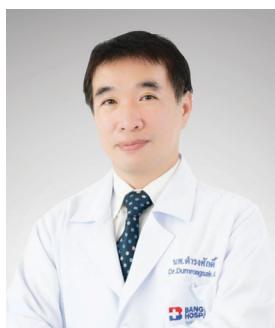


Development of a Virtual Polyclinic on a Mobile Application in Surat Thani Province, Thailand

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Abstract

OBJECTIVES: The study of the development of a virtual polyclinic service system on a mobile application in Surat Thani Province entailed: 1) To study the components of a virtual polyclinic clinic service system on a mobile application, 2) To develop and analyze a service system on a business model, and 3) To study trends and feedback toward a virtual polyclinic service system on a mobile application.

MATERIALS AND METHODS: This is a mixed methods research with the following approaches: 1) A qualitative study by conducting a focus group interview of 15 informants about the components of, and an analysis of, the business model of a virtual polyclinic service system. 2) A video clip orientation to describe the steps for receiving a virtual polyclinic services, and 3) A quantitative study by questionnaire about the trend of virtual polyclinic services. The total number of respondents was 400.

RESULTS: The study revealed that: 1) A virtual polyclinic on a mobile application has three main processes including registration, service activities, and payment. The service processes are also divided into the main activities and the support activities. 2) The outcomes from an analysis of a virtual polyclinic service system business model on a mobile application are described through 9 perspectives of business model canvas (BMC). The principal investigator used a video clip as a tool for describing how to receive services. 3) For trends of a virtual polyclinic service on a mobile application, there were 360 questionnaires eligible for this study, these represented 90% of total respondents. The top feedback was related to an overview of flows of service system and system performance, outcomes, quality, user profile and service system responsiveness.

CONCLUSION: From the result of the study on the opinions of the respondents, a Virtual Polyclinic on a mobile Application is an interesting application if developed for real use.

Keywords: virtual polyclinic, business model, mobile application, Surat Thani Province

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Polyclinic¹⁻³ is a form of healthcare service operator that offers multidisciplinary team services. Its service processes include:

1. Registration and screening
2. Diagnosis by physician
3. Laboratory or imaging
4. Service payment
5. Receiving medicine

The data of all processes are recorded in its healthcare information system. It is a process of receiving services from a health care provider where the provider and the client interact directly face-to-face. In 2011, World Health Organization revealed a survey about the deployment of digital technology on mobile platforms in healthcare services and coined the definition of 'mobile health' (mHealth)⁴ to apply to emerging mobile communications and network technologies for healthcare. Nowadays, digital transformation has changed the way businesses operate. Human needs are a key driver for business transformation to satisfy their needs. Before the COVID-19 pandemic, although many applications were

available for encouraging face-to-face communication between physician and patient and supporting the transfer of data such as medical record files or images, they were not widely used and the number of downloads was low. When the COVID-19 pandemic started, clinics and healthcare personnel could not provide services to patients as normal. Reducing direct interactions in activities and travel was vital to help control the spread of the disease. Many hospitals provide medicine delivery services by post/ mail, although this may cause an increase of risk on how medication is prescribed and used.

The BMC had 9 key components as exhibited in the following table including:

1. Value Proposition
2. Customer Segments
3. Customer Relationships
4. Channels
5. Key Activities
6. Key Resources
7. Key Partners
8. Cost Structure
9. Revenue Streams

These components were interrelated and associated with a business overview. They visualized the business direction and addressed key strategies to success as well as developed business innovation.^{7,9,10}

Therefore, the researcher had the idea to develop a virtual Polyclinic on a mobile application following the same process of using the system as a patient would on a visit to a hospital. Developing the application, the researchers used the BMC to analyze the components of a service system and to show how the service system functions using a short film.

Materials and Methods

A virtual polyclinic service system on a mobile application in Surat Thani Province was a mixed methods research. The principal investigator conducted the project in 3 steps:

- **Step 1:** A qualitative study to learn of the components of, and the analysis of, the business model of a virtual polyclinic service system.
- **Step 2:** The development of a virtual polyclinic service system on a mobile application.
- **Step 3:** A quantitative study to evaluate the outcome of a virtual polyclinic service system on a mobile application.

In **step 1** and **step 3**, these were divided into four major topics comprising: Population and Sample Size, Research Instrument, Data Collection and Data Analysis.

In **step 2**, A development of a virtual polyclinic service system on a mobile application, the principal investigator used a video clip orientation to describe the steps for receiving virtual polyclinic services.

I. *A qualitative study to learn of the components of, and the analysis of, the business model of a virtual polyclinic service system.* In this step, the principal investigator divided it into 2 processes:

1. Reviewed the literatures on medical services on mobile applications^{12,13} and analyzed the BMC.
2. Designed questions for conducting an interview about the components of a virtual polyclinic service system on a mobile application and analyzed the BMC.

Population: This study was divided into 5 groups including the hospital executive team, the physician/ specialist team, the pharmacist team, the medical personnel team and the information technology developer team. The total was 15 interviewees.

Research Tools: The principal investigator used an in-depth interview with a semi-structured interview and open-ended questions to gather data on the components of a virtual polyclinic service system on a mobile application to develop its service system.

Data Collection: During data collection process, the principal investigator explained the objectives of the study and asked for cooperation in the interview. The approach included face-to-face interviews and online interviews, such as a Line call. The information obtained from the interviews was used to classify the content of the diagrams in the business model.

Data Analysis: Data analysis was used to analyze content and themes. It included an analysis of the components of a virtual polyclinic service system on a mobile application and an analysis of a virtual polyclinic service system of the BMC to develop a virtual polyclinic service system on a mobile application.

II. *The development of a virtual polyclinic service system on a mobile application:* In the step of development of a virtual polyclinic service system on a mobile application, the principal investigator described the service system with a video clip namely “Virtual Polyclinic on Mobile Application” which mimics the workflow of an Out Patient Department (OPD).

III. *The quantitative study to evaluate a virtual polyclinic service system on a mobile application: an assessment of a virtual polyclinic service system on a mobile application.* This is a quantitative research to assess opinions on the quality of electronic services.¹⁶ All respondents were requested to watch a video clip before answering an online questionnaire, the principal investigator evaluated a virtual polyclinic service system on a mobile application as follows:

Population and Sample Size: The information from National Statistical Office indicated that the population of Surat Thani province is 1,068,060 people. The information from social media^{14,15} indicated that the percentage of social media users in Thailand is 78.7%. Thus, the principal investigator expected that the number of social media users in Surat Thani was 840,563. In reference to Taro Yamane formula, with a sample size for precision of 0.5,

and where the confidence level was 95%, the appropriate sample number was 400.

Research Tool and Quality Testing: The online questionnaire was divided into 3 parts.

1. General information of the respondents
2. Process and System Availability
3. Feedback in each perspective including Service Outcome, Service Quality, Data Privacy, and Responsiveness¹⁶⁻¹⁹

The questionnaire quality was verified by five experts with Item-Objective Congruence (IOC). Cronbach's alpha coefficient of the confidence of the survey questionnaire was 0.95.

Data analysis

The descriptive statistic was applied and presented with percentage and measures of central tendency in this section.

Result

Components of a Virtual polyclinic service system and Business Model Analysis.

The results of the components of a virtual polyclinic service system on a mobile application had three processes including registration, service activities, and payment. However, the service activities were also divided into major activities and support activities as seen in Figure 1.

An analysis of the BMC¹² is demonstrated in Figure 2 below. The principal investigator described the relationship of nine components into three major areas including:

1. Customer and Value Proposition.
2. Provider and System Activities.
3. Cost Structure and Revenue Streams.

Development of virtual polyclinic service system

As part of the service system development and the analysis of a virtual polyclinic service system on a mobile application, the principal investigator developed a virtual polyclinic service system on a mobile application and described the process flow through a video clip, namely 'Virtual Polyclinic on Mobile Application', to explain the objectives of this research.

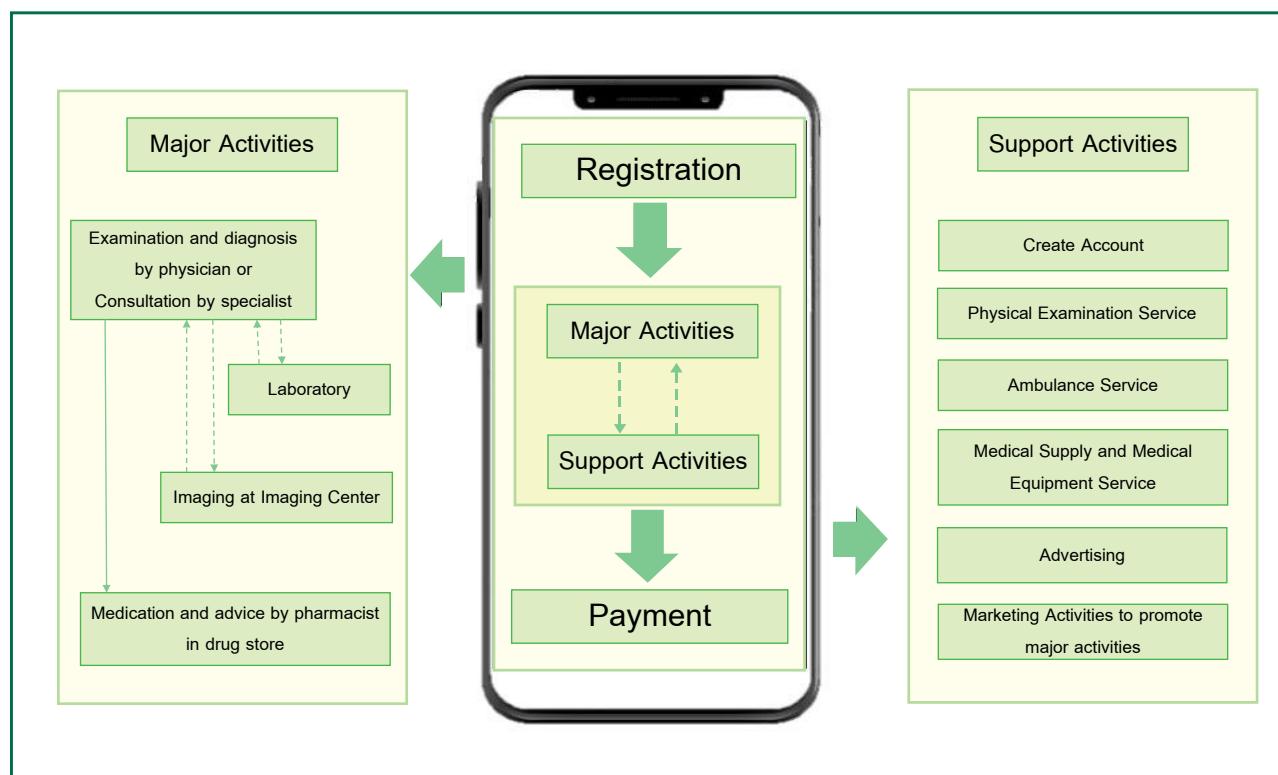


Figure 1: The components of a virtual polyclinic service system on a mobile application

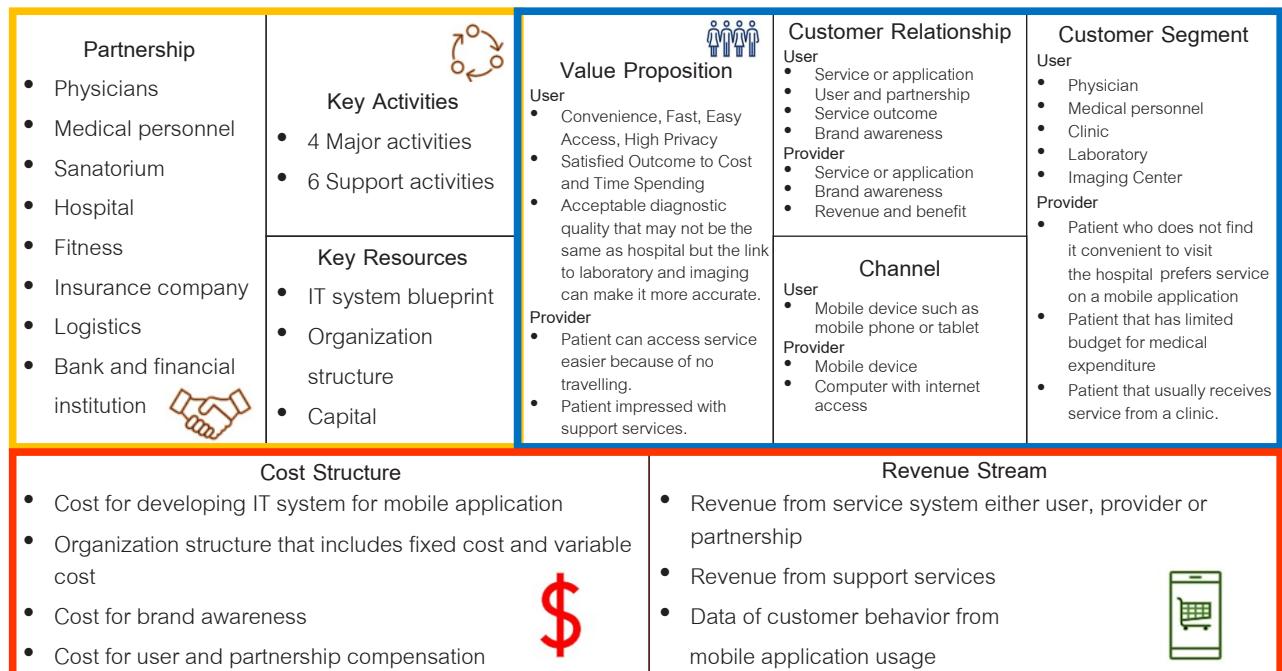


Figure 2: Outcome of an analysis of virtual polyclinic service system on mobile application



Figure 3: QR Code: video clip “Virtual Polyclinic On a Mobile Application”

Evaluation of a virtual polyclinic service system on a mobile application

An evaluation of a virtual polyclinic service system on a mobile application is shown in Table 1 and Table 2. The study revealed that the top feedback of respondents were Process and System Availability, Result, Quality, General information of the respondents and Customer Satisfaction. Moreover, all medical activities in the video clip were applicable. The physical examination via video call was linked with laboratory and imaging results made the diagnosis more reliable. The feedback of respondents was high.

Discussion

Components of a service system in a mobile application and Business Model Analysis.

Table 1: Overview of evaluation of a virtual polyclinic service system on a mobile application

Topic	Feedback Level		
	Mean	S.D.	Rating
Process and System Availability	4.47	0.63	Highest
Outcome of Service System	4.40	0.62	Highest
Quality of Service System	4.49	0.60	Highest
Data Privacy	4.48	0.61	Highest
Responsiveness	4.47	0.61	Highest

All business application activities consist of three main components: registration, business activities, and payments. The above elements in each business have a different importance depending on the importance of information in business. For this study, a model was developed by simulating the process of using a healthcare provider's services. If the application is actually developed, such medical service activities may be covered in some areas, especially in large cities. From the perspective of imaging activity, the service could not extend to some areas; thus, the service would be carried out by partnership hospitals. The partnership hospitals could also fulfill some activities that the video call physical examination or telemedicine was not able to deliver. In the future, the development of artificial intelligence (AI) would encourage more accuracy of physical examination and diagnosis.

The researchers utilized the BMC to develop innovative business analytics services^{7,9,10} of such applications that could be useful in non-commercial public health applications. Moreover, the analysis of BMC visualized that besides medical personnel; National Health Security Office (NHSO),

Table 2: The result from evaluation of a virtual polyclinic service system on a mobile application

Topic	Feedback Level		
	Mean	S.D.	Rating
Process and System Availability			
The service starts from signing in for registration and unique patient identification.	4.58	0.53	Highest
Patient can receive treatment from specialists in related specialty.	4.64	0.54	Highest
The virtual physical examination is delivered and the treatment is appropriate to detected abnormality.	4.27	0.67	Highest
The system is linked with blood test services of the certified laboratory near you.	4.54	0.59	Highest
The system is linked with imaging services of the certified imaging center near you.	4.53	0.59	Highest
The system is linked with pharmacy services of the drug store near you.	4.60	0.54	Highest
Patient can request for a consult with other medical personnel such as dietician, physical therapist, registered nurse, etc.	4.49	0.59	Highest
Each medical activity in the video clip is applicable.	4.17	0.78	High
Payment is by mobile banking, credit card and e-Wallet at your convenience.	4.52	0.59	Highest
The overview of a virtual polyclinic service system on a mobile application is easy and appropriate for our new way of life.	4.32	0.64	Highest
Outcome of Service System			
Patient receives appropriate consultation or treatment from specialist.	4.44	0.57	Highest
The physical examination by video call is linked with laboratory and imaging results for more accurate diagnosis.	4.20	0.73	High
The treatment outcome for common disease is good and satisfactory.	4.44	0.57	Highest
The follow up treatment can be undergone without visiting the hospital.	4.53	0.57	Highest
Quality of Service System			
Every medical personnel and healthcare operator provides services in compliance with professional standards and the Medical Act.	4.44	0.59	Highest
There is a reliable quality assessment system of services.	4.49	0.57	Highest
Save time from hospital visits.	4.65	0.53	Highest
Save cost compared to cost of receiving services in hospital.	4.39	0.69	Highest
Data Privacy			
Users are protected by password-based authentication.	4.42	0.64	Highest
Users are entitled to access their profile and service records.	4.47	0.61	Highest
Users have ownership over their consultation and treatment records.	4.49	0.60	Highest
Users are required to give consent before releasing their medical information from the system.	4.53	0.57	Highest
Responsiveness			
If users make a mistake command, they can cancel it themselves.	4.27	0.70	Highest
There is a Call Center service to support if any problem occurs.	4.55	0.55	Highest
There is a Chat service to support users.	4.50	0.57	Highest
The ambulance service is also available on the mobile application.	4.57	0.57	Highest

Social Security Office (SSO), Comptroller General's Department (CGD) and insurance companies were the key partnerships because they played an important role in medical coverage and the healthcare budget. A virtual polyclinic service system on a mobile application would operate continuously and successfully if it received good support from these third party players. Furthermore, higher frequency of application usage would mirror the patient's needs and magnify new ideas to the developer team to deliver more value add.

Development of virtual polyclinic service system

Developing a prototype application requires a large amount of development capital, as well as testing the system in order to be able to use it effectively. The researcher did not fully develop an application to provide a service system, but merely simulated a service business by showing the use of the system through a short film. For the above reasons, the service system analysis cannot study the outcome of the service. This meant that the researcher was only able to ask for opinions from the respondents in various fields related to the quality of

electronic services and the trend of providing such systems. A short film showed when and how to use the service of a Virtual Polyclinic Service System on a mobile application. It is a presentation of the main activity only. If content is developed for public relations in a business model, it could present a variety of stories to make the service interesting and followed on social media.

Evaluation of a virtual polyclinic service system on a mobile application

Initially, given the reason for developing a prototype for a real service, the study at this stage is only to find answers in terms of opinions on the quality of the electronic service system as well as the tendency of users towards the system. While the researchers conducted the study during the COVID-19 pandemic, respondents may express positive opinions about all aspects of the service system, unlike past studies that were shown not to favor telemedicine. The results of the actual implementation of the system may be a study for further business, which may involve a significant amount of

future education and development funds and, as a proprietary business concept, would not be published in a peer-reviewed journal. Furthermore, the quality of the electronic service system also depends on many factors such as the design of a secure system, appropriate business activities, trusted service provider as well as the internet network. These will affect the service results and the quality of service of the service system in the future.

Future research recommendations

The limitation of this research was the development of fully functional application because of the lack of budget and time constraints. The next study would be the development of a functional application for pilot testing and to resolve any technical and functional issues experienced by users.

Conclusion

According to the study on the opinions of the respondents, a Virtual Polyclinic on Mobile Application is an interesting

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