TPT: EXPLORING TELECONSULTATION ON PHYSICAL THERAPY

โครงการศึกษาการบริการด้านปรึกษาแพทย์ออนไลน์สำหรับกายภาพบำบัด

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ABSTRACT

Physical therapy (PT) is one of the health professions aiming to improve and restore movement and function, manage pain, reduce the symptoms of many chronic diseases, and recover or prevent from physical injuries. In Thailand, patients, also, their caregivers, usually require going to hospitals for the treatment services. However, not all patients are able to travel to hospital due to several reasons, for example, their severe conditions, distance to the hospital, or inconvenient time for treatment. With the current COVID-19 pandemic, the physical therapy service onsite become more difficult. Therefore, teleconsultation, i.e. giving the therapeutic advice through electronic means, such as videoconferencing, can be an alternative tool for delivering treatment services. Hence, we propose “TPT: Exploring Teleconsultation on Physical Therapy”, a web-based platform for delivering teleconsultation services for physical therapy. Patients will receive personalized therapeutic advices and treatments virtually with physical therapists via teleconferencing. TPT will manage the physical therapy appointments, fee payments, and registration. With TPT, it not only reduces the cost and time for travel and the risk to get infected by COVID-19, it also supports healthy lives and promote well-being for all ages.

KEYWORDS: PHYSICAL THERAPY/TELECONSULTATION
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โครงการศึกษาการบริการด้านปรึกษาแพทย์ออนไลน์สำหรับกายภาพบำบัด

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บทคัดย่อ

กายภาพบำบัด เป็นหนึ่งในวิชาชีพด้านสุขภาพที่มุ่งปรับปรุง ฟื้นฟูสภาพร่างกาย และการเคลื่อนไหว และรวมถึงการจัดการกับความเจ็บปวด ลดอาการของโรคเรื้อรังต่างๆ และฟื้นฟูหรือป้องกันการบาดเจ็บของร่างกาย ในประเทศไทย ผู้ป่วยและผู้ดูแลผู้ป่วยมักจะต้องไปโรงพยาบาลเพื่อรับบริการการรักษา อย่างไรก็ตาม ผู้ป่วยบางรายไม่สามารถเดินทางไปโรงพยาบาลได้เนื่องจากสาเหตุหลายประการ เช่น มีอาการเจ็บป่วยที่รุนแรง ระยะทางไปโรงพยาบาลที่ห่างไกล หรือไม่สะดวกไปรับการรักษาเนื่องจากเวลา และในปัจจุบันด้วยสถานการณ์การระบาดของไวรัสโควิด-19 การไปรับการรักษาที่โรงพยาบาลจึงยากขึ้น ดังนั้นการให้คำปรึกษาและคำแนะนำการรักษาผ่านวิธีการทางอิเล็กทรอนิกส์ (teleconsultation) สามารถเป็นเครื่องมือทางเลือกในการให้บริการทางด้านการรักษาได้ ดังนั้น โครงการศึกษาการบริการด้านปรึกษาแพทย์ออนไลน์สำหรับกายภาพบำบัดหรือชื่อย่อทีพีที ได้ถูกจัดทำขึ้นเพื่อเป็นแพลตฟอร์มบนเว็บสำหรับให้บริการให้คำปรึกษาทางไกลสำหรับการทำกายภาพบำบัด ซึ่งผู้ป่วยจะได้รับคำแนะนำการรักษาเฉพาะบุคคลและการรักษาแบบเสมือนจริงกับนักกายภาพบำบัดผ่านการประชุมทางไกล ทีพีทีจะจัดการนัดหมายกายภาพบำบัด ชำระค่าธรรมเนียม และลงทะเบียน ทีพีทีจะไม่เพียงแต่ช่วยลดต้นทุนและเวลาในการเดินทางและความเสี่ยงในการติดเชื้อโควิด-19 แต่ยังสนับสนุนคุณภาพชีวิตที่มีสุขภาพดีและส่งเสริมความเป็นอยู่ที่ดีสำหรับคนทุกวัย

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CHAPTER 1
INTRODUCTION

This chapter mainly focuses on our project motivation, problems, objectives, scope, expected benefits, and the organization of the document.

1.1 Motivation

Physical therapy (PT) is one of the health professions provided by physical therapists. The physical therapy aims to improve and restore movement and function, manage pain, reduce the symptoms of many chronic conditions and diseases, and recover or prevent from physical injuries. Physical therapists provide care for patients in a variety of settings, including hospitals, clinics, fitness facilities, work settings and nursing homes. In Thailand, physical therapy may not cover all area. Patients, also, their caregivers, usually require going to the specialized hospitals or clinics to receive the treatment service. The limited numbers of healthcare providers cause patients inconvenient to travel for several reasons, for example, distance to the hospital, inconvenient time for travel to get a treatment etc.

For the past couple years, the difficulty to travel to hospital to receive treatment has been increased due to the COVID-19 pandemic in Thailand. The number of infected patients and mortality were continuously rising. Some business, such as, transportation, tourism, entertainment, restaurants, healthcare, and medical services, were halt. Hospital become the risky place to visit, especially for the patients who regularly visit onsite for physical therapy. Moreover, forbidding travel across the cities, lockdown and curfew, and the limited number of people allowed in the building prevent patients for the normal courses of treatments.

With many challenges mentioned above, there can be a delay in physical therapy treatment. In some cases, this can cause patient worse or paralyzed. Therefore, teleconsultation, i.e. giving the therapeutic advice through electronic means such as videoconferencing, becomes an alternative tool for delivering treatment services to pre-

vent the delay of treatment. Patients and physical therapists can be connected through videoconferencing; they can see each other and their treatment movement. Hence, we are motivated to create a web-based platform for delivering teleconsultation services for physical therapy, called "TPT: Exploring Teleconsultation on Physical Therapy", to connect between physical therapists and patients. With TPT, it not only reduces the cost and time for travel and the risk to get infected by COVID-19, it also supports healthy lives and promote well-being for all ages.

1.2 Problem Statement

This part focuses on our problem statements driving us to develop the TPT system. We categorized the problems into two main points as followed:

- Accessibility to the treatment: patients do not have access to physical therapy treatment during the COVID-19 pandemic.
- Time-consuming: Traveling to hospitals to get the treatment onsite can cause some cost and time. Patients may receive the delayed physical therapy treatment due to inconveniences in travel, which can make their conditions worse.

1.3 Objectives of the project

The objectives of our project includes:

- To make a physical therapy treatment accessible from any online platforms.
- To make patients receive treatment on time.
- To reduce number of onsite visits to hospitals for patients.
- To reduce the risk of getting COVID-19 infection from traveling to hospitals.

1.4 Scope of the project

Our scope of the project is to use a technology of video conferencing to help patients to connect with physical therapists via a web-based platform for a single hospital.

TPT will facilitate patients to manage their appointments with physical therapists, conduct a teleconsultant via video conferencing, and make a payment by both credit card and mobile banking.

1.5 Expected benefits

Our expected benefits from the project includes:

- Patients can access the treatment from their own place.
- To improve the traditional treatment process by reducing waiting time in the appointment.
- To reduce travel costs to travel to hospitals.
- To reduce the numbers of times to travel to hospitals.
- To reduce the risk of getting infection from COVID-19.

1.6 Organization of the document

This document consists of 7 chapters as follows:

- Chapter 1: Introduction contains 6 sections, including project motivation, problem statement, objective, scope of the project, expected benefits, and organization of the document.
- Chapter 2: Background describes the background and related work of the project.
- Chapter 3: Analysis and Design describes the process of the project, methodology, system architecture represented by a diagram, structure chart, data flow diagram, data base design, and I/O design.

CHAPTER 2
BACKGROUND

This chapter consists of related background required for our project.

2.1 Teleconsultation

Teleconsultation is one type of telehealth. It enables patients to virtually get physician consultations. According to WHO (2010), teleconsultation is defined as "the delivery of healthcare services, where distance is a critical factor, by all healthcare 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." The common purpose of teleconsultation is to boost long-term healthcare through the communication of technology between patients and providers.

Teleconsultation is a subtype of telehealth services, as we mentioned above, that enables doctors to connect to patients and provide remote support and diagnosis. Teleconsultations may be offered in several ways (i.e., asynchronous, synchronous e-mail, text, audio, or visual technologies) and different diseases. Teleconsultation on non-operative diseases like mental illnesses would make the transition easier than surgical diseases (e.g., orthopedic illnesses). However, while doctors are unable to perform actual operations using teleconsultation, doctors can use them to provide information about forthcoming surgeries and to perform checks after the operation. The key distinguishing feature of teleconsultations from face-to-face medical consultations is that patients and physicians do not need to meet in person. Patients must spend time, effort, and funds to meet a medical doctor for a face-to-face consultation. Instead of hours or days in hospitals and waiting for an appointment, patients can receive medical care comfortably for a teleconsultation. For example, a patient can simply visit the teleconsultation platform, find the right doctor, schedule the medical examination and receive a telecommunica-

tions consultation in any convenient location [1].

2.2 Physical Therapy

Physical therapy is a specialty in healthcare involvement in the assessment, evaluation and treatment of people with functional mobility limitations. It has been shown that choosing physical therapy helps you get back fast and safely and can save you money due to reduced healthcare costs.

2.2.1 Importance of physical therapy

There 5 important thing includes [2]:

- Fixed defective movement pattern: If you are injured or you suffer from chronic pain, physical therapy can help to solve the underlying symptoms of pain. It can not only alleviate malaise, but can also help you make corrections to prevent ongoing problems. Physical treatment is also enough to deal with an injury and get you back into the game.

- Prevention of the accumulation of scar tissue: it is common that scar tissue develops after an injury or surgery, but the accumulation of that scar tissue must be avoided as it can cause discomfort and stress. Physical therapists use stretching and other manual techniques to prevent this growth and to ensure that the accumulation of scar-tissue does not interfere with healing.

- Tight muscles and articulations stretch: it is important to stretch for flexibility and range of movement. Physical therapists will plan an effective stretching scheme for patients.

- Reinforcing: Reinforcing exercises helps strengthen musculature of patients, so that joint pressure is minimized. Physical therapy can help strengthen the muscles and the surrounding muscles. Sometimes, strength imbalances cause injury.

- Improve results: physical therapy helps optimize postoperative performance by treating discomfort, scar tissue, resilience, range of motion and more.

2.3 Physical Treatment Process in the Hospital: A case study from Faculty of Physical Therapy, Mahidol University

When a patient goes to hospital for the first time, they have to register to obtain a patient card. The patient require to fill his/her general information, such as name, gender, telephone number, address, date of birth, age, and national ID card number. After registration, the receptionist will ask the questions about symptoms and classify symptoms. If it is a follow-up visit, they can inform the receptionist about for the appointment. Patients will be sent to a physical therapist for a treatment. If the follow-up treatment is needed, the physical therapist make an appointment as appropriated. After the treatment is finished, patients have to go to the finance department to make a payment.

2.4 Video conferencing technology

In order to deliver treatment service for teleconsulting, video conferencing is the main technology involved. This section described video conferencing technology we research for TPT. More information will be discussed in the following sections.

2.4.1 WebRTC

WebRTC can be used to make a video call through the website in real-time [3]. As a peer-to-peer connection, WebRTC uses three API to implement WebRTC: Media Stream, RTCPeerConnection, and RTCDataChannel.

- The Media Stream, also known as getUserMedia, requires the permission to access the device of the owner such as camera and microphone to be used for the call on the WebRTC . This also includes other functions such as screen sharing, etc.

- RTCPeerConnection is a part of the peer communication handling, which is used to transmit images and send the voice to the other party. This includes the encryption and throughput management.

- RTCDataChannel API [4], i.e., WebSocket, enables a peer-to-peer exchanging of arbitrary data, for example, when playing games, it locates the position of the enemy and our position. Therefore, it requires very low latency and high throughput for a better gaming experience. Another example is a chatting application, e.g.,

Line, as we talk and exchange messages in real-time.

2.4.2 PeerJS

PeerJS is the library of JavaScript that wraps the browser's WebRTC implementation. It provides a complete, configurable, and easy-to-use peer-to-peer connection API [5]. Equipped with nothing but an ID, a peer can create a P2P data or media stream connection to a remote peer.

2.4.3 WebEx Meeting API

WebEx Meeting APIs provide the applications with the direct access to the Cisco WebEx Platform [6]. The WebEx REST APIs include the ability to schedule and manage a meeting, attendee invitation, and manage meeting recording. In shorts, the WebEx Meeting already compiled the necessary functions for a video conferencing.

2.4.4 Discussion

Both WebRTC and PeerJS require a STUN/TURN Server [7]. Stun server is established, because the NATs provide a device with an IP address for using within a private local network. This IP address cannot be used externally. Without a public address, it is impossible to implement the WebRTC peers for communication. The TURN server is RTCPeerConnection. It sets up direct communication between peers over UDP. If it fails, RTCPeerConnection will resort to TCP. If it still fails, the TURN server can be used as a fallback relaying data between endpoints. For the scope of our project, it is difficult to implement and can be costly. We conclude our solution to use the WebEx Meeting API, which is suitable for our requirement.

2.5 Related work

In this part, we explain about the information of 3 related works, including, CORA, Professional Physical Therapy, and Athletico. We compare our TPT with these application in the following section.

2.5.1 CORA

The CORA Physical Therapy is a rehabilitation agency using proven clinical practices and cost efficient protocols for treating patients. Their objective is to help patients to return to their jobs and to their lifestyle as soon as possible. Their clinics offer a full range of treatments, including external physical treatment and general rehabilitation, remedial therapy for workers, rehabilitation for sports and auto injuries, and senior rehabilitation. Operating in more than 210 clinics in 9 states in the United States, the CORA includes specialty clinics under the Body Gears brand in Florida, Georgia and Illinois, Kentucky, Missouri, North Carolino, South Carolina, Tennessee, and Virgen.

CORA Physical therapy uses the Telehealth Virtual Visits [8] of MedBridge [9] to expand the access of patients, including Medicare [10], to high-quality treatment. MedBridge is a leading online patient education solution that allows healthcare organizations to enhance results and optimize delivery of health care. CORA is one of the largest ambulatory and physical therapy providers nationwide with services including general physical therapy and refurbishment, worker compensation treatment, sports and rehabilitation of sports and car wounds and the rehabilitation of elderly persons [11].

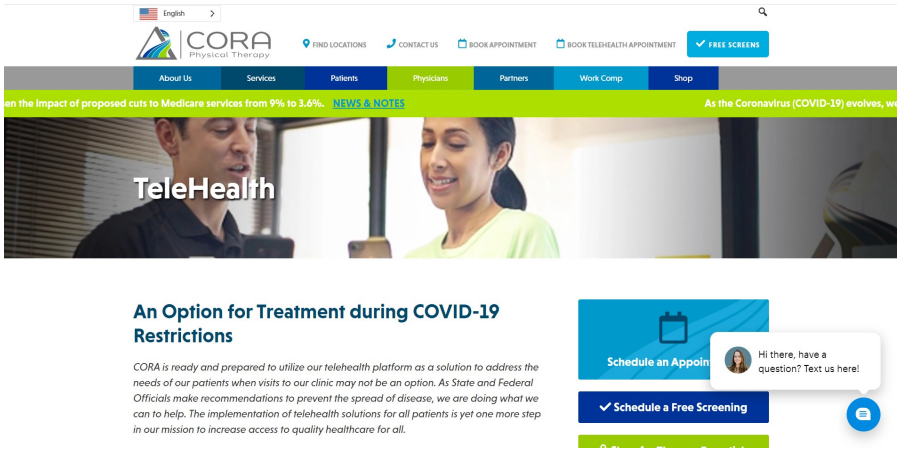

Figure 2.1: CORA Physical Therapy

2.5.2 Professional Physical Therapy

Professional physical therapy is a US leading provider, across New York, New Jersey, Connecticut, Massachusetts, and New Hampshire of outpatient physical, hand therapy, and rehabilitation. Existing patients are currently offered telehealth in compa-

nies with plans to extend services to new patient injury assessments. Under the recent outbreak of coronavirus, professional physical therapy provides a solution for existing patients who are willing to continue their refurbishment but unable to visit the clinic. Physitrack® is a telehealth platform that can make an appointment [12]. The appointment consists of a scheduled video call between a patient and a physical therapist or an occupational therapist. Patients can access their home exercise programs via Physitrack®. The utilization of this alternative treatment method offers patients the ability to follow their physical or ergo therapeutic exercise program, maintain their strength and mobility and remain active through a live Professional Physical Therapy licensed therapist. Telehealth cannot replace hands-on therapy sessions completely in person, but it is a safe, secondary option. Dan Dourney, who is a Chief Executive Officer at Professional Physical Therapy said, “We care about the health and wellbeing of our patients, and understand that unforeseen circumstances, such as illness, inclement weather, and transportation issues, can make it difficult for our patients to get to a clinic for treatment. While in-clinic rehabilitation is still the preferred and proven treatment method, Telehealth offers a realistic and practical alternative for patients who cannot get to the clinic, so they don’t lose the momentum of their recovery.” [13].

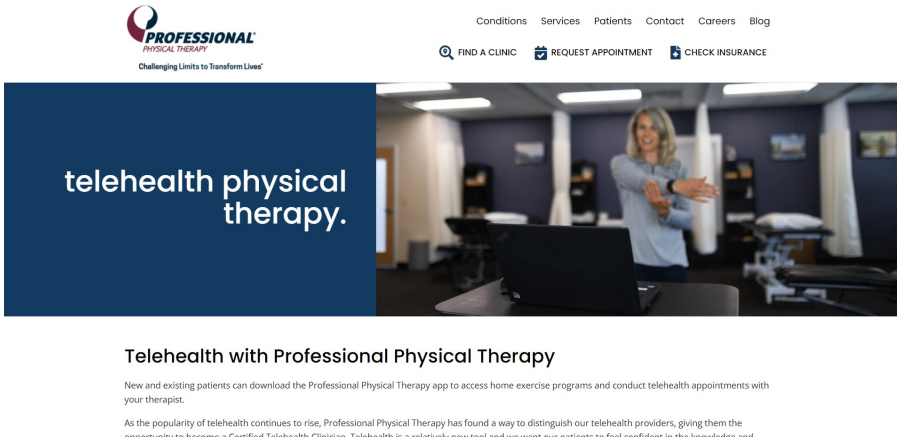

Figure 2.2: Professional Physical Therapy

2.5.3 Athletico

Athletic Physical therapy provides community, employer and athletic services in more than 450 locations across twelve states in the United States with more than 4,500

employees in the highest quality of orthopedic rehabilitation. Athletico works with patients and refers to doctors based on patients, positive work environment, high quality care and high standards of healthcare. Athletico is committed to continuous improvement and measures patient outcomes and satisfaction. Athletic services are physical and occupational therapy, the reimbursement of workers, female health therapy, clog-making and sports training.

Athletico is one of the first to provide virtual appointments for patients to contact trustworthy medical experts via a live Internet video feed in the ambulatory physical therapy area. Patients can connect directly to an Athletico clinician for a 30-minute evaluation via a smartphone, tablet, or computer. The clinician evaluates the problem of the patient and recommends the best course of care during the free assessment. In the Athletico clinic, the clinician can arrange the evaluation for a follow-up or refer the patient to a local doctor for advanced treatment, depending on the severity of the injury. The clinician would direct the patient to an emergency room for urgently needed matters.

In order to provide new services, Athletico has partnered with Mend [14] as a TV leader. Mend is providing the technology interface for patients with just a few taps to communicate with Athletico clinicians. The company provides its communication and engagement platform services throughout the United States to countless health care providers [15].

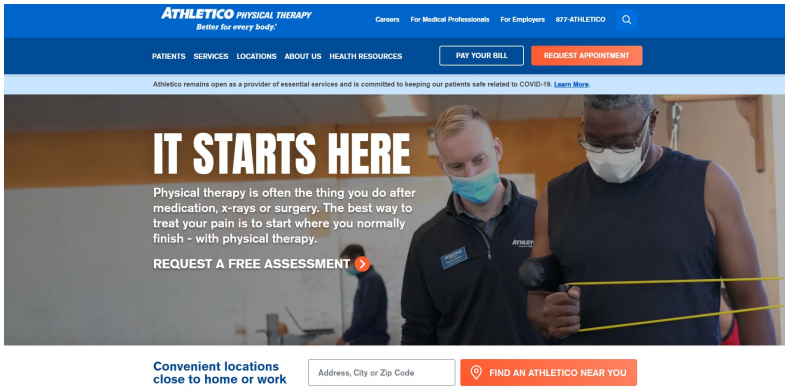

Figure 2.3: Athletico Physical Therapy

2.5.4 Comparison

In this part, we compare between TPT and two following applications as shown in Table 2.1.

Table 2.1: Comparison between TPT, CORA, Professional Physical Therapy, and Athletico on their features.

Features	**TPT**	**CORA**	**Professional PT**	**Athletico**
Telehealth	√	√	√	√
Website	√	√	√	√
Online appointment	√	√	√	√
Online bill payment	√			√
Home program	√		√	
Tracking the status of appointments online	√			
Tracking the status of payment online	√			
Request medical certificate online	√			
Request referral form online	√			

All platforms have telehealth service, website, and appointment. For online payment, for services only Athletico has this feature. Only Professional Physical Therapy allows patients to see and do home programs by themselves. While TPT has all mentioned functions, it also provides tracking the status of appointments and the payment online, request for medical certificate, and referral form online.

In summary, TPT has a comprehensive list of features supporting both patients and physical therapists to have a complete flow of telehealth service in one platform.

CHAPTER 3
ANALYSIS AND DESIGN

This chapter consists of the system architecture overview, the process analysis and design, the database analysis and design, the I/O design, and the current progress. We separate the process analysis and design into two sections, which are data system structure chart and flow diagram. Database analysis and design consists of three sections which are the ER-diagram, relational schema, and data dictionary. The I/O design consists of two sections which are the Interface design and the transition diagram.

3.1 System Architecture Overview

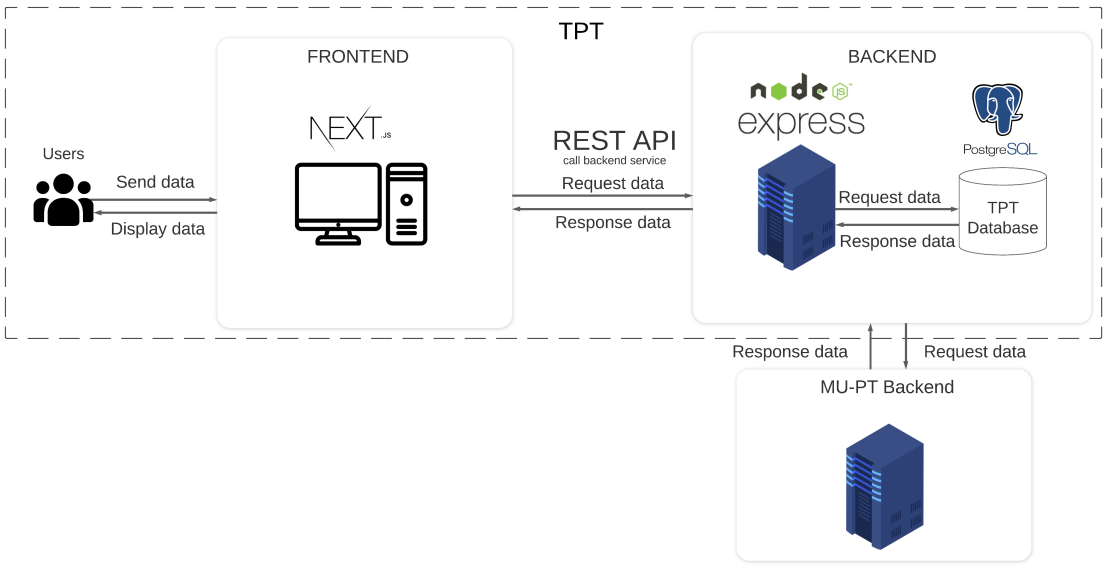

Figure 3.1: System Architecture Overview

Figure 3.1 shows our system architecture overview. Users can access our web applications via any devices, e.g., computers, notebooks, tablets, or smartphones, by connecting to the internet. Users will interact with the web application through the front-

end interface developed by NEXT.JS. It uses APIs for sending information in JSON format from front-end to back-end and vice versa. In the back-end side, there are 2 servers that are the Physical Therapy (PT) server and our TPT server. The PT server is the existing data server consisting of patients, appointment and physical therapist's data of the Faculty of Physical Therapy, Mahidol University. TPT server will take care of the application data from the front-end and the data from PT server. The TPT server itself serves as the temporary data storage before sending data to the PT server. We plan to implement a TPT server using Node.js and PostgreSQL as the database management system.

3.2 Process Analysis and Design

There are two sections in this part which contains the system structure chart and the data flow diagram.

3.2.1 System Structure Chart

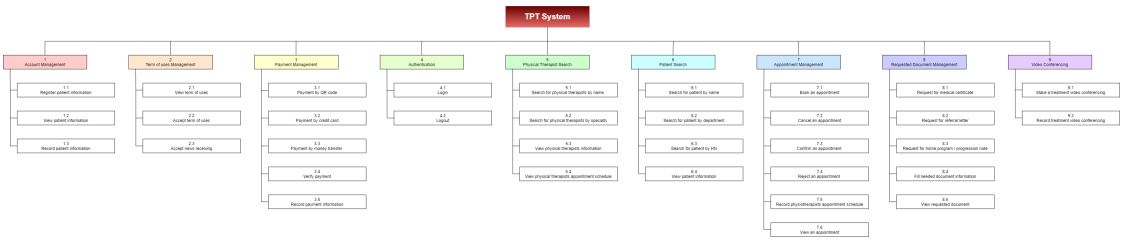

Figure 3.2: System Structure Chart

Figure 3.2 shows the TPT system structure chart, which can be divided into 9 main processes including: Account management, Term of use management, Payment management, Authentication, Physical therapist search, Patient search, Appointment management, Requested document management, and Video conferencing. For more information in each part will be discussed in the next section below.

Account management

In account management (Figure 3.3), it consists of 3 processes: register patient information, view patient profile, and record patient profile.

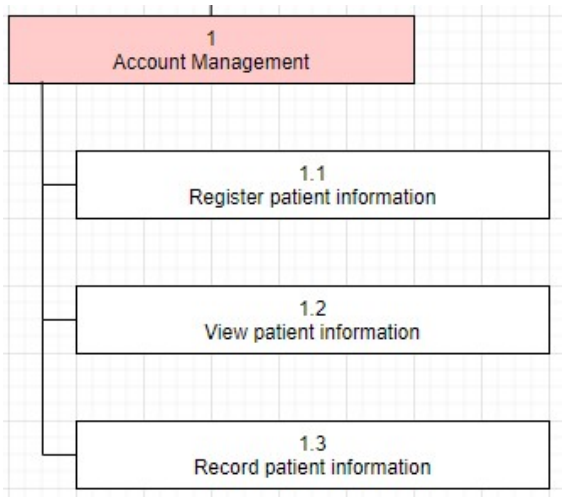

Figure 3.3: Account Management Process

Term of use management

Term of use is required as the consent form for patients before using the application and receiving the treatment. This part focuses on 3 processes: view term of use, accept term of use and accept news receiving.

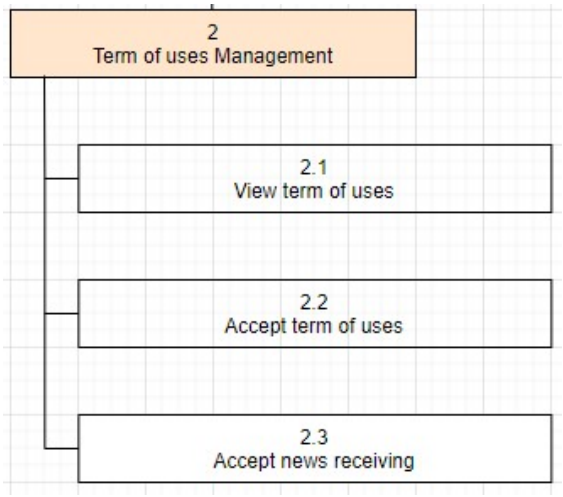

Figure 3.4: Term of use Management Process

Payment management

In payment management, there are 5 processes: users making a registration or treatment payment by QR code or credit card, uploads the payment receipt, check and confirm the payment receipt by staffs, and record payment information.

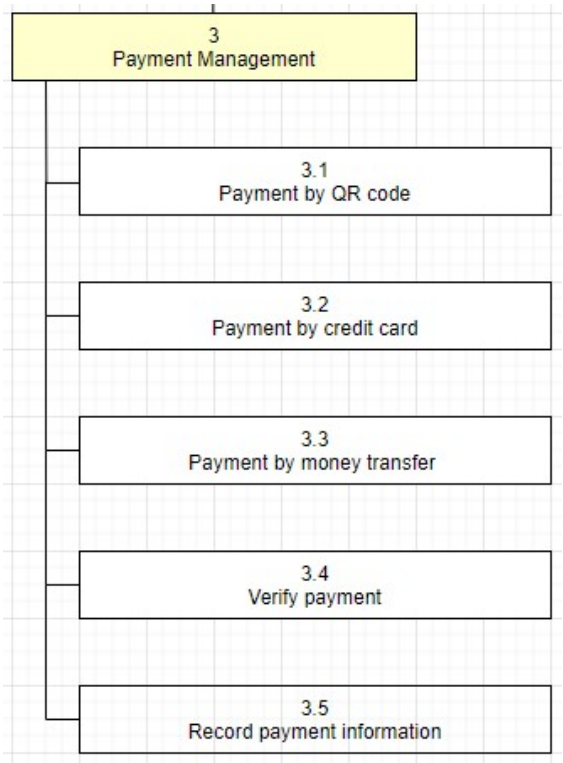

Figure 3.5: Payment Management Process

Authentication

In authentication, there are 2 processes: login and logout.

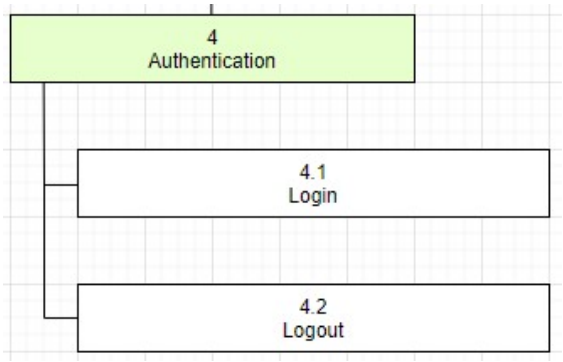

Figure 3.6: Authentication Process

Physical therapist search

In physical therapist search, there are 4 processes including view physical therapist information and their schedule, search physical therapist information by name and specialty.

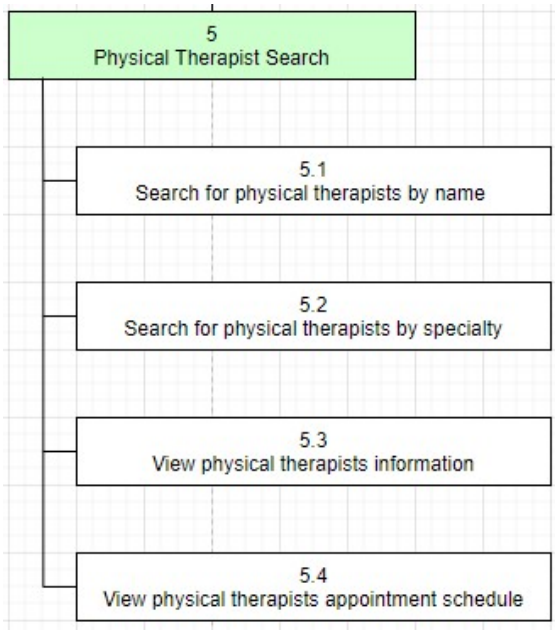

Figure 3.7: Physical Therapist Search Process

Patient search

In patient search, there are 4 processes, including view patient information and search patients by HN number, name, and department.

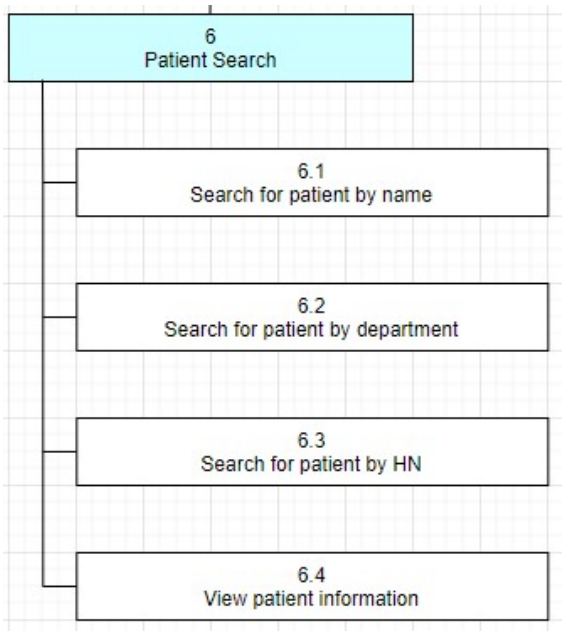

Figure 3.8: Patient Search Process

Appointment management

In appointment management, there are 6 processes including book, cancelling, confirming, and reject an appointment, record a physical therapist appointment schedule, and view an appointment.

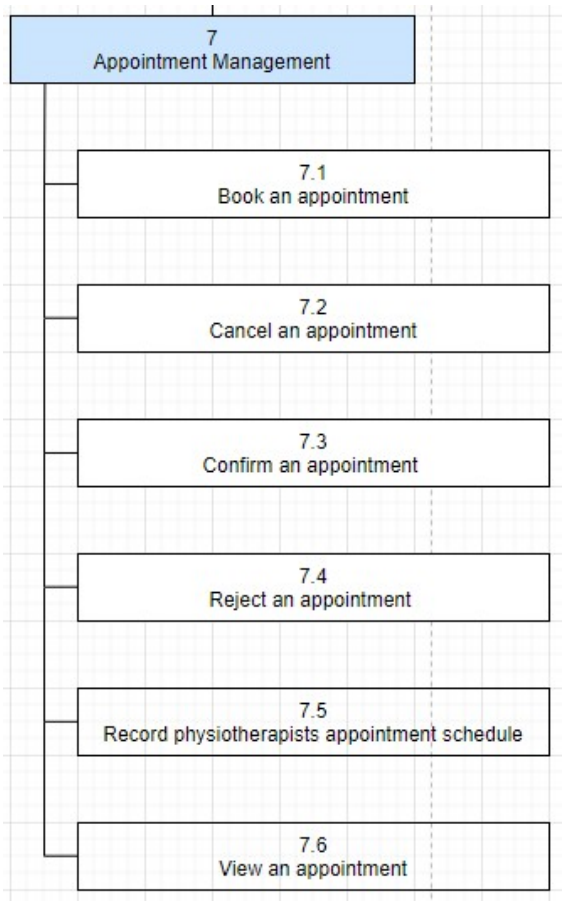

Figure 3.9: Appointment Management Process

Requested document management

In requested document management, there are 5 processes: request medical certificate, referral letter, home program / progression note, fill needed document information, and view requested document.

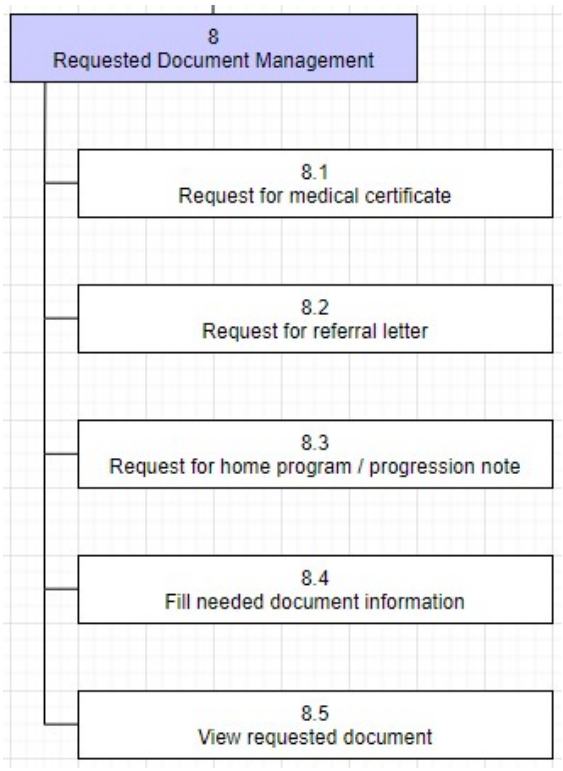

Figure 3.10: Requested Document Management Process

Video conferencing

In video conferencing, there are 2 processes: make and record treatment video conferencing.

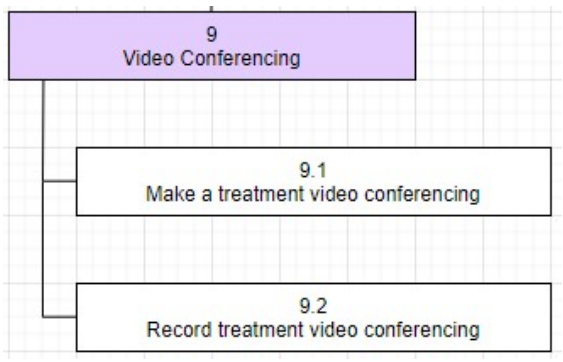

Figure 3.11: Video Conferencing Process

3.2.2 Data flow diagram

Figure 3.12 shows the data flow diagram level 0 that illustrates overall the TPT system.

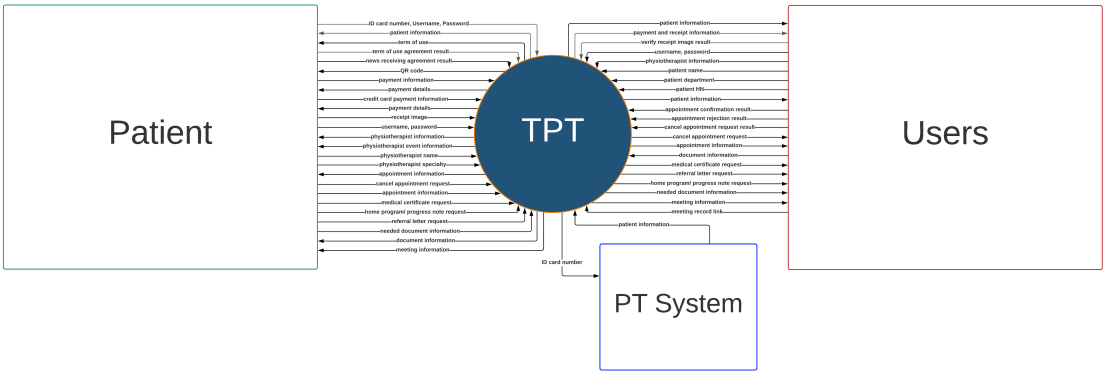

Figure 3.12: Data Flow Diagram: Level 0

Figure 3.13 shows the data flow diagram level 1. There are 9 subsystems including: account management, term of use management, payment management, authentication, physical therapist search, patient search, appointment management, requested document management, and video conferencing.

For the Figure below (Figure 3.14 - 3.22) shows the data flow level 2; including

- Account management (Figure 3.14)
- Term of use management (Figure 3.15)
- Payment management (Figure 3.16)
- Authentication (Figure 3.17)
- Physical therapist search (Figure 3.18)
- Patient search (Figure 3.19)
- Appointment management (Figure 3.20)
- Requested document management (Figure 3.21)
- Video conferencing (Figure 3.22)

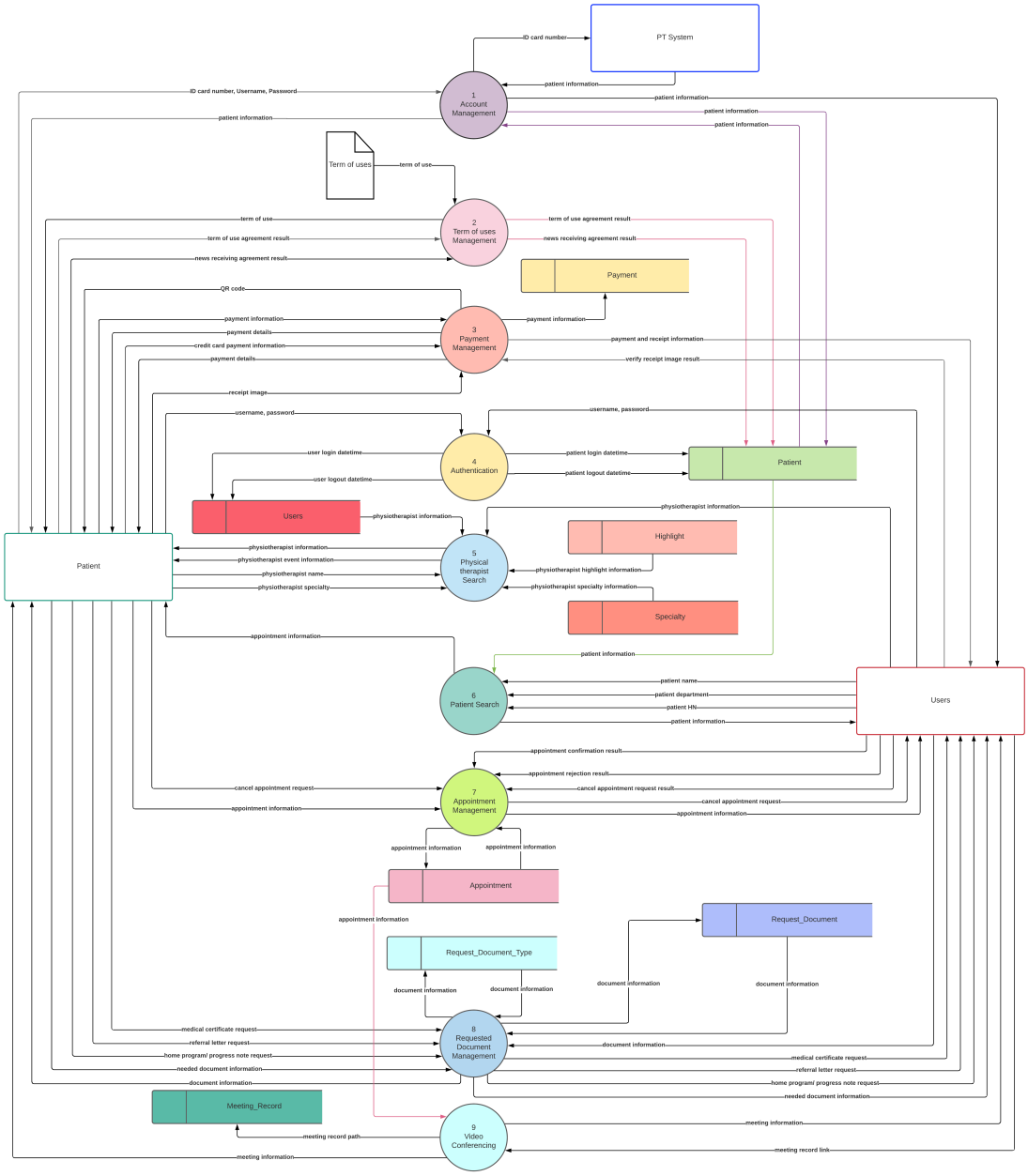

Figure 3.13: Data Flow Diagram: Level 1

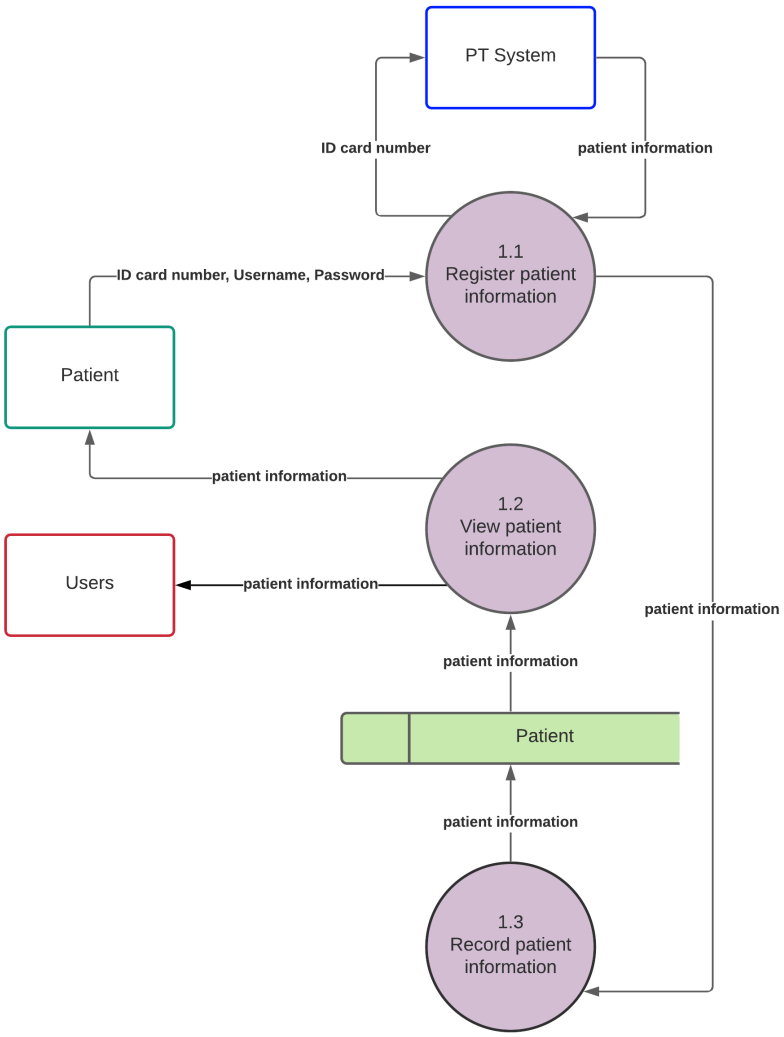

Figure 3.14: Data Flow Diagram: Level 2 - Module 1

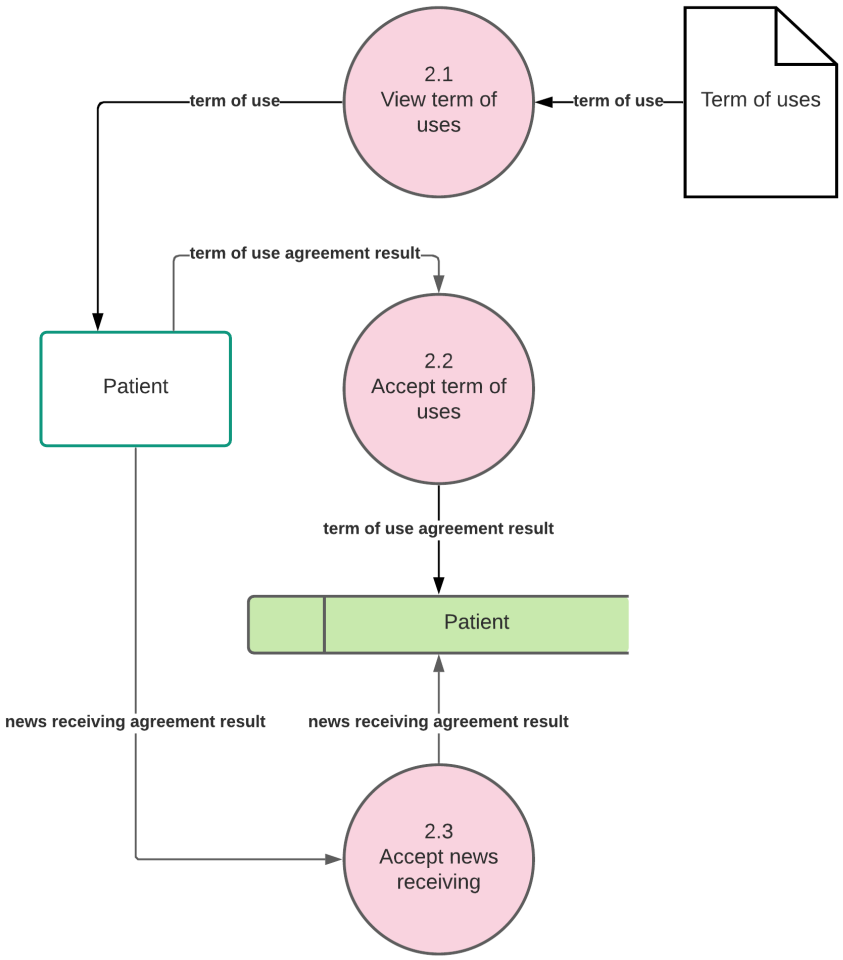

Figure 3.15: Data Flow Diagram: Level 2 - Module 2

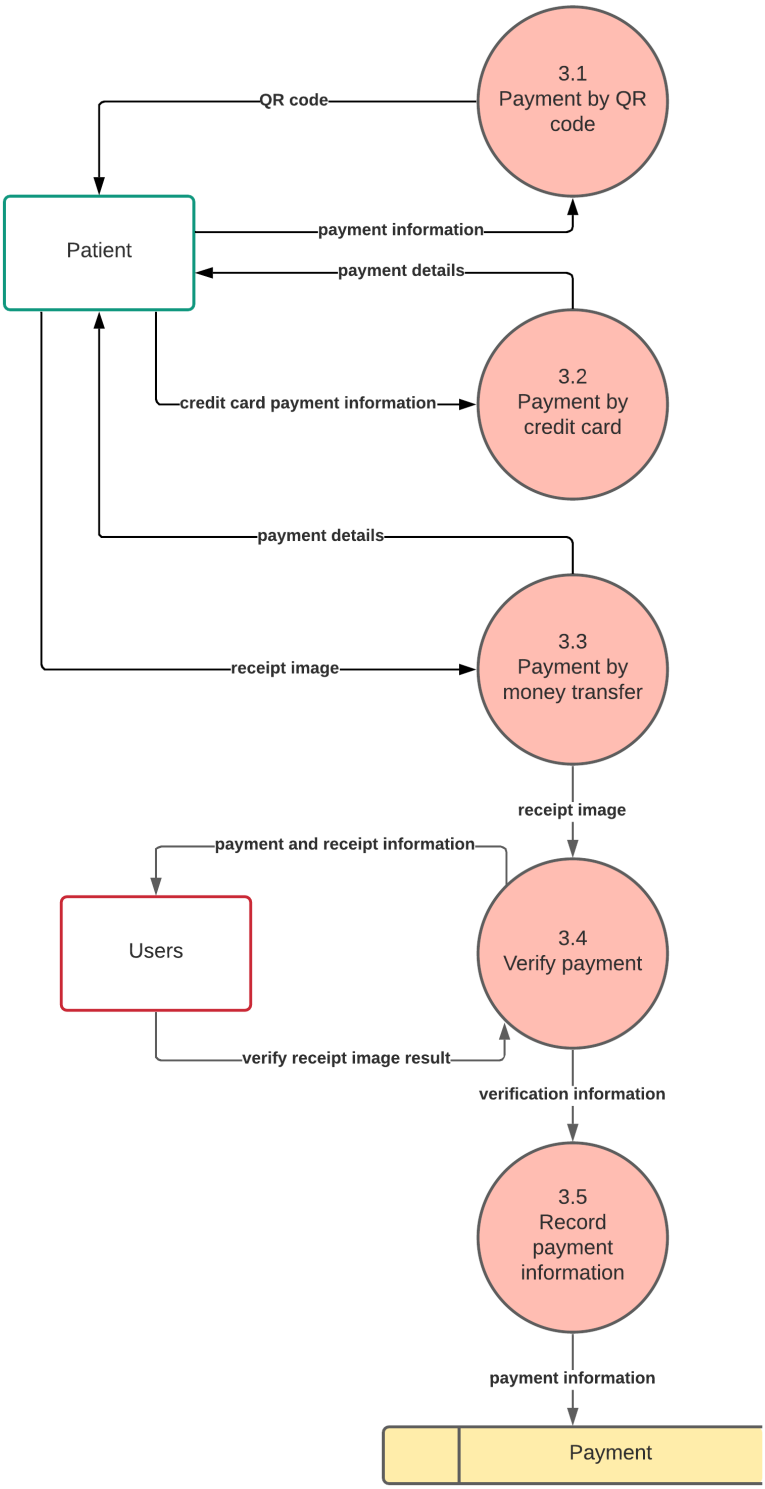

Figure 3.16: Data Flow Diagram: Level 2 - Module 3

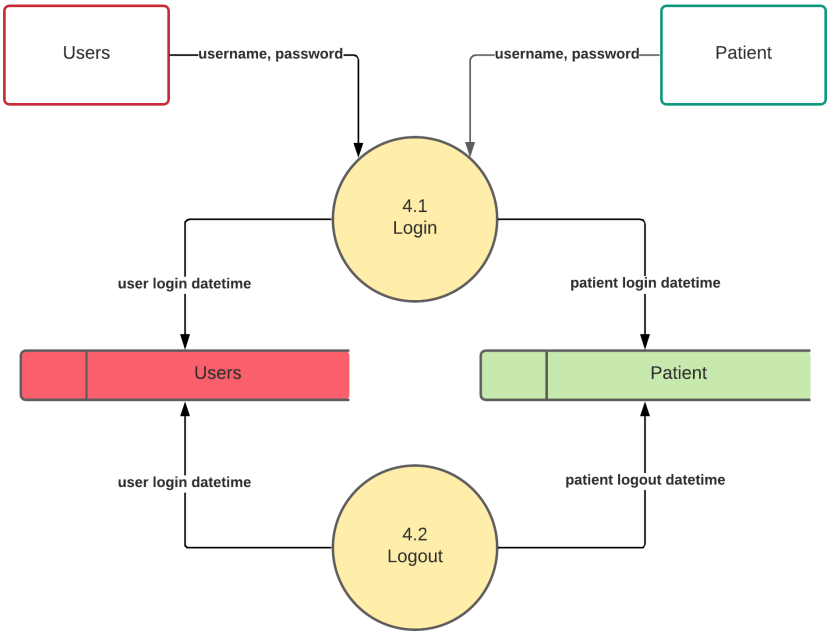

Figure 3.17: Data Flow Diagram: Level 2 - Module 4

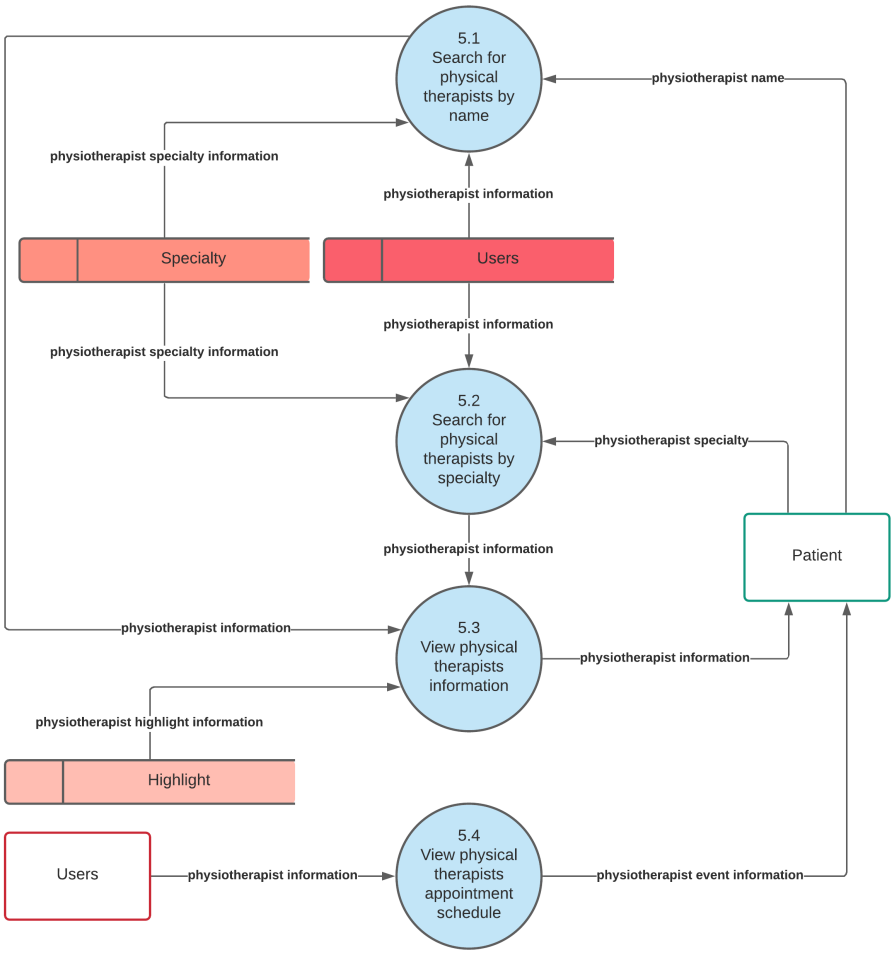

Figure 3.18: Data Flow Diagram: Level 2 - Module 5

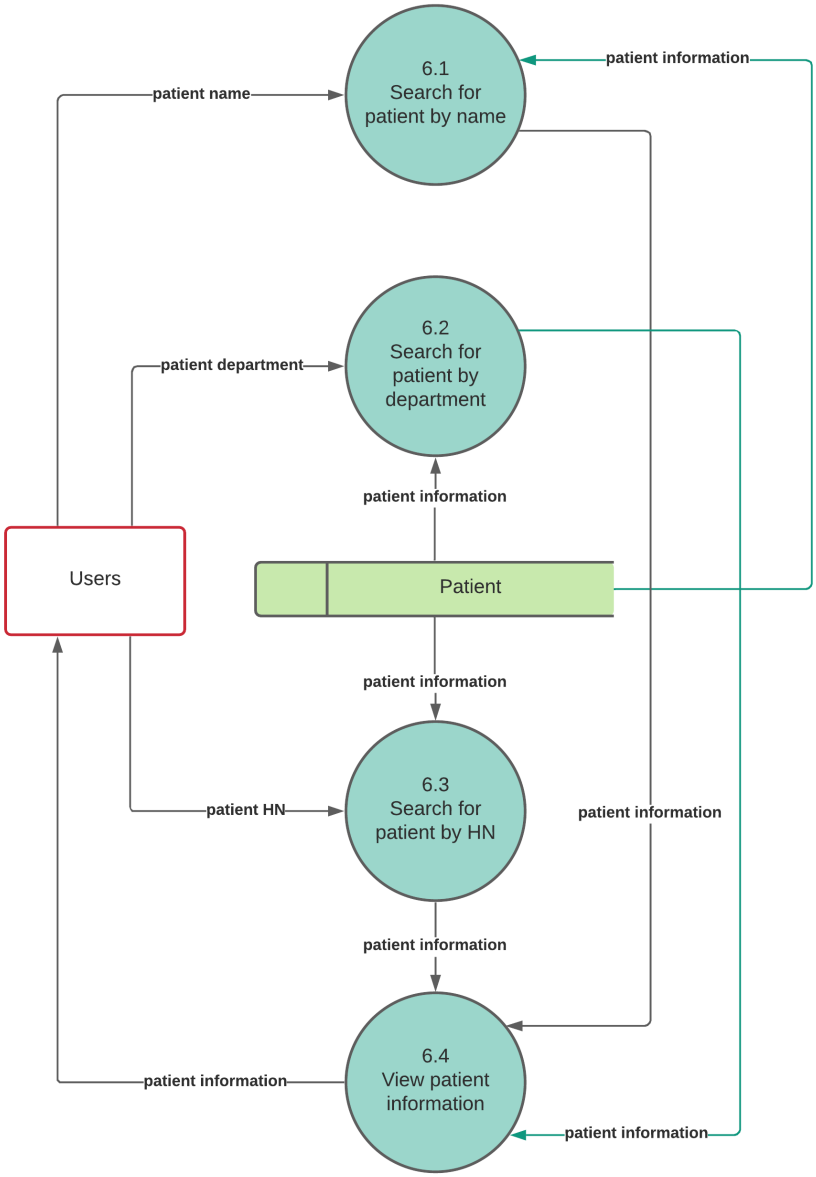

Figure 3.19: Data Flow Diagram: Level 2 - Module 6

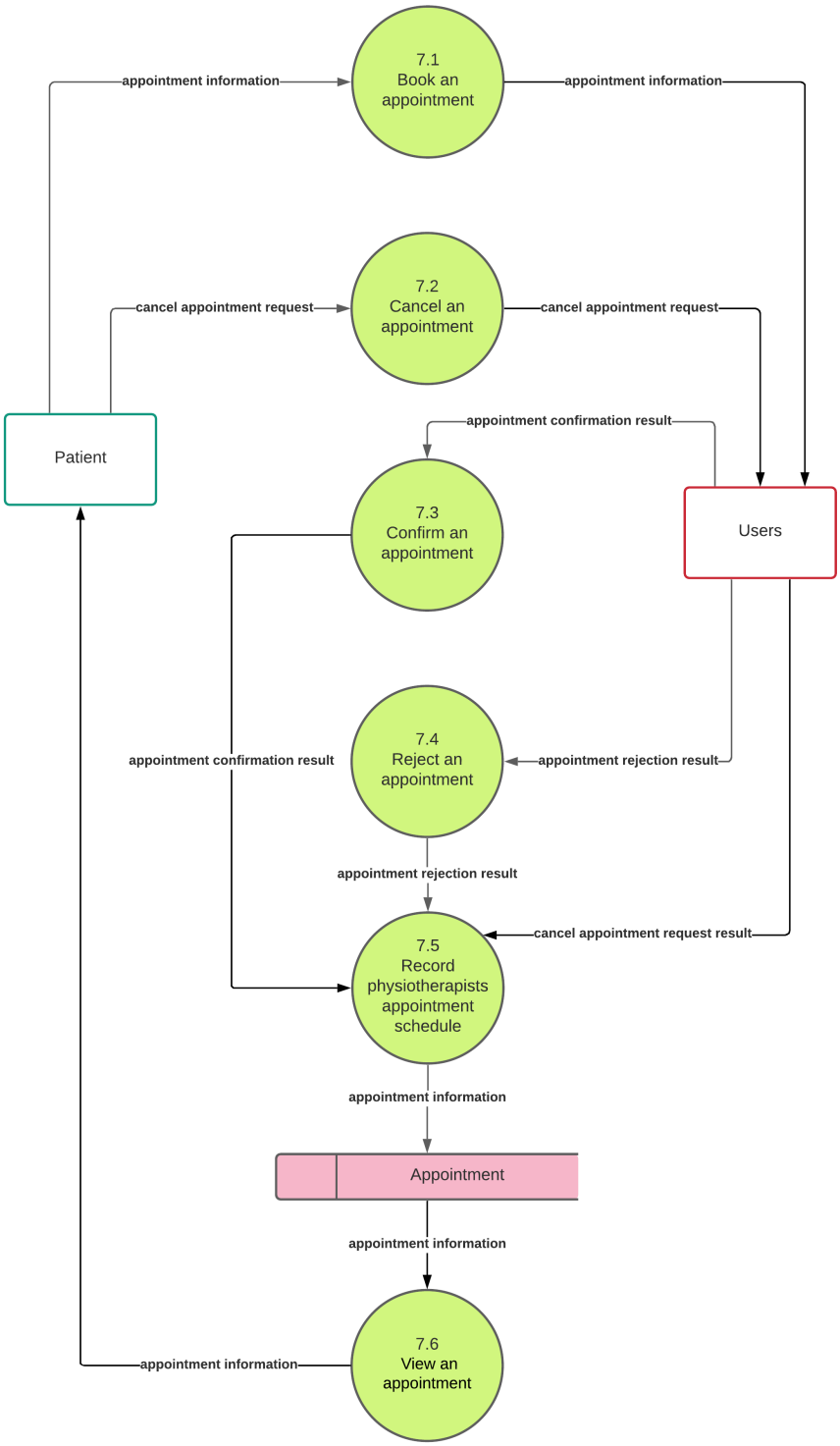

Figure 3.20: Data Flow Diagram: Level 2 - Module 7

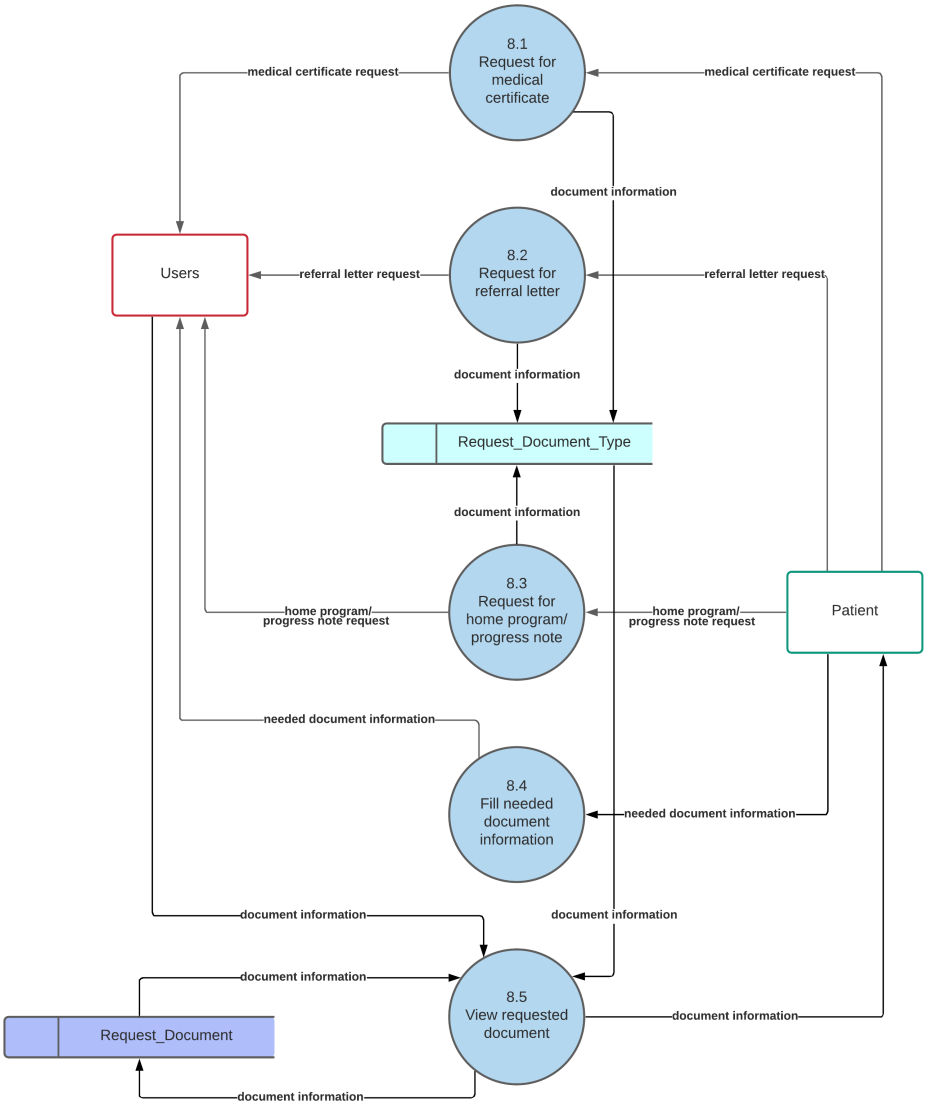

Figure 3.21: Data Flow Diagram: Level 2 - Module 8

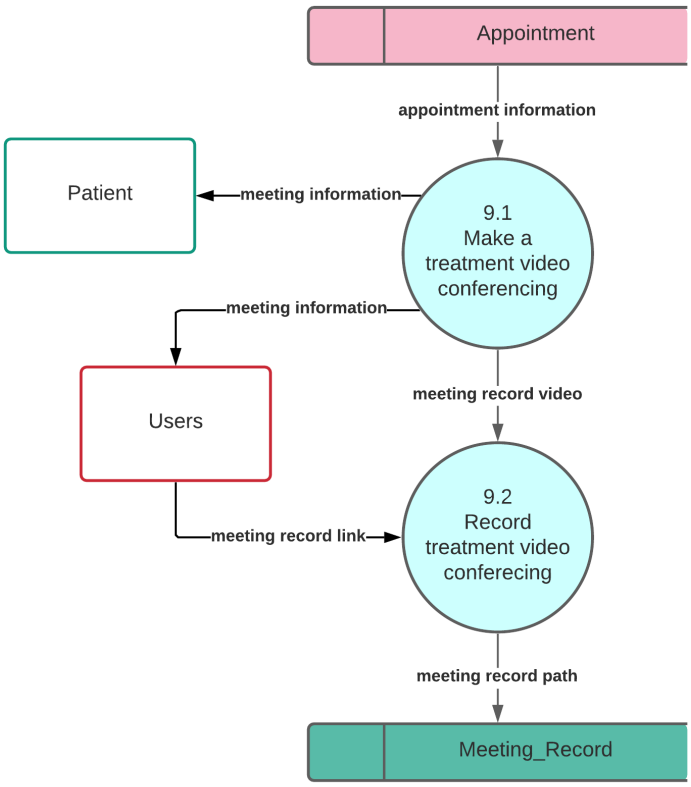

Figure 3.22: Data Flow Diagram: Level 2 - Module 9

3.3 Database Analysis and Design

3.3.1 ER-Diagram

Figure 3.23 shows the Entity-Relationship (ER) diagram of the TPT system. The ER diagram contains 9 entities, including Specialty, Users, Highlight, Patient, Request_Document, Request_Document_Type, Appointment, Meeting_Record, and Payment.

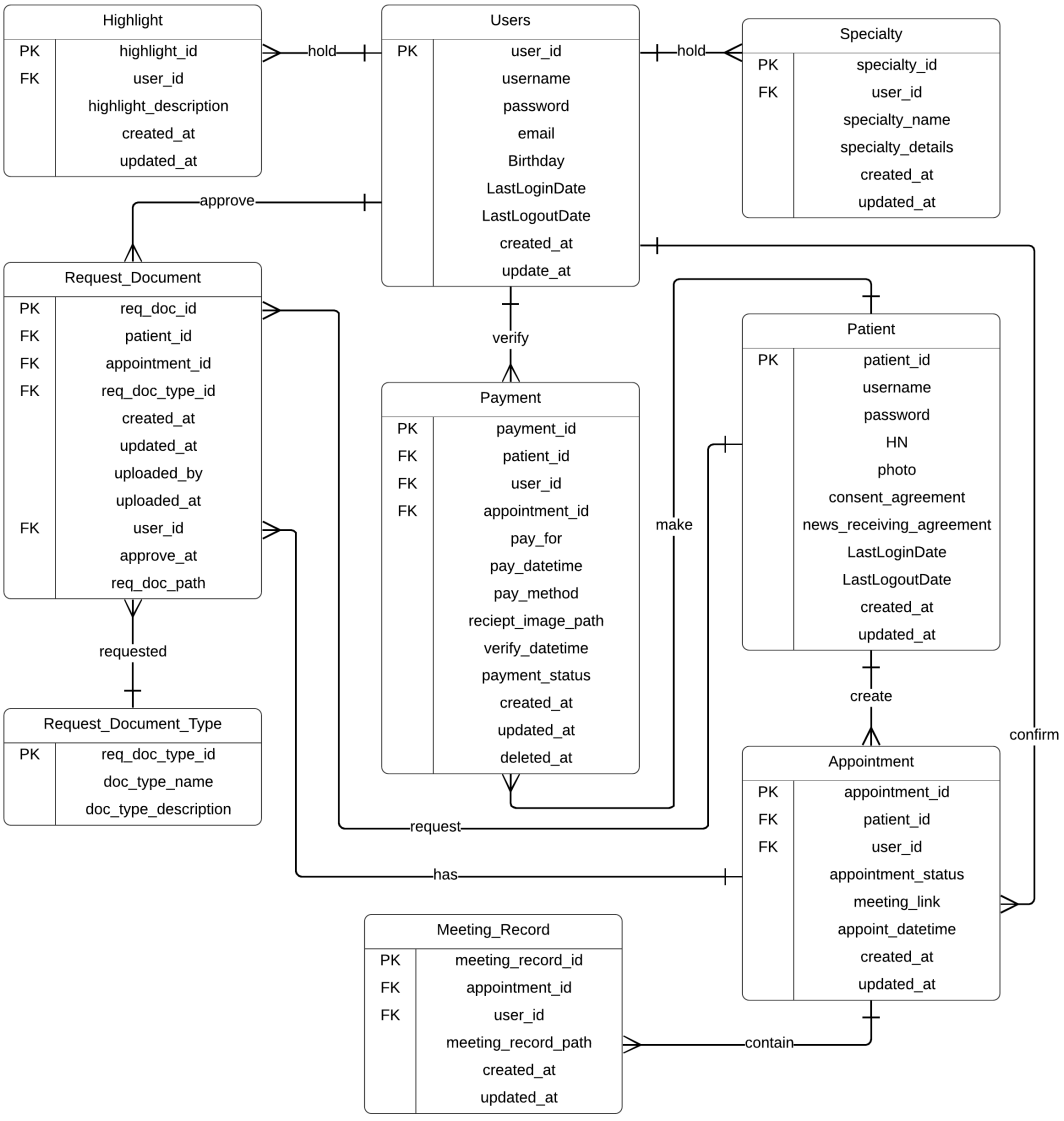

Figure 3.23: The Entity-Relationship Diagram of TPT

3.3.2 Relational Schema

Figure 3.24 shows the relation schema that was transformed from the ERD of the TPT system (Figure 3.23).

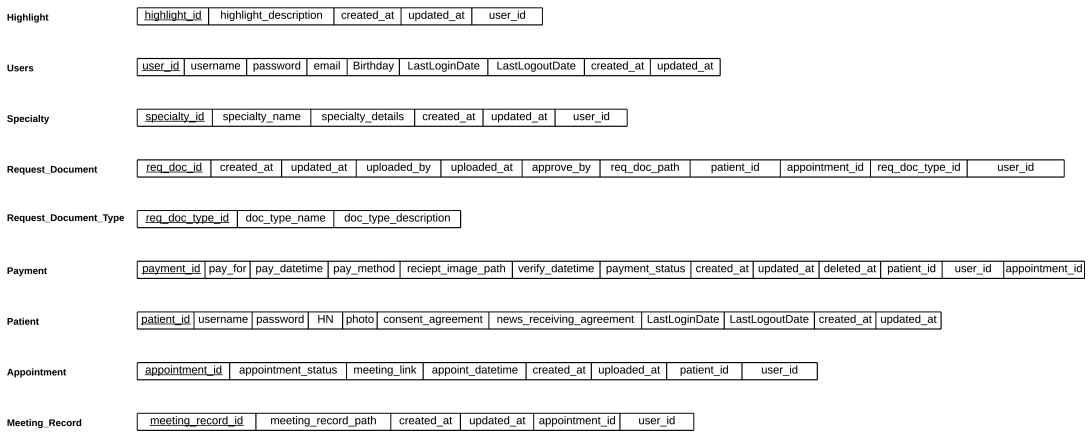

Figure 3.24: The Relational Schema of TPT

3.3.3 Data Dictionary

Figure 3.25 shows the data dictionary explaining the details of each attribute, including description, data type, range, nullable, and referential constraints.

TABLE NAME	ATTRIBUTES	CONTENTS	TYPES	FORMAT	RANGE	ALLOW NULLS	PK or FK	REFERENCES TABLE
Users	user_id	The number for identify user	BIGINT	x		NO	PK	
	username	The information is used for login	VARCHAR(100)	x		NO		
	password	The information is used for login	VARCHAR(100)	x		NO		
	created_at	Date and time of creating the information	TIMESTAMP	YYYY-MM-DD HH:MM:SS		NO		
	updated_at	Date and time of updating the information	TIMESTAMP	YYYY-MM-DD HH:MM:SS		NO		
	email	Email of user	VARCHAR(50)	x		NO		
	Birthday	Date of birth	DATE	YYYY-MM-DD		NO		
	LastLoginDate	Date and time history of login	DATETIME	YYYY-MM-DD HH:MM:SS		NO		
	LastLogoutDate	Date and time history of logout	DATETIME	YYYY-MM-DD HH:MM:SS		NO		
Highlight	highlight_id	The number for identify highlight	BIGINT	x		NO	PK	
	user_id	The number for identify user	INT	x		NO	FK	user_id[Users]
	highlight_description	The detail of highlight	VARCHAR(255)	x		NO		
	created_at	Date and time of creating the information	TIMESTAMP	YYYY-MM-DD HH:MM:SS		NO		
	updated_at	Date and time of updating the information	TIMESTAMP	YYYY-MM-DD HH:MM:SS		NO		
Specialty	specialty_id	The number for identify specialty	BIGINT	x		NO	PK	
	user_id	The number for identify user	BIGINT	x		NO	FK	user_id[Users]
	specialty_name	The name of each specialty	VARCHAR(50)	Xxxxxxx		NO		
	specialty_details	The detail of each specialty	VARCHAR(255)	x		NO		
	created_at	Date and time of creating the information	TIMESTAMP	YYYY-MM-DD HH:MM:SS		NO		
	updated_at	Date and time of updating the information	TIMESTAMP	YYYY-MM-DD HH:MM:SS		NO		
Patient	patient_id	The number for identify patient	BIGINT	x		NO	PK	
	username	The information is used for login	VARCHAR(100)	x		NO		
	password	The information is used for login	VARCHAR(100)	x		NO		
	HN	Hospital number	VARCHAR(10)	x		NO		
	photo	Patient photo	VARCHAR(100)	x		NO		
	consent_agreement	The form for patient that must read and accept before sign up	INT	x	0, 1	NO		
	news_receiving_areement	Patient can or cannot receiving the new news	INT	x	0, 1	NO		
	LastLoginDate	Date and time history of login	DATETIME	YYYY-MM-DD HH:MM:SS		NO		
	LastLogoutDate	Date and time history of logout	DATETIME	YYYY-MM-DD HH:MM:SS		NO		
	created_at	Date and time of creating the information	TIMESTAMP	YYYY-MM-DD HH:MM:SS		NO		
	updated_at	Date and time of updating the information	TIMESTAMP	YYYY-MM-DD HH:MM:SS		NO		
Request_Document	req_doc_id	The number for identify document that was requested	BIGINT	x		NO	PK	
	patient_id	The number for identify patient	BIGINT	x		NO	FK	patient_id[Patient]
	appointment_id	The number for identify appointment	BIGINT	x		NO	FK	appointment_id[Appointment]
	req_doc_type_id	The number for identify document type	BIGINT	x		NO	FK	req_doc_type_id[Request_Document_Type]
	uploaded_by	The person that upload the information	BIGINT	x		NO		
	uploaded_at	Date and time of uploading the information	DATETIME	YYYY-MM-DD HH:MM:SS		NO		
	user_id	The number for identify user	BIGINT	x		NO	FK	user_id[Users]
	approve_at	Date and time of approving the document that was requested	DATETIME	YYYY-MM-DD HH:MM:SS		NO		
	req_doc_path	Path of each requested document	VARCHAR(255)	x		NO		
	created_at	Date and time of creating the information	TIMESTAMP	YYYY-MM-DD HH:MM:SS		NO		
	updated_at	Date and time of updating the information	TIMESTAMP	YYYY-MM-DD HH:MM:SS		NO		
Request_Document_Type	req_doc_type_id	The number for identify document type	BIGINT	x		NO	PK	
	doc_type_name	The name of each document	VARCHAR(50)	x		NO		
	doc_type_description	The description of each document	VARCHAR(100)	x		NO		
Appointment	appointment_id	The number for identify appointment	BIGINT	x		NO	PK	
	patient_id	The number for identify patient	BIGINT	x		NO	FK	patient_id[Patient]
	user_id	The number for identify user	INT	x		NO	FK	user_id[Users]
	appointment_status	The status of appointment process of each patient	VARCHAR(20)	x		NO		
	meeting_link	Webex link	VARCHAR(100)	x		NO		
	appoint_datetime	Date and time of the appointment	DATETIME	YYYY-MM-DD HH:MM:SS		NO		
	created_at	Date and time of creating the information	TIMESTAMP	YYYY-MM-DD HH:MM:SS		NO		
	updated_at	Date and time of updating the information	TIMESTAMP	YYYY-MM-DD HH:MM:SS		NO		
Meeting_Record	meeting_record_id	The number for identify meeting record	BIGINT	x		NO	PK	
	appointment_id	The number for identify appointment	BIGINT	x		NO	FK	appointment_id[Appointment]
	user_id	The number for identify user	BIGINT	x		NO	FK	user_id[Users]
	meeting_record_path	Path of each meeting record	VARCHAR(255)	x		NO		
	created_at	Date and time of creating the information	TIMESTAMP	YYYY-MM-DD HH:MM:SS		NO		
	updated_at	Date and time of updating the information	TIMESTAMP	YYYY-MM-DD HH:MM:SS		NO		
Payment	payment_id	The number for identify payment	BIGINT	x		NO	PK	
	patient_id	The number for identify patient	BIGINT	x		NO	FK	patient_id[Patient]
	user_id	The number for identify user	BIGINT	x		NO	FK	user_id[Users]
	appointment_id	The number for identify appointment	BIGINT	x		NO	FK	appointment_id[Appointment]
	pay_for	Registeration payment or appointment payment	VARCHAR(20)	x		NO		
	pay_datetime	Date and time that patient make a payment	DATETIME	YYYY-MM-DD HH:MM:SS		NO		
	pay_mothod	The way that patient make a payment	VARCHAR(20)	x		NO		
	receipt_image_path	Path of each payment receipt imge	VARCHAR(255)	x		NO		
	verify_datetime	Date and time of verifying payment	DATETIME	YYYY-MM-DD HH:MM:SS		NO		
	payment_status	The status of payment process of each patient	VARCHAR(20)	x		NO		
	created_at	Date and time of creating the information	TIMESTAMP	YYYY-MM-DD HH:MM:SS		NO		
	updated_at	Date and time of updating the information	TIMESTAMP	YYYY-MM-DD HH:MM:SS		NO		
	deleted_at	Date and time of deleting the information	TIMESTAMP	YYYY-MM-DD HH:MM:SS		NO		

Figure 3.25: The data dictionary of TPT

3.4 I/O Design

This section provides details in the design of the input and output of the user interface. There are two parts including the interface design and the transition diagram.

3.4.1 Interface Design

In this section, we show the drafted design of the TPT application using wire-frame. Currently, there are 7 main pages: home page, make-an-appointment page, payment page, my appointment page, teleconsult service page, search physical therepist

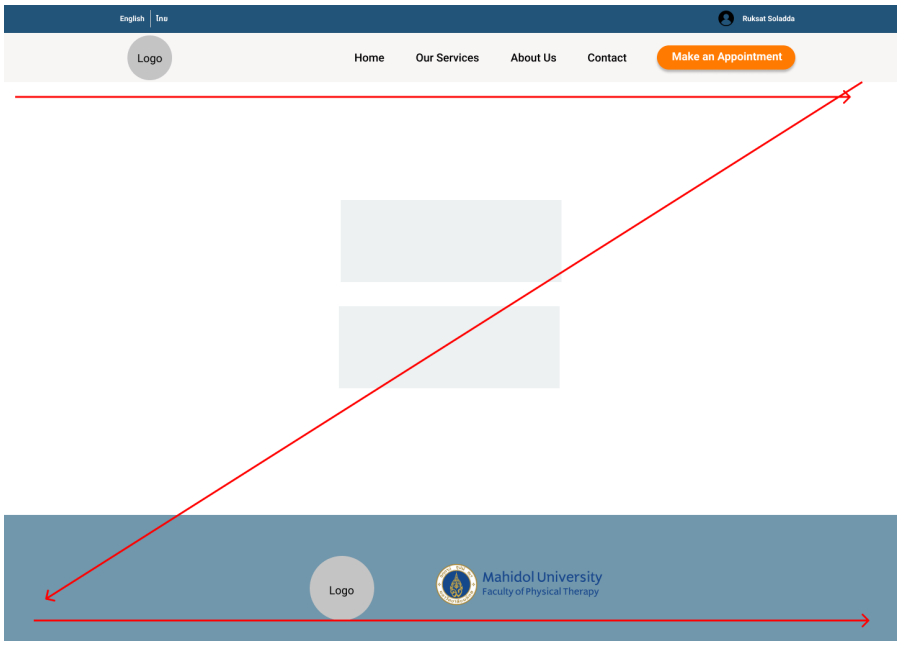

Figure 3.26: TPT Website Template

page, and request document page. For the color theme of our web application, we use blue and orange. In every page except the home page, we use a z-shaped pattern, as shown in Figure 3.26, to design the page. The z-shaped pattern is suitable for sites, that have minimal copy and a few key elements designed to grab the user's attention [16]. In other words, when there is less information on the website, putting all information in the center of the website make it balanced. For more information about each page will be discussed in the next section below.

Home page

The home page design put everything in the center. This makes the page look balanced and easy to use for users. When users first visit the website, they will see the home page as shown in Figure 3.27. At the top of the page, users can choose their preferred language (English or Thai) on the left-hand side. On the right, there will be the menu to sign in or sign up. Then, there will be a navigation bar consisting of "Home", "Our Services", "About Us", "Contact", and "Make an Appointment". When users click on any menus, the page will move down to the topic that they chose. The navigation bar will always be at the top of the page.

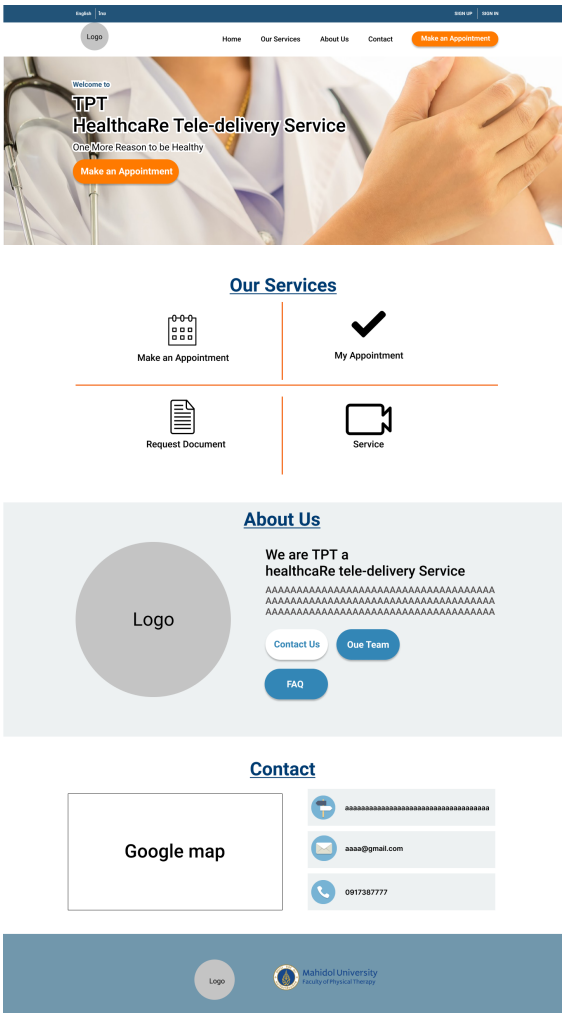

Figure 3.27: Home Page before Sign-in

When users have already signed-in, their home page will be changed to the one shown in Figure 3.28. The thing that changes form Figure 3.27 is the menu to sign in or sign up on the top right. It will be the name of the user.

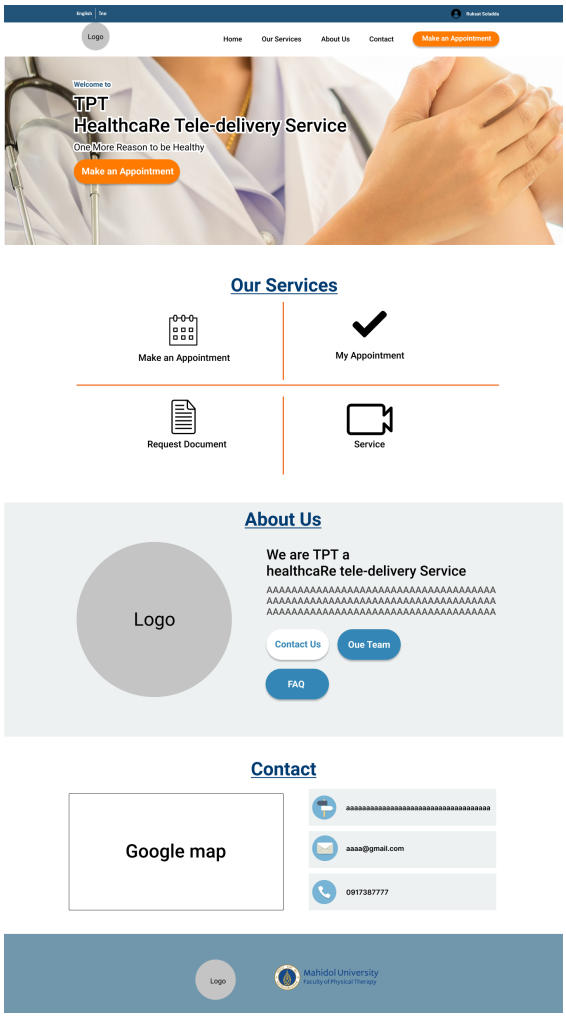

Figure 3.28: Home Page after Sign-in

Make an appointment page

When users click on “Make an Appointment” on the navigation bar or from “Our Services”, they will be navigated to “Make an Appointment” in Figure 3.29. Note that users are required to sign-in before making an appointment. For making an appointment, users can first select specialty (i.e., area in physical therapy). Then, users can select the name of preferred physical therapists. If the users do not know their treatment specialty and physical therapists’ name, the user can leave them empty. After that, they can select date, user can choose month and year from the available slots. The calendar will show available and unavailable time slots for appointments. The available date and time will be shown in black. Finally, user can confirm the date/time they chose (Figure 3.30)

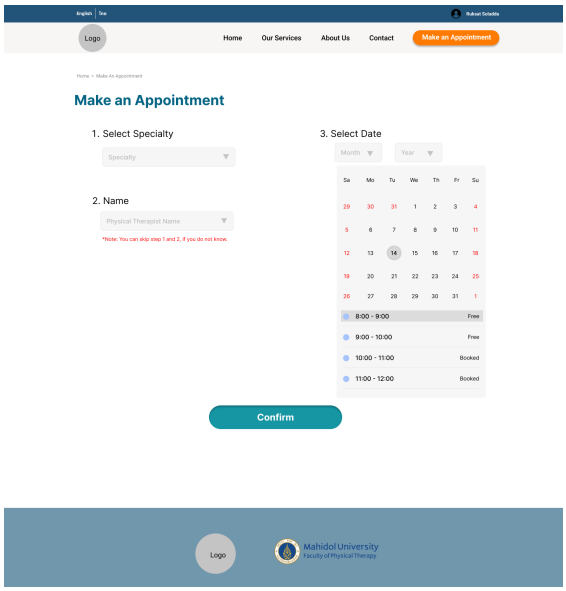

Figure 3.29: Make an Appointment Page

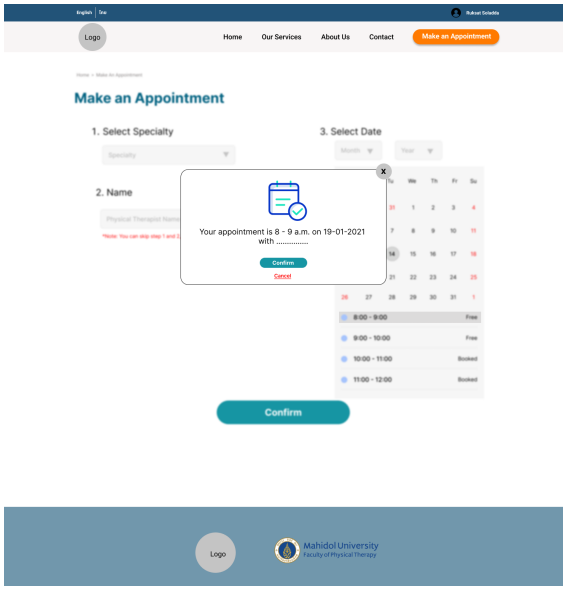

Figure 3.30: Confirmation Popup

Figure 3.30 shows the confirmation popup showing the details of the appointment, e.g., date, time, and physical therapists' name as filled-in by users. If users want to make changes, they need to click the cancel button to close the popup and remake the appointment. After this process, users need to pay the appointment fee as shown in Figure 3.31.

Payment page

Figure 3.31 shows the first design of the payment page with the QR code for appointment payment. After the payment, users must upload the receipt.

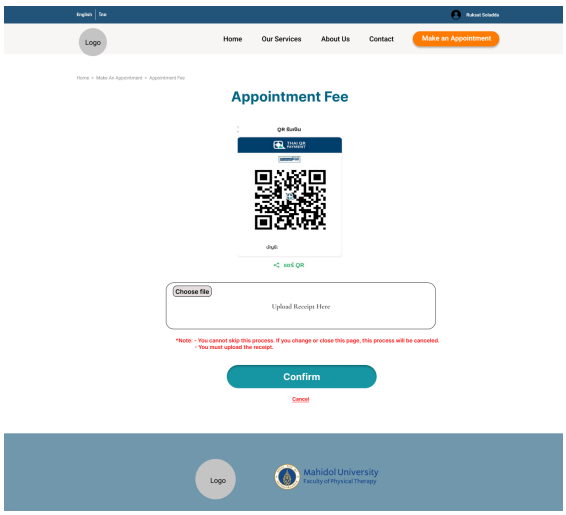

Figure 3.31: Appointment Fee

When a user clicks the cancel button, the warning message will pop up to confirm the cancellation (Figure 3.32). Note that the entire process of appointment will be aborted. If the user does not want to cancel, they can click the close button on the top right-hand side of the popup for closing.

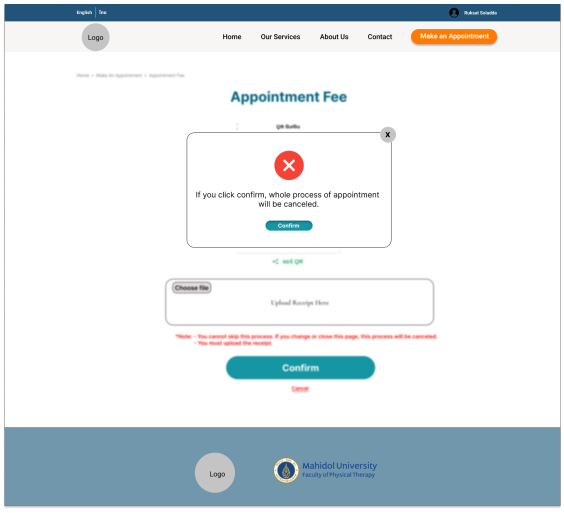

Figure 3.32: Appointment Cancellation

If users have not uploaded the receipt, there will be a warning popup to remind them before completing the appointment process (Figure 3.33).

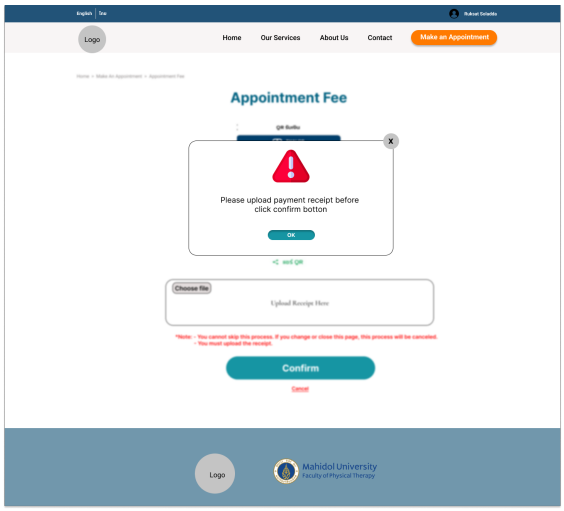

Figure 3.33: Warning Popup to Upload the Receipt

If users already complete all steps, they can click the confirmation button. The confirmation message will pop up as shown in Figure 3.34.

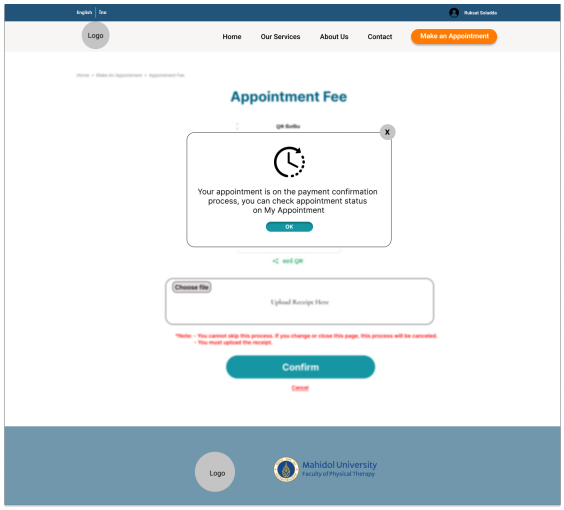

Figure 3.34: Appointment Confirmation Popup

My appointment page

As shown in Figure 3.35, “My Appointment” page shows the history of appointments in the tabular format. There are 4 statuses of the appointment used for filtering, including, “all status”, “complete”, “pending”, and “confirmed”. The appointment table

include the information about date, the name of physical therapists, status, and note. The "pending" status will be showed in yellow color, while the "confirmed" status will show in green. In the note section, it includes the details of the pending status, for example, waiting for payment information. For "pending" and "confirmed" status, there will be a cancellation button to allow users to cancel the appointment.

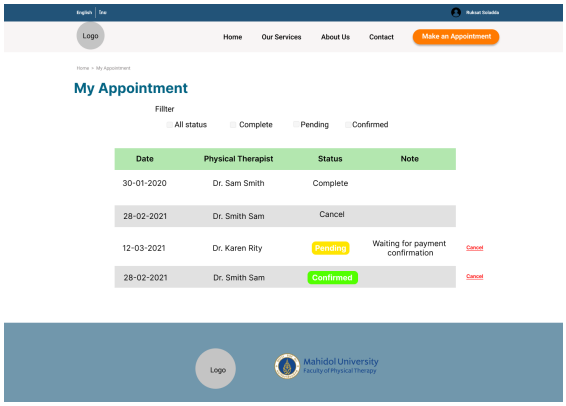

Figure 3.35: My Appointment Page

If users click the cancellation button, the warning message will pop up and wait for user confirmation (Figure 3.36). If users do not want to cancel, they can click the close button on the top right-hand side of the popup for closing.

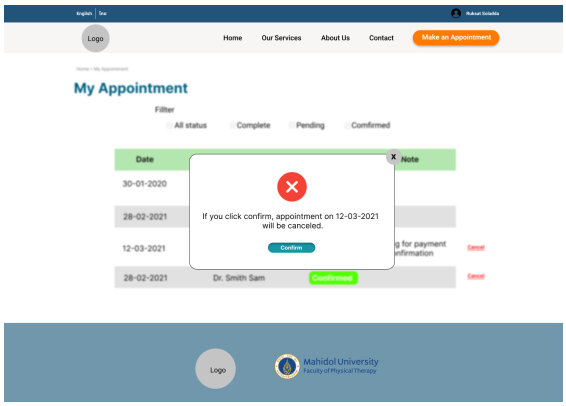

Figure 3.36: Appointment Cancellation Popup

Teleconsult service page

As shown in Figure 3.37, "Teleconsult service" page shows the date and the Webex link for receiving the teleconsultation. Users click the link that they want and it

will redirect to Webex. Webex browser will open. As a result, the user can talk with a physical therapist.

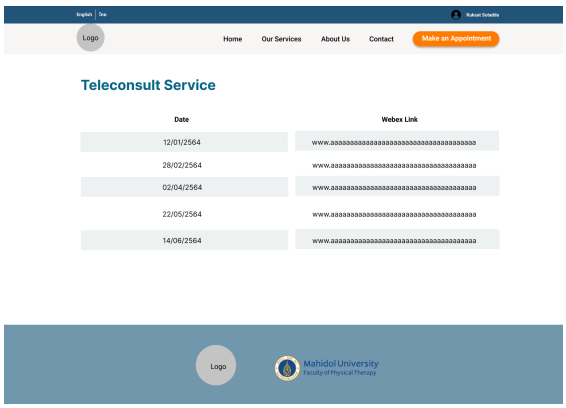

Figure 3.37: Teleconsult Service Page

Search physical therapist page

When the user opens this page, there is a list of physical therapists. Users can also search for a specific physical therapist by name or specialty, as shown in Figure 3.38.

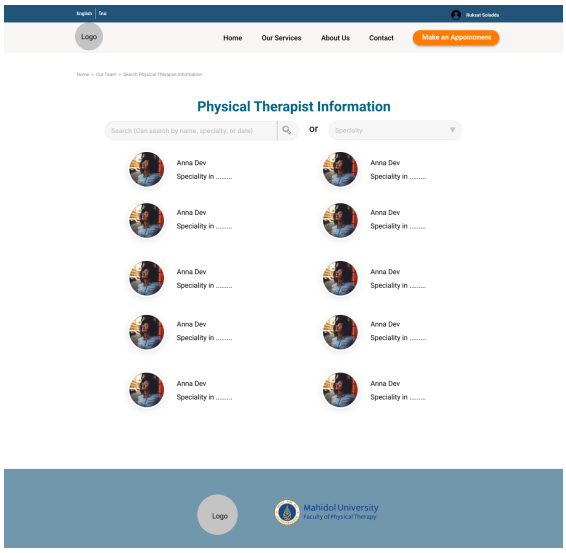

Figure 3.38: Search Physical Therapist Page

If the user wants to see more information about each physical therapist, the user can click the name of physical therapist. The page will be shown as in Figure 3.39. There are highlight information of physical therapists and users can see the available date on the calendar.

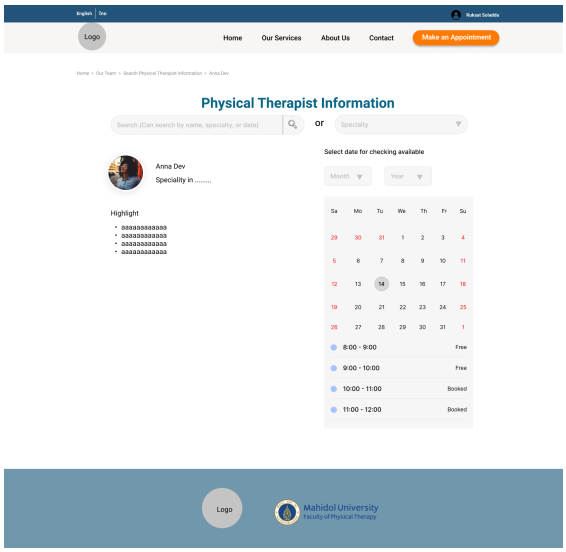

Figure 3.39: Physical Therapist Information Page

Request document page

The request document page (Figure 3.40) allows users to make a request to obtain 3 types of documents: a medical certificate, a referral form and home program/progression note. There is a check box in front of each type of documents for selection. On the right-hand side of the icon in each document, there will be a blue box showing a description of each document. After users select the document, they can click the confirmation button and page will change as shown in Figure 3.41. Note that users will be received those requested document via email registered in the system.

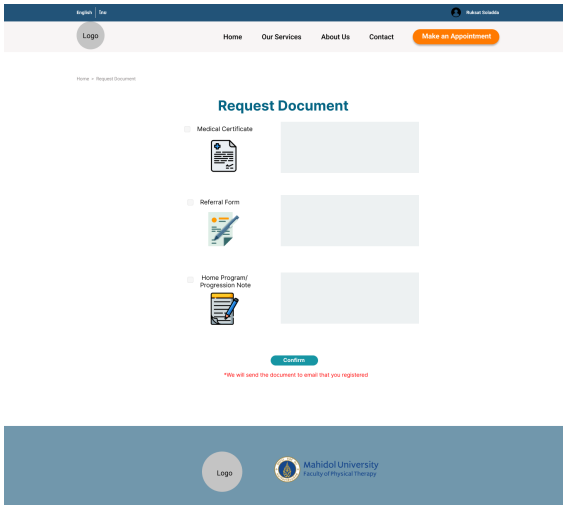

Figure 3.40: Request Document Page

From Figure 3.41, this is a page for filling more information about request document. User must fill name, ID card number, date, service date, date, and department.

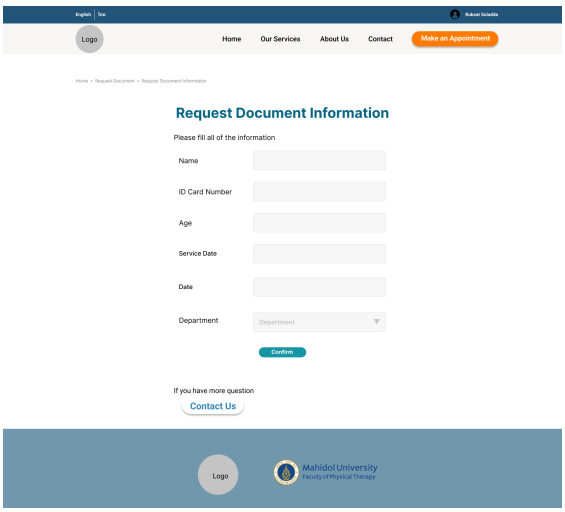

Figure 3.41: Request Document Page

3.4.2 Transition Diagram

Figure 3.42 shows the transition diagram of our main page. The arrows indicate the flow of the navigation.

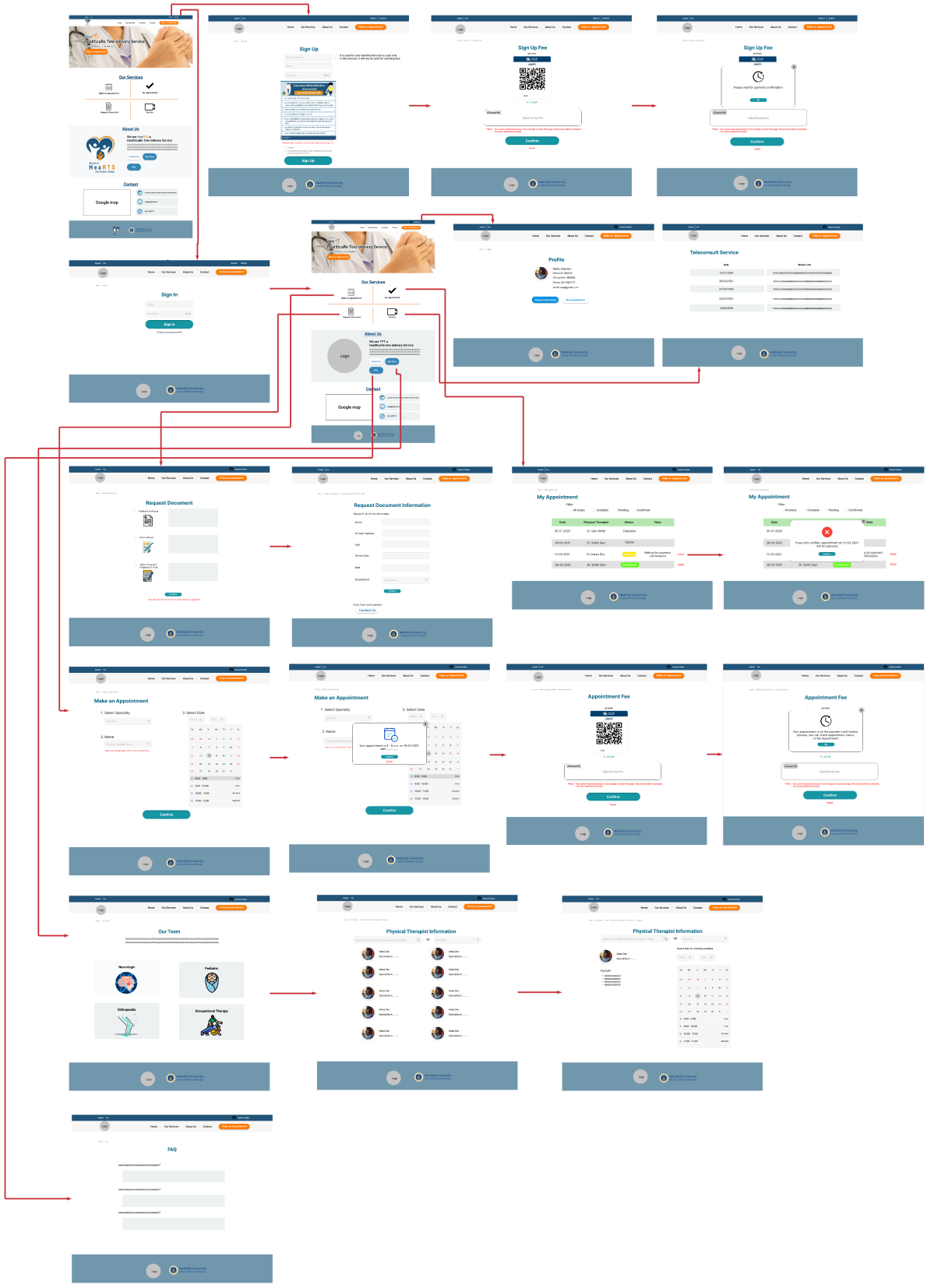

Figure 3.42: Website Transition Diagram

3.5 Current progress

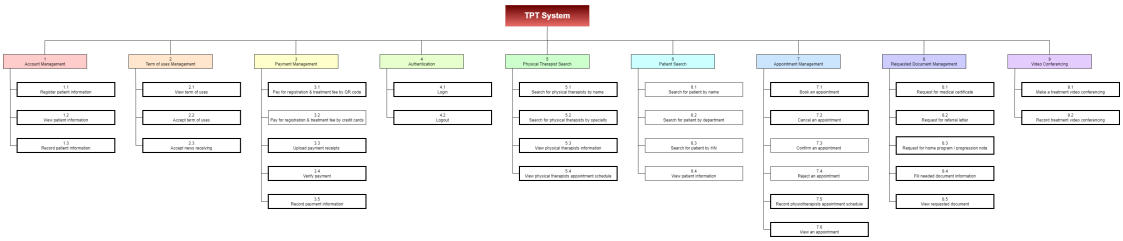

Figure 3.43: System Structure Chart Current Progress

Figure 3.43 shows the TPT system structure chart current progress, which can be divided into 9 main processes including: Account management, Term of use management, Payment management, Authentication, Physical therapist search, Patient search, Appointment management, Requested document management, and Video conferencing. The thing that we done, we use the bold frame for checking. For more information in each part will be discussed in the next section below.

Account management

We done all of account management process (Figure 3.44), it consists of 3 processes: register patient information, view patient profile, and record patient profile.

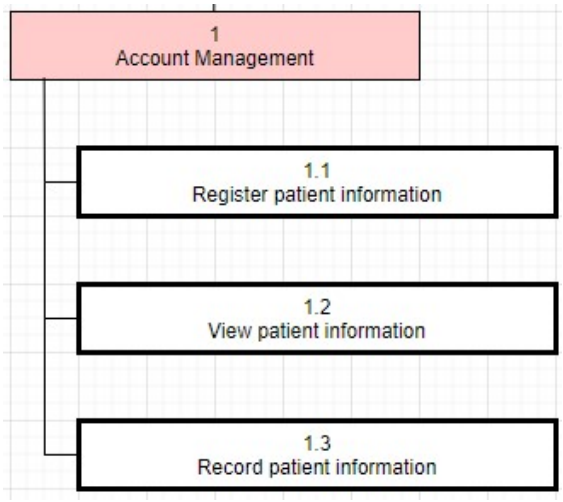

Figure 3.44: Account Management Process

Term of use management

We have completed all of Term of use management process. This part focuses on 3 processes: view and accept term use and accept news receiving.

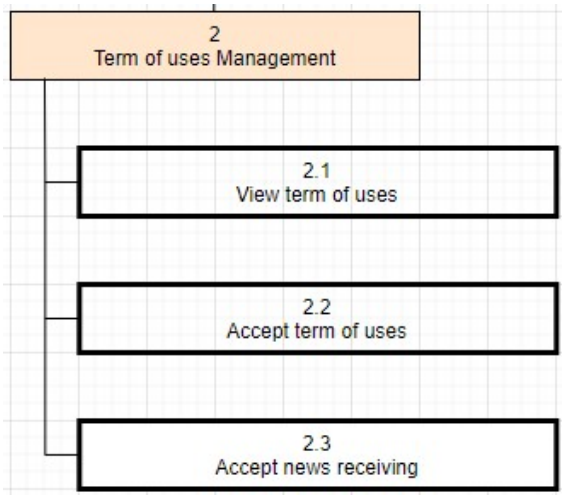

Figure 3.45: Term of use Management Process

Payment management

In payment management, we finished 4 from 5 processes: users making a registration or treatment payment by QR code, uploads the payment receipt, verify payment, and record payment information.

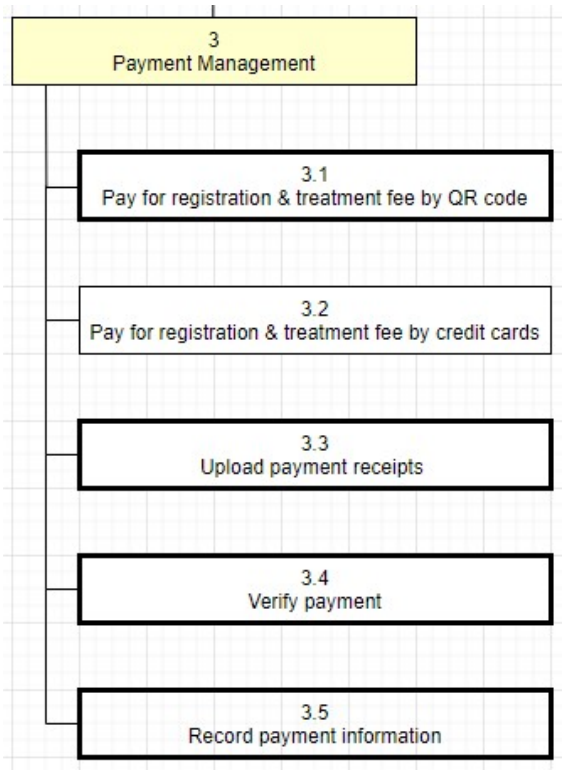

Figure 3.46: Payment Management Process

Authentication

In authentication, we finished all 2 processes: login and logout.

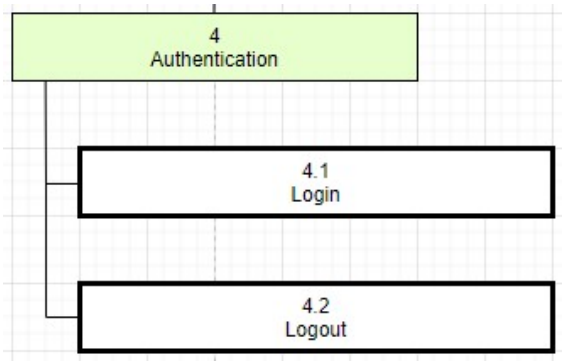

Figure 3.47: Authentication Process

Physical therapist search

In physical therapist search, we done all 4 processes including view physical therapist information and their schedule, search physical therapist information by name and specialty.

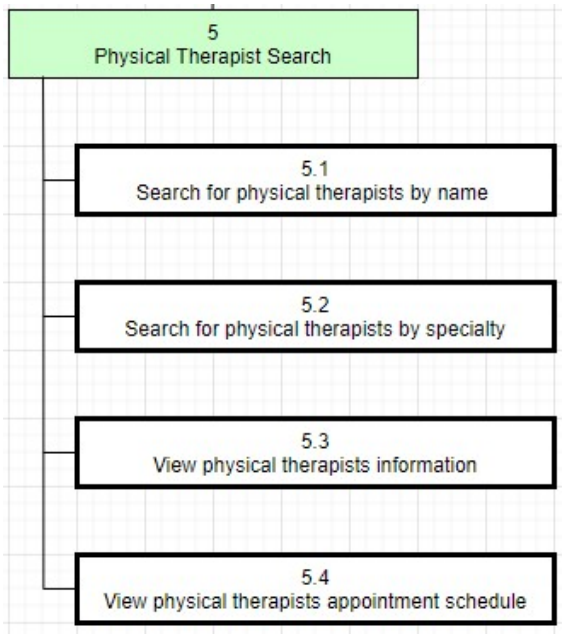

Figure 3.48: Physical Therapist Search Process

Patient search

We have not start in this process.

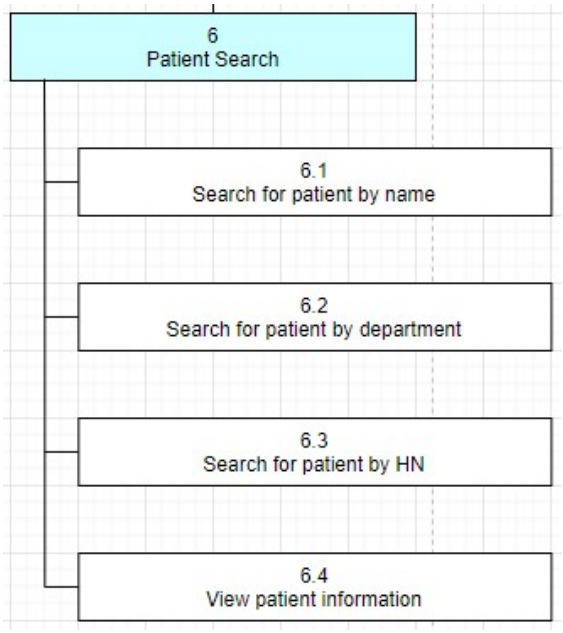

Figure 3.49: Patient Search Process

Appointment management

In appointment management, we have completed 4 process form 6 processes including book, cancelling, record a physical therapist appointment schedule, and view appointment.

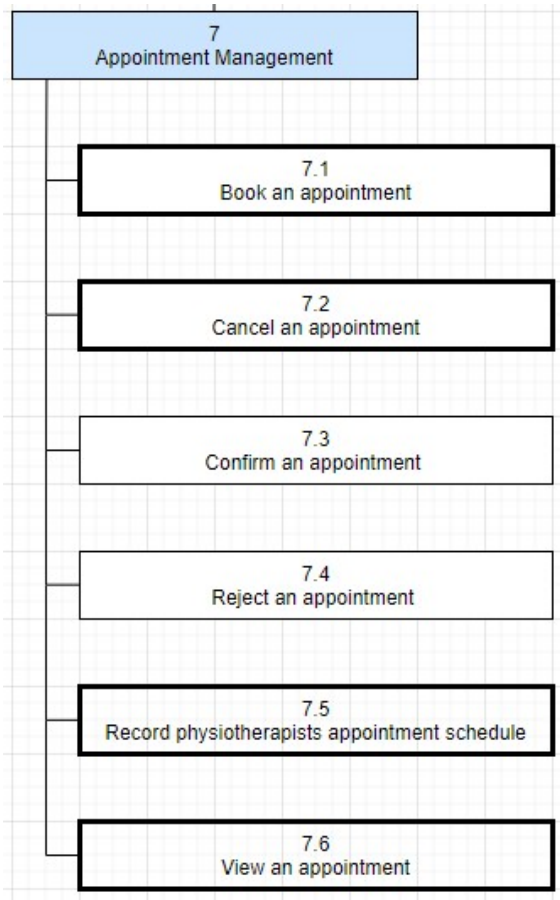

Figure 3.50: Appointment Management Process

Requested document management

In requested document management, we done all 5 process: request medical certificate, referral letter, home program / progression note, fill needed document information, and view requested document.

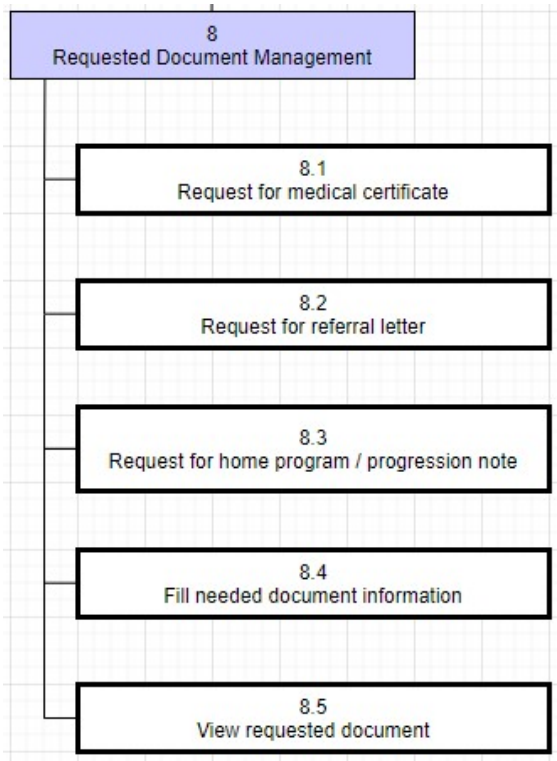

Figure 3.51: Requested Document Management Process

Video conferencing

In video conferencing, we have completed all 2 processes: make and record treatment video conferencing.

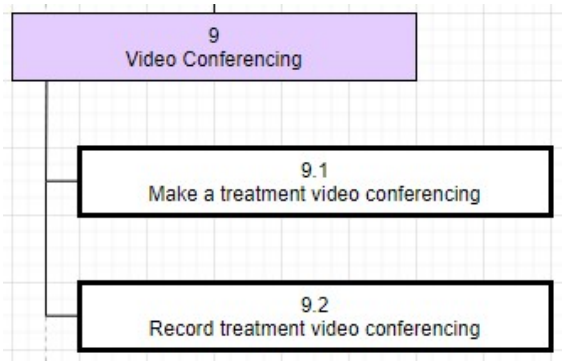

Figure 3.52: Video Conferencing Process

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