfully. Another self-reported barrier was the lack of education to using the teleophthalmology platform. The patient described how he was not given preliminary teaching or advice on how to launch the software and navigate the platform. Such report stresses the importance of a developed technological infrastructure appears to be a main barrier to access and provision of teleophthalmology care. The lack of infrastructure, whether in regard to internet connectivity, platform stability and usability or digital literacy would greatly interfere with disease diagnosis and thus, subsequent management. This could thus be the main barrier for consultation implementation and adoption of a telemedicine by ophthalmologists.

Another pertinent barrier was the issue of ensuring security measures to maintain patient confidentiality which can help reassure patients that their data is safe and their rights are respected. According to the respondents, confidentiality poses a key factor in determining usability and persuasion to using the telemedicine platform. For example, a few patients suggested that a clear and validated data collection and storing protocol can be useful in ensuring patient confidentiality and security. Further, it was also described how it is important for healthcare providers, such as clinicians and nurses, to clearly explain to patients about data safety measures in order to ensure confidence and ease of consultation. Previous study have reported the lack of control patients have over the collection, use, and sharing of their personal data, which could compromise their privacy. In addition, some smartphone applications may automatically share sensitive information, such as location data, without the user's explicit consent. Therefore, it is crucial to prioritize patient privacy and confidentiality to establish a trustworthy doctor-patient relationship [13].

Patient perceived factors for barriers that might deter telemedicine use includes complex eye conditions that will require physical examinations and extensive investigations which might not be possible in telemedicine. For example, a diabetic retinopathy patient has described how his follow up regimen includes using the optical coherence tomography and fundus angiography machine to determine the severity of his eye condition and need for laser treatment. Therefore, he believes that telemedicine consultation might not be able to serve such purposes. Further an important point stated

by the community care nurse caring predominantly for geriatric patients have highlighted the basic importance of having stable internet access, and available computer or electronic device for accessing the telemedicine platform online. This further stresses the technological stability and readiness is a significant supplementary factor in ensuring the logistical success of telemedicine delivery. For example, a previous study on the barriers to telemedicine have identified that regular updates of both hardware and software are necessary for functioning of the platforms used for telemedicine. The main logistic barriers identified for implementing tele-health services were inadequate information and communication technology infrastructure, such as poor internet connection, insufficient access to electricity, and electronic health equipment [4]. Thus, online platforms might not be the most suitable medium for some public hospital patients, especially those with a lower socio-economic profile who might not be able to afford such equipment. However, this might not be directly relevant to the expatriate respondents in our interview, as they all reported to have access to an online platform and encompass high technological literacy skills.

4.2.3 To identify the critical success factors for telemedicine services in Thailand

It has been identified that important influencing factors for patients to use telemedicine for ophthalmology includes convenience (70%), usability (15%) and cost-effectiveness (15%) of the application. Other success factors include high quality of digital infrastructure which is accompanied by high digital literacy and training.

Convenience as one of the identified key critical success factors

From the interview conducted, convenience appears to be a key decisive factor in influencing patients and service providers to adopt teleconsultations. Both patients and service providers have highlighted the importance of convenience, and how some even prioritize this factor more than cost. For example, patient A1 was reported to that "*not having to deal with the logistics, transport and waiting in the queue is an important factor. I also prefer to save money and in general, some telemedicine appointments can also be cheaper as well.*" Further, from the service provider's point of view, convenience is a key factor in using telemedicine for consultations as this can help save the clinician time, and improve efficiency in practice. For example, Doctor

R17 offered the insight that "telemedicine in ophthalmology can enable remote monitoring of certain patients with chronic ophthalmic conditions such as glaucoma or diabetic which can help to detect and address health issues early, reducing the need for emergency visits or hospitalizations." Furthermore, Doctor S18 also described how "telemedicine can help to reduce the administrative burden on healthcare providers by streamlining communication with patients or even other healthcare professionals. For example, telemedicine platforms can allow providers to communicate with patients via secure messaging or video calls which can save time compared to phone calls or in-person community visits."

Application usability

Useability appears to be the most common factor in the adoption of telemedicine and a majority of the service provider (24 respondents, or 80%), are more concerned with the usability of the platform, as this might influence the consultation or affect their judgement in clinical decision making. For example, Doctor D reported that ""*I am concerned with the resolution of the platform as I need to perform an extensive eye examination before I can diagnose or give advice to my patients.*" This is particularly relevant as high resolution view of the eye is extremely important for disease diagnosis and management. Further, the lack of application usability can also interfere with proper history taking or management plans if there was issues with platform stability, audio and visual quality. For example, Patient A1 described in their previous experience, the lack of proper audio settings prevented a successful history taking which led to confusion and communication issues between the doctor and patient.

Importance of cost-effectiveness

Another identified critical success factor is cost. From the majority of the respondent's answers, it can be inferred that cost is an important factor for use of telemedicine services especially for patients (service users). In fact, the factors patients identified as being cost-effective with teleopthalmology includes saving on commuting and logistical costs, potential insurance coverage, or lack of required unpaid leave for time off work. For example, patient E5 reported that he envisions telemedicine to be cost-cutting and a cost-effective means for future consultations. Similarly, *doctor D reported that " cost will be a key factor for some of our patients as some of them will have financial issues. If costs can be kept low, I am sure that patients will be quite*

receptive". Such pain point could potentially be alleviated by insurance coverage, if applicable. For example, previous literature has shown that lack of insurance coverage have been associated with lower odds of attending telemedicine conference. Further cost-saving measures on transport have also been a contributing factor, where a reduction in travel cost attributed from telemedicine was shown to be correlated to higher interest in using such service, and a higher likelihood of getting a routine follow-up online [17]. Similarly from the interview in the service provider's point of view, it is also agreed that insurance coverage can be a persuasive factor for patients to use telemedicine platforms for ophthalmology consultations. Several service providers have also highlighted that especially in a public hospital, cost cutting management plans have been employed due to financial burdens on the patients. Thus, if telemedicine could help alleviate these financial burdens, then it would likely respond to the patient's needs. However, for a subset of higher income patients (i.e. salary of >70000 baht), cost was not reported to be an issue, but rather, the quality and accuracy of examination and management that is prioritized.

As previously identified, important features in the telemedicine platform are relatively consistent and similar for both patients and medical providers. For example, easy user interface and intuitive software is identified to be a key factor in attracting both patients and service providers in using this software for medical applications. The acceptance of teleconsultation is significantly impacted by staff who struggle with technology and are resistant to change. In order to successfully implement telemedicine, it's important to have a well-structured organization with a team consisting of a leader, a physician who is specifically trained in telemedicine, para-clinical staff who are also trained in telemedicine, and a tele-technician. Systematic training is also essential in ensuring staff familiarity with the platform, as well as a troubleshooting function available for urgent technical difficulties. Such was also reflected in a previous study conducted in Australia, where the availability of trained staff for the function of telemedicine platforms was a key factor in integrating it into daily practice [14].

CHAPTER V
CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusion

In summary, this research aims to investigate the attitudes and perceptions of Thai and expatriate individuals towards telemedicine services, particularly in ophthalmology. Additionally, the study will identify the obstacles that hinder individuals from accessing telemedicine and ophthalmological services. Finally, the research will also explore the key factors that contribute to the success of telemedicine services, both in Thailand and on a global scale.

In terms of perceptions and attitudes, results from the interview demonstrated that attitudes towards telemedicine and teleophthalmology vary based on demographic factors such as age, gender, and educational level. Older patients (50 years and above) were less inclined to use telemedicine services due to unfamiliarity, lack of trust, and a lack of perceived personal touch. On the other hand, younger patients (below 50 years) were more interested in using telemedicine due to convenience, time-saving, and reduced risk of infection. Convenience was the main factor cited for telemedicine use in the younger population, while a lack of perceived personal touch and unfamiliarity were identified as barriers for the older population. However, expatriate patients from both age groups had positive perceptions of telemedicine due to its convenience and effectiveness in overcoming language barriers and logistical issues associated with attending large public hospitals.

The interview has also allowed for the identification of several barriers that can impede the implementation and adoption of telemedicine in ophthalmology. One significant barrier identified is the lack of technological infrastructure and advancement necessary for a comprehensive ophthalmological examination, which may negatively affect the reliability and trustworthiness of the service. Lack of infrastructure was also cited to be an identified barrier for teleophthalmology in previous literature. For example, previous studies have reported that the implementation of teleophthalmology for detecting diabetic retinopathy was not successful due to issues with poor field

definitions, small pupil size, and media opacities that resulted in upgradable images. Tele-ophthalmology programs that use non-mydriatic fundus cameras have a higher occurrence of upgradable images, especially because cataracts are more common. A study showed that for diabetic retinopathy, upgradable images ranged from 3.1% to 10.6%, while for macular edema, they ranged from 12.6% to 22.3% [14]. Patients' lack of knowledge about how to use the telemedicine platform is also a reported barrier, suggesting that the development of the infrastructure should include education for patients on how to navigate the system. Further, previous literature review have shown that use and exposure to internet is strongly associated with interested in using telemedicine. Similarly, previous use of skype or similar web conference service and familiarity with telemedicine related platform have also been associated with patient interest [15]. This is also translated to health care providers, where unfamiliarity with the telemedicine platform was deemed to be a barrier for use. Therefore, it has been suggested that formal training of doctors to increase technological literacy, familiarity of use as well as an user-friendly interface are factors which can increase uptake of use of telemedicine [16].

Maintaining patient confidentiality is also essential for ensuring the trustworthiness and security of the service, with patients advocating for clear and validated data collection and storage protocols. Patients with complex eye conditions may also be hesitant to use telemedicine as they require physical examinations and extensive investigations that may not be possible remotely. Furthermore, logistical barriers, such as inadequate access to the internet, computers, and electronic devices, can prevent patients, especially those with a lower socio-economic profile, from accessing telemedicine services. Ensuring stable internet access and regular updates of hardware and software is necessary for the successful implementation and delivery of telemedicine. Overall, these findings suggest that technological infrastructure, patient education, and privacy and security protocols are critical success factors in providing telemedicine services in ophthalmology.

Identified main critical success factors include convenience, usability and cost-effectiveness. For patients, convenience is the most significant factor as it saves them time and money, while providers benefit from improved efficiency. Convenience was also a significant factor identified in previously published literature; in fact, some

have even cited it as to be the main aspect in convincing patients to adopt telemedicine [12]. The convenience that telemedicine can offer appears to be particularly relevant in a large public university teaching hospital as there are many patient cases leading to long waiting time, lack of sitting area and perceived risk of contacting various infectious diseases. In fact, all of the patients from the interview reported that in their experience, they had to wait for at least 2 hours before being able to see the doctor for their consultation, and such was a huge deterrence for them to attend their appointments. The importance of convenience was also reflected in previous surveys conducted. For example, a survey regarding telehealth satisfaction conducted in the United States have shown that convenience and speed drive utilization are the top reasons for telehealth consultations [14].

Service providers heavily rely on high-resolution views to diagnose and treat patients, making the usability of the application critical to their success. Cost-effectiveness is also essential for patients, as it eliminates transport and logistical expenses, as well as unpaid leave from work. Insurance coverage can further help reduce these costs and make telemedicine a desirable option for patients. Successful implementation of this technology requires a well-structured organization and a team trained in telemedicine. Overall, telemedicine in ophthalmology provides a promising solution for convenient, affordable, and efficient access to quality healthcare services for both patients and service providers.

According to the interview results, the writer has analysed that the critical success factors as well as the barriers and challenges of telemedicine services in ophthalmology. These findings can be summarized in the following table:

Table 5.1 The summary of the critical success factors, barriers and challenges of telemedicine services

Key Successful factors	Key barriers and challenges identified
• Identified factors for patients to attend telemedicine services for ophthalmology include: lower cost, increased logistical convenience and accessibility. • Patients prioritize convenience over cost, while service providers prioritize the usability of the platform for their clinical decision making. • Previous exposure to technology and familiarity with telemedicine platforms are positively associated with patient interest, while training and a user-friendly interface are critical in increasing the uptake of telemedicine by service providers. • Insurance coverage could help alleviate the cost burden for patients, and the importance of convenience cannot be overstated. • Infrastructure and technological advancements are crucial for reliability and trustworthiness, and security measures to maintain patient confidentiality are essential for patient confidence.	• Patients still feel a lack of trust in telemedicine rather than face to face as they feel that the doctors can have a more thorough examination with physical touch • Lack of patient friendly usability and application can deter the majority of the geriatric patients from using the telemedicine platform for ophthalmology • The implementation of telemedicine could face challenges such as poor image quality, ungradable images, and lack of control over personal data collection, use, and sharing.

5.2 Recommendations

Due to the previously identified barriers, the recommendations have been divided into platform and technologically related recommendations as well as human resource development suggestions.

In order to successfully implement telemedicine in ophthalmology, selecting an appropriate platform is crucial. One of the main considerations when choosing a platform is ensuring that it is secure, reliable, and user-friendly for both patients and healthcare providers. Compliance with regulatory requirements and data

governance policies, as well as ensuring the privacy and confidentiality of sensitive patient data, are also important considerations when selecting a telemedicine platform. Security measures should include encryption and compliance with relevant privacy laws and regulations, particularly for the transmission of sensitive patient data. High-quality images and video are essential for accurate diagnosis and treatment in ophthalmology, so the ideal platform should provide high-quality imaging and video capabilities with minimal lag or delay. Compatibility with the equipment and devices used in ophthalmology, such as slit lamps, fundus cameras, and OCT machines, as well as with patients' devices such as smartphones or tablets, is also crucial. Additionally, the platform should have a simple and intuitive interface, requiring minimal training for both healthcare providers and patients. Integration with the existing electronic medical record (EMR) system is also necessary to ensure that patient records are updated and accessible. The availability and quality of customer support is another important factor to consider when selecting a telemedicine platform. Adequate customer support, including prompt responses to technical issues and user inquiries, is essential to ensure that the platform operates smoothly and effectively. Finally, the cost of the platform and associated fees, such as licensing or subscription fees, should also be taken into account to ensure that it is within the hospital or clinic's budgetary constraints.

Another recommendation to help tackle the identified barrier of lack of adequate digital infrastructure is for the hospital to invest in high-quality equipment that can capture and display clear images of the eye. This includes cameras, microscopes, and monitors, which can help providers make accurate diagnoses and treatment plans. However, hospitals or clinics may need to consider their budget when renting equipment such as visual acuity charts, which can be used as an aid during consultations. Additionally, the cost and logistics of heavy equipment such as optical coherence tomography may pose challenges for relatively resource-poor hospitals that require investigations. Several factors should be considered when selecting equipment for teleophthalmology, including image and video quality, compatibility with the platform used for telemedicine, ease of use for both providers and patients, mobility and portability, cost, and customer support. High-quality images and videos are essential for accurate diagnosis and management, while compatibility with existing equipment and the hospital's EMR system and software is crucial. Easy-to-use equipment can reduce

errors and improve efficiency, particularly for geriatric patients or those who are not digitally literate. Portability is beneficial for telemedicine used in various locations or on home visits. While equipment costs can vary, it is important to factor in quality considerations to ensure diagnostic accuracy, while also ensuring that the equipment is within the hospital or clinic's budget. Finally, adequate customer support with prompt responses to technical issues and user inquiries is essential, particularly in urgent patient cases.

As previously noted, the lack of proficient staff and patient engagement can impede the successful adoption and long-term viability of telemedicine in ophthalmology. Therefore, it is crucial to provide adequate training for both staff and patients on how to effectively use the telemedicine platform and equipment. This will help to minimize technical issues and ensure that consultations proceed without complications. To this end, the hospital or clinic should develop training materials that cover the fundamentals of telemedicine in ophthalmology, such as the purpose of telemedicine visits, how to prepare for a visit, how to access the telemedicine platform, and what to expect during the visit. Troubleshooting techniques for urgent situations should also be included in the training materials. In addition, live training sessions should be offered by the hospital or clinic to both healthcare providers and patients. These sessions should reinforce the training materials and provide an opportunity for participants to ask questions and seek clarification. Furthermore, adequate technical support should be provided to staff and patients, including assistance with scheduling and preparing for telemedicine visits. This support can directly address the barriers of unfamiliarity and lack of trust, as staff and patients will feel more comfortable using the platform if they are provided with substantial assistance. To ensure ongoing improvement in training, audits should be conducted to evaluate the effectiveness of training, identify any issues that arise during real-life telemedicine consultations, and propose solutions to these issues.

To overcome the barrier of lack of human-resources related barrier for teleophthalmology implementation, the development of protocols and procedures can be a viable solution. A multidisciplinary meeting involving various specialists and staff should first identify the purpose and scope of telemedicine in ophthalmology, which includes determining the types of conditions and procedures that can be safely and

effectively managed through telemedicine. Next, a workflow should be developed to outline the steps involved in the telemedicine process, from scheduling visits to documenting and managing patient care. The roles and responsibilities of staff should also be defined, including who is responsible for scheduling visits, conducting telemedicine visits, documenting care, and following up with patients. In addition, protocols for patient evaluation and care should be established, covering visual exams, patient symptoms and complaints assessment, and determining when in-person care is necessary. Technical issues should also be addressed by developing protocols for troubleshooting and escalating issues to IT support when necessary. Ensuring patient privacy and security is also essential and protocols should be developed for securing patient data and complying with regulations. Staff training on the established protocols and procedures is important, and the process should be continually monitored and evaluated for efficiency and effectiveness, with adjustments made as needed.

To address the obstacle of data security and patient consent in teleophthalmology, it is essential to prioritize patient privacy protection during telemedicine consultations. This involves using secure internet connections, ensuring that providers conduct visits in private settings, obtaining patient consent before each consultation, using secure communication methods, and following proper documentation and storage procedures. Encouraging both healthcare providers and patients to conduct telemedicine visits in a private setting such as a closed-door room or office is important. Patient consent should be obtained before each telemedicine consultation, and patients should always be informed of the risks associated with telemedicine visits. To ensure that patients understand how their data will be protected and how to report privacy concerns, healthcare providers should provide them with clear and concise information. Additionally, it is important to use encrypted messaging or emails to communicate with patients before and after telemedicine visits, and avoid using unsecured communication methods. Healthcare providers should be trained to follow proper documentation and storage procedures for patient data and records.

To address the barrier of the lack of face-to-face communication or the inability to sense touch, building strong relationships with geriatric patients is crucial. Healthcare providers should be trained in soft skills and communication skills that are required to offer consultations online. As part of this training, healthcare providers

should be encouraged to establish a friendly and welcoming demeanour, greeting patients warmly and showing empathy and compassion for their concerns. Clear explanations of procedures, treatments, or recommendations should also be provided to patients using language that is easy to understand. Visual aids, such as images or videos, can be used to reinforce these explanations and build trust with patients. To establish a rapport and build trust with patients, healthcare providers should take the time to learn about their patients' backgrounds, interests, and concerns. After the consultation, healthcare providers should follow up promptly with patients to check on their progress and address any concerns they may have. Providing educational materials, such as handouts or online resources, can help to reinforce the recommendations and build trust with patients. Finally, patients should be encouraged to provide feedback on their experience with the telemedicine consultation, which can help identify areas for improvement and build trust with patients by demonstrating the healthcare provider's commitment to their satisfaction.

5.3 Limitations

It should be noted that this research has some limitations, particularly with regards to its generalizability. The study was conducted solely in Bangkok, Thailand, and thus the findings may not be relevant or applicable to other countries or even different regions within Thailand. For example, in regions with higher poverty rates or limited resources, the barriers to delivering ophthalmic care through telemedicine may differ, with greater emphasis placed on the lack of digital infrastructure available. Additionally, disparities in access to healthcare services, patient preferences, and cultural attitudes towards telemedicine between urban and rural areas may also impact the generalizability of the study's findings. Moreover, differences in regulatory and legal frameworks governing telemedicine between Thailand and other countries could influence the implementation and success of telemedicine in Thailand. Therefore, it is important to consider the context and local conditions of each setting when evaluating the potential of telemedicine in ophthalmology, as well as the barriers that need to be addressed to ensure its successful implementation.

5.4 Future Research

Telemedicine has been an increasingly popular mode of delivering healthcare services, including in the field of ophthalmology. As technology continues to advance, there are several future research opportunities for ophthalmology telemedicine. There is still much to be explored regarding its potential and the barriers that must be overcome to improve its effectiveness in this field. One area for future research could be the investigation of the effectiveness of telemedicine in ophthalmology for various eye diseases, including glaucoma, age-related macular degeneration (AMD), and diabetic retinopathy. These diseases require ongoing monitoring and management, and telemedicine may provide a more convenient and cost-effective approach to delivering care. The research could explore whether telemedicine can result in better patient outcomes and improved disease management compared to traditional in-person care. Another area of focus for future research could be to identify the barriers to telemedicine in ophthalmology. As perceptions, challenges, and success factors may differ across different settings and countries, it is crucial to gather information from ophthalmology clinics to identify unique barriers. This research could help to identify the most effective strategies for implementing telemedicine in ophthalmology and ensure that it is accessible and beneficial to all patients. Advancements in artificial intelligence (AI) algorithms also present an exciting opportunity for enhancing telemedicine capabilities in ophthalmology. These algorithms can potentially detect and diagnose eye diseases more accurately and efficiently, which may improve patient outcomes and reduce the burden on healthcare providers. Future research could explore the use of AI algorithms in telemedicine for ophthalmology and evaluate their effectiveness. Additionally, research could focus on the use of telemedicine in low-resource settings and pediatric ophthalmology. Telemedicine may provide a more cost-effective and convenient approach to delivering eye care services to patients in remote or underserved areas, as well as children who may have difficulty attending in-person appointments. Evaluating the effectiveness of telemedicine in these settings could help to improve access to eye care services and reduce disparities in eye health. Finally, research could evaluate patient satisfaction with telemedicine and compare its outcomes with traditional in-person care. This could help to identify the areas where telemedicine is most effective and where it can be improved.

Such research could also help to increase patient acceptance and adoption of telemedicine in ophthalmology, ultimately leading to improved access to more convenient and accessible eye care services.

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