REMI: A Telemedicine System for Antenatal Care – Development and Feasibility Study

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***Abstract*—Telemedicine is gaining importance for remote healthcare delivery, with chatbots providing an automated way to interact with patients via text. This study examines the design and development of a hybrid clinical–AI chatbot, referred to as REMI (Robot for Expecting Mother's Information), a chatbot integrated with the LINE platform to support pregnant women in monitoring gestational weight gain (GWG) and promoting healthy lifestyles, while enabling healthcare providers to review data and offer personalized advice. Thai singleton pregnant women with pre-pregnancy BMI above 18.5 kg/m^2 self-recorded their weight gain through REMI; among 452 women enrolled in REMI, 245 also received routine antenatal care. A control group of 207 women received usual care at the hospital. Feasibility results indicate that although the proportions of normal and high BMI varied across groups, there were no significant differences in excessive weekly GWG between them. Most REMI users engaged frequently and adapted quickly to the system. These findings suggest that REMI can effectively support pregnant women between clinic visits, potentially reducing outpatient visits and assisting clinicians in patient education and monitoring.**

***Index Terms*—Telemedicine, Chatbot, Pregnancy, Antenatal Care, , Feasibility Study, Mhealth, Nutrition**

I. INTRODUCTION

Many countries continue to face challenges in providing accessible and high-quality healthcare to their populations, particularly in resource-limited contexts. Traditionally, in-person healthcare has been the standard, requiring patients and physicians to meet at healthcare facilities. However, such models can increase barriers for patients, exacerbate health inequities, and place unnecessary burdens on both individuals and the health system.

Recent years have seen increasing interest in leveraging telemedicine to supplement or partially replace non-emergent in-person visits, particularly for specialties in which physical examination or specialized equipment are not always required [15], [16]. In antenatal care, many routine appointments—especially those centered on patient education, follow-up, and counseling—are suitable for virtual delivery. Pregnant women typically attend scheduled visits throughout pregnancy, during which they receive advice, health education, and monitoring for healthy weight gain and other outcomes.

During pregnancy, there is plenty of essential information for pregnant women to digest. One of these are knowledge about healthy eating and proper weight gain during pregnancy because obesity is a worldwide public health problem, including for Thailand. According to the World Obesity Atlas 2025, approximately 17% of Thai adults are living with obesity, indicating a high prevalence by WHO standards and posing significant public health concerns, particularly among women of reproductive age. [18]. Previous studies reveal that pre-pregnancy BMI and inappropriate gestational weight gain (GWG) had adverse maternal and fetal outcomes, such as gestational hypertension, preeclampsia, diabetes, fetal macrosomia, and fetal growth [10]. A system for telemedicine in the antenatal care clinics is a promising technology for transferring information and monitoring GWG for pregnant women in a pandemic as well as in other situations, as some aspects of the care may be transferred online. This research considers contexts within which patients of antenatal care clinics reside in. It is possible that these patients are also seeking more than medical treatment. They may also be looking for a listening ear to ease their anxiety. Issues of concern can range from acceptable food types to searching for a psychosocial support for pregnant women. [1], [2]

As people spend more time on the internet, online communication channels have emerged as suitable technologies for telemedicine systems supporting pregnancy. Traditional phone-based communication is increasingly complemented by instant messaging platforms such as Facebook Messenger, LINE, and WhatsApp. Live chat, a form of synchronous communication, has also been widely adopted as an accessible service channel in healthcare (e.g. [3], [8]). However, live chat requires continuous human staffing to ensure timely responses, leading to scheduling and operational costs that can be challenging to sustain.

For this purpose, a new technology, Chatbots (Chatting Robots), has recently been introduced to alleviate the needs of manpower. This design remains relevant, as recent developments in digital health systems place greater emphasis on safety-aware AI, explainability, and interoperability with established clinical protocols. Moreover,the rapid acceleration of digital health adoption have highlighted the need for scalable telemedicine solutions that reduce reliance on continuous human staffing while maintaining effective patient–provider communication. Chatbot-based systems therefore present a practical approach for supporting maternal care, particularly in settings with limited healthcare resources.

The purpose of this study is to develop a mobile technology

using a chatbot software system called REMI, in order to support pregnant women for monitoring healthy lifestyle and their gestational weight gain.

II. BACKGROUND AND RELATED WORK

Chatbots can enable new customer experiences, where customers get their answers at their convenience instead of waiting for operating hours. During high volume request periods, chatbots can still respond to requests without needing to add more human resources. Chatbots have been explored in healthcare domains; for instance, in mental healthcare services [7], in primary care services [11], and for an obesity intervention [14].

Chatbots can be categorized in various ways depending on their interaction mechanisms and response strategies. In this study, we focus on chatbot types most relevant to healthcare applications, namely rule-based, AI-powered, generative AI (LLM)-based, and hybrid chatbots. Rule-based chatbots rely on predefined rules, keywords, and fixed responses, ensuring consistency and clinical reliability but offering limited flexibility. AI-powered chatbots extend this capability by applying natural language processing and machine learning techniques to infer user intent and handle previously unseen queries. More recently, generative AI and large language model (LLM)–based chatbots have demonstrated the ability to generate fluent and context-aware responses, showing promise in patient education and counseling. However, concerns regarding hallucinations, explainability, and deterministic clinical rule enforcement remain critical challenges in safety-sensitive medical contexts [5], [17]. Hybrid chatbots aim to address these limitations by combining deterministic rule-based clinical logic with AI-assisted conversational capabilities, balancing medical safety with conversational flexibility

This paper proposes the development of a Thai-language LINE chatbot, REMI (Robot for Expecting Mother's Information), which adopts a hybrid clinical–AI design to support antenatal care. The system assists soon-to-be parents by answering their questions and concerns during their pregnancy. The proposed chatbot provides an alternative channel for basic Q&As. Its knowledge base is developed based on information extracted from verifiable textbooks [12], [13], using a rule-based technique for responding to queries. While textbook-based answers provide medically reliable information, textbook phrases are normally formal and often fail to match with user's natural language queries. Therefore, we also employed natural language chat phrases to provide example queries that are more similar to the language of queries being asked by users. To supplement natural language queries with questions from a Thai language webboard to our chatbot database, we utilize Google's Dialogflow to train the data to build a chatbot that is able to answer with reliable data, as well as to understand and answer natural language queries.

The objectives of this work included, first, we aim to present a description of an antenatal chatbot development and second, we want to pilot this chatbot on pregnant women and report insight and results. The rest of the paper is organized as follows: In the next section, we present a method to develop a chatbot software system to support pregnant women in Thailand. Then, we present how REMI has been applied in a clinical setting while demonstrating the feasibility of applying chatbot technology into a telemedicine in antenatal care clinics in the result section. We conclude this paper with discussions about successes and limitations of applying a chatbot system for antenatal care visits, as well as looking into directions for future work.

III. SYSTEM DESIGN AND DEVELOPMENT

Our goal of developing a software system for supporting care of pregnant women was to apply a technology which is easy to use, non-intrusive, and able to support human aspects of care such as answering to patients' questions and worries. Mobile phone-based technologies, such as mobile applications or chats, have become easily accessible to people of different demographics and backgrounds, as mobile phones are increasingly ubiquitous.

Within the mobile phone technologies, LINE is among the most popular communication channels in Thailand, attracting 56 million users in 2025 (with more than 78% of the total population using the service) [6]. LINE is a chat application, installed on mobile phones, that allows text messaging as well as voice&video calls between two or more users. It is free to use. Most people living and working in Thailand already have a LINE account for communicating with their friends, families, and coworkers. Local businesses

A. System overview

We have developed REMI based on a hybrid clinical–AI design, with the accompanying software systems. REMI's main functions are to collect data of the patients' pregnancy and to answer to patients' questions. All pregnancy related data, which comprise weight, food intake, and vitamin intake, are recorded during pregnancy. They will be processed and analyzed and presented on a web-based portal for healthcare professionals. Figure 1 shows an overview of the system.

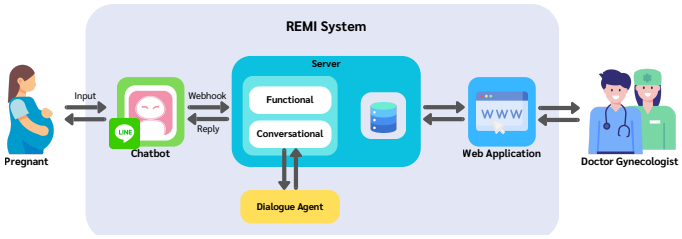

Fig. 1. An overview of the software system for REMI and related components.

B. LINE Chatbot Development for Patients

Our system supports 2 types of users: patients and physicians. For a patient-facing interface, we developed a chatbot on the LINE application. The chatbot is an automated program whose main objective is to converse with human users. We

developed an autoresponder into the chatbot for its ability to chat with patients.

Figure 2 shows example screenshots of the REMI chatbot. The first screenshot shows a conversation designed to collect user's profile, which happens when a user signs up to use the chatbot. The second screenshot shows a summary of the user profile after the user responds to all the questions. Then, the system will evaluate the user's pregnancy status, and gives the user recommendations in the third screenshot. Text was translated from Thai to English for an illustration purpose.

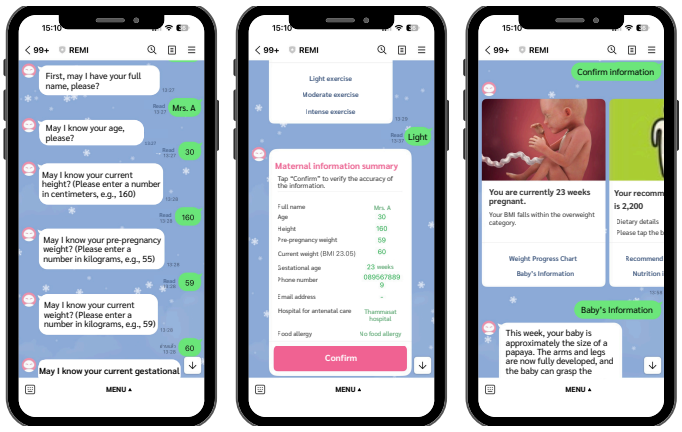

Fig. 2. Screenshots showing user interface of the REMI chatbot (text translated from Thai to English for an illustration purpose).

The REMI system development is further divided into two main parts: functional and conversational components. The functional component supports conversations whose interactions are designed, while the conversational component supports more free-style conversations. The development of chatbot's functional component exploited the PHP Laravel Framework [9] to collect antenatal health data from users. However, the functional component relies on rule generations of predefined interactions, which cannot cover all possible questions and answers between users and the chatbot. Therefore, we developed the conversational component by using Natural Language Processing (NLP) with Google Dialogflow as an automatic response mechanism. The conversational component will improve the question-and-answer interaction between the chatbot and users, as it makes the chatbot better understand the human language. In the following subsections, we discuss the developments of both functional and conversational components in detail.

1) Functional Component: The functional component of the REMI chatbot is developed to collect data from patients in the form of textual conversations. It also performs other functions whose rules and methods are quantifiable, such as weight gain calculation. The functional component focuses on the required functions and data workflow. At this stage, the system does not attempt to understand natural language used in interactions between users and the chatbot. Natural language processing capabilities are instead handled by the conversational component. This section describes the functions of the functional component. Upon initial use, users are required to add the chatbot as a LINE friend. The system then guides users through a sequence of predefined questions. There are a total of 11 initial questions regarding the following data: 1) name, 2) age, 3) height, 4) pre-pregnancy weight, 5) current weight, 6) gestational age, 7) phone number, 8) email address, 9) antenatal care hospital, 10) exercise level, and 11) food allergy history.

The following list outlines the main functions of the REMI's functional component.

- **Weight data collection**
  REMI collects weight data from users every week, all weight data will be calculated into Gestational Weight Gain (GWG) and provide personalized care recommendations. Recommended Weight Gain (RWG) can be calculated, and the threshold will be graphically displayed in the chatbot. The personal weight graph allows users to see weekly weight changes. Other information, such as ideal
- **Food and vitamin intake recording**
  Each week, the chatbot asks users to record their meals, prenatal vitamin intake, and exercise.
- **Food and exercise recommendations for pregnancy**
  REMI provides education on food nutrition, by presenting recommended meals from dietitians and recommending exercise during pregnancy.
- **Pregnancy progress tracking**
  REMI can remind users to record their weight, food, vitamin, and exercise data. the system sends out 2 notifications on Sundays: asking for weights in the morning at 9 a.m. and asking for food and vitamin intake as well as exercise in the evening at 6 p.m. Data collection will be in a question format, seeking answers.

For example, "You're 12 weeks pregnant this week, how much weight did you gain this week?" "What did you eat this week?". Users respond by typing their answers into the chatbot and can track their pregnancy progress using the following information tools: 1) a weight chart showing each week's weight recordings, 2) a simulated picture and appearance of the fetus according to the gestational age, and 3) an optimal body weight and a weight gain rate. The last tool helps inform the users whether they were underweight, overweight, or within appropriate weight range in the previous week, which can be an important personalized factor in the patients' behavioral change towards more suitable nutritional habits. The development of REMI's functional component exploited a rule-based questioning and answering mechanism, allowing automated responses between the chatbot and users. By setting conditions or creating rules on the desired topics, we can perform many functions as designed. Rule-based conversations for data collection are constructed to cover both the breadth and depth of our antenatal care requirements.

2) Conversational Component : The conversational component is developed to handle natural conversations between users and the chatbot. While the main functions are managed by the rule-based functional component, free-flow conversa-

tions still need support. This led to the development of a Question-and-Answer Database, which includes text excerpts from maternity health textbooks.

We extracted information from books in the Knowledge Materials Project for Pregnant Women written by an obstetrician/gynecologist. Text excerpts include passages on topics and questions like:

- Why do we need antenatal care and what to do?
- How is my fetus developing?
- How should I behave while pregnant?
- Assorted pregnancy problems

The database's source of information also contains an advice handbook on nutrition and exercise, a handbook on targeting optimal weights for pregnant women through nutrition, a book of 20 questions and answers for breastfeeding and questions related to emotional and stressful pregnancy.

We extracted information from the above sources, and dissected text excerpts into the following categories: nutrition, food, fetus, arising issues, pregnancy symptoms, ultrasound examination, and preparation for delivery. Text from health textbooks with information related to pregnancy and other additional topics, such as stress, allows us to prepare accurate answers for users' potential questions.

For the conversational component, REMI uses Google Dialogflow, integrating machine learning (ML) and natural language processing (NLP) to interpret user inputs and generate natural responses. Natural Language Processing (NLP) enables flexibility in user inputs and supports the chatbot's understanding of user intentions. In Dialogflow, these intentions are represented as Intents, which are trained with example inputs and linked to predefined responses, allowing the system to generate context-appropriate replies. Dialogflow employs Artificial Intelligence (AI) to facilitate the analysis of user–chatbot interactions through processes such as spelling correction, word segmentation, word classification, part-of-speech (POS) tagging, and entity recognition. The platform performs intent classification to associate user inputs with predefined intents and subsequently generates appropriate responses. In cases of misclassification, the model can be enhanced by retraining with recent conversational data, such as REMI's chat history.

C. Web-based Physician Portal

For the physician-facing interface, we developed a web application for physicians to track their patients' pregnancy progress. This web application utilized the PHP Laravel Framework. Our web application is regarded as a portal for physicians as it presents their patients' data that were collected from REMI and analyzed by the system's server.

Figure 3 shows a screenshot of web-based physician portal. The portal shows a listing of all patients who are currently under care of the physician, together with the patients' status. The dashboard also contains weight graphs, weight signs, as well as pregnancy complications of an individual patient. Individual weight signs are shown in color. A weight sign in red indicates complications. A weight sign in orange indicates an excessive weight gain status. A weight sign in yellow

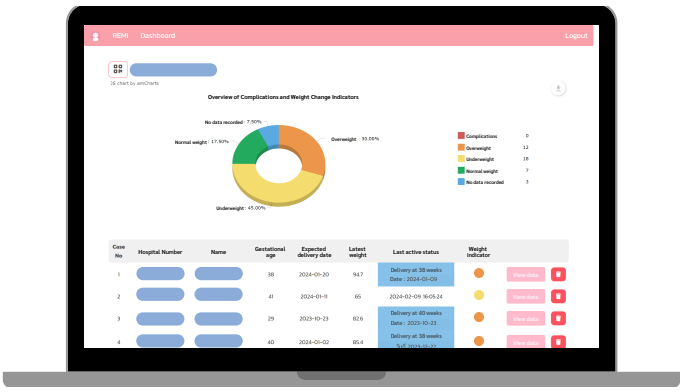

Fig. 3. A screenshot of web-based physician portal (text translated from Thai to English for an illustration purpose).

indicates an underweight gain status. A weight sign in green indicates a normal weight gain. And a weight sign in blue denotes no records of weights. Weight signs can be determined by calculating weekly weight gains, which are the differences between the pre-pregnancy weights and the current weights of each gestational week. Physicians can see charts of individual patients with their weight information. The physicians can also view food intakes, vitamin and exercise logs of their patients. The conversation history between the patients and REMI are also available for viewing. Upon knowing their patients' current problems, physicians may send a chat message to patients, either individually or collectively, to talk and alleviate their concerns by educating about the issues at hand.

IV. FEASIBILITY STUDY

A. Study Setup

Our development methods of chatbot and its accompanying web-based portal were implemented during the period between May 2020 and December 2020. Following a receipt of an IRB approval from the Thammasat University Institute Review Board in 2019 (reference to IRB number MTU-EC-OB- 2-079/61), the project received the first batch of patients in May 2020. Thai singleton pregnant women with pre-pregnancy BMI above $18.5 kg/m^2$ were enrolled to register in the chatbot program. The overall criteria emphasized that all participants were gestational age of less than 14 weeks. This section presents details of the cohort of patients, illustrations of actual questions and answers conversed between patients and REMI, an evaluation of thechatb ot response, and characteristics of user study cohort categorized by weight groups and gestational weight gains.

B. Results: Characteristics of the patient cohort group

The development of the proposed system has resulted in an observational cohort study of 452 patients. The study was undergone at Thammasat University Hospital, Thailand. Patients registered with REMI of total 245 participants are comprised of 2 groups. The first group are the patients who are under a specific physician's antenatal care and recruited through the outpatient clinic. The second group of patients

Fig. 4. Screenshots showing user interface of the REMI chatbot (text translated from Thai to English for an illustration purpose).

receive a QR code to add REMI as a friend from other sources, such as from a TU Hospital's public relations event. The control group of total 207 participants are the pregnant women from usual antenatal care. Table I below summarizes maternal basic demographics data.

The system was used in a field experiment to collect data of pregnant women which is divided into two user groups: physician-supervised users and general users. From the data collected between May 25, 2020, and December 25, 2020, there were a total of 452 users. Within the REMI chatbot group, there were a total of 245 patients. We have classified the level of weight gain per week as follows. The patients were divided into 2 groups. The patients with normal BMI and overweight groups were within their recommended weight gain for 56 people (40.29%) and had their weight gain exceeded for 83 people (59.71%). The patients on obesity and marked obesity were within their rerecommended weight gain for 15 people (14.15%) and had their weight gain exceeded for 91 people (85.85%).

Within the usual care group, there were a total of 207 patients. The patients with normal BMI and overweight groups were within their recommended weight gain for 39 people (49.37%) and had their weight gain exceeded for 40 people (50.63%). The patients on obesity and marked obesity were within their rerecommended weight gain for 30 people (23.44%) and had their weight gain exceeded for 98 people (76.56%). Table II summarizes the comparison of GWG within the cohort.

TABLE I
Maternal characteristics of REMI Chatbot and Usual care group.

Characteristics	REMI Chatbot , n (%) (n=245)	Usual care , n (%) (n=207)	P-value
Age in years, mean (SD)	31.3 (5.9)	31.2 (6.0)	0.84
Pre-pregnancy BMI in kg/m^2, mean (SD)	24.6 (5.1)	27.3 (4.1)	< 0.001
GWG[a]/week in kg, mean	0.6	0.5	0.002
BMI in kg/m^2, mean (SD)			< 0.001
Normal 18.5 - 22.9	93 (37.96)	2 (0.97)	
Overweight 23 - 24.9	46 (18.78)	77 (37.20)	
Obesity 25-29.9	70 (28.57)	82 (39.61)	
Marked obesity more than 30	36 (14.69)	46 (22.22)	

[a]GWG: gestational weight gain

TABLE II
Comparing GWG between pregnant women with REMI Chatbot and Usual care group.

BMI Groups	REMI chatbot (n=245) (%)	Usual care (n=207) (%)	P-value[c]
Normal BMI and overweight group	56 (40.29) 83 (59.71)	39 (49.37) 40 (50.63)	0.204
Obesity and marked obesity	15 (14.15) 91 (85.85)	30 (23.44) 98 (76.56)	0.095

[a]RWG: recommended weight gain
[b]EWG: excessive weight gain
[c]$p < 0.05$ is significant

V. DISCUSSION

A. Principal Findings

As a trend for mobile health applications is ongoing currently, there is little evidence on the effectiveness of current applications on monitoring and encouraging behavioral change for improving health related outcomes, especially in pregnant women

In this study, we designed and developed a chatbot for pregnant women. The objectives of this study are focused on two points. First, we aim to present a description of an antenatal chatbot development. Second, we communicate insights gained from piloting this chatbot on real users. We showed in the result section the general statistics of our study user cohorts categorized by weight groups and gestational weight gains. We focus on the integrated concepts between using chatbot technology and patient self-monitoring model. We used the LINE platform because of the technology's favorability in Thailand and its ease of use.

From our data, it showed that pregnant women were concerned and interested to join using the chatbot program as there were a considerable number of self-enrollments into the program. They had an intention to monitor their weight gain and to explore knowledge about healthy food such as milk and taking vitamins during pregnancy as shown in Table 2.

However, for effectiveness of the chatbot for weight management in terms of monitoring for proper GWG, our data revealed that participants in the chatbot program have a number of excessive GWG with no significant difference from that of our usual care, especially in the obesity group.

A previous study showed the impact of technology-based system compared with in-person behavioral weight loss management demonstrated no significant difference in terms of physical activity record but a significant difference in terms of weight loss in group that combined between in-person behavioral control and technology- based systems. The technology-based system group who used technology with monthly calls did not change in physical activity or get greater weight loss than in-person behavioral control group. They concluded that using technology may produce an additional effect on weight

control when combined with in-person behavioral [4].

For the effectiveness of mobile technology for weight management, we should be concerned that the program is designed for whom and set the questions to provide information to participants. The program should be user friendly in a way that encourages and promotes participants to change their behavior of eating and provide informative education on healthy habits. The point of maintaining proper weight gain were more likely to adhere to a healthy eating pattern and usually monitor their weight

B. Chatbot Development for Antenatal Care

REMI, a chatbot for keeping track of weight and making natural conversation with pregnant women, was successfully developed on the LINE platform. the system was designed based on a hybrid clinical–AI design, integrating both functional and conversational components. The functional component serves antenatal care routine data collection, such as weight, food and vitamin intake, as well as food and exercise recommendation. The conversational component supplies answers to patients' arising questions. We intentionally employed a mix of techniques: rule-based functions with a predefined set of questions and answers and applied Google's Dialogflow to handle human language and users' intents. The final system was completed with a physician-facing web portal to allow physicians to track patients' pregnancy progress, and to further take actions if needed. the chatbot can also be viewed as a foundational hybrid framework that is compatible with future integration of LLM-based components under strict clinical governance, as well as the incorporation of other machine learning technologies to further enhance its capabilities.

VI. CONCLUSIONS

The purpose of this paper was to investigate the design and development of the REMI chatbot, which is a software system to support pregnant women for monitoring GWG and health lifestyle during pregnancy. The system is a telemedicine, which provides assistance for monitoring different measures of health during pregnancy, provides personalized recommendations as the pregnancy progresses, responds to conversation and questions from users with pre-approved knowledge, and allows physicians to monitor their health and intervene as necessary. Four hundred and fifty-two pregnant women were registered in the chatbot program. Two hundred forty-five pregnant women were registered and received antenatal care in Thammasat University Hospital. Preliminary findings indicate that the proposed system is appropriate for the use case of telemedicine for antenatal care visits. Future work will be done to promote the use of REMI to more user groups and be extended to out-of-town patients and hospitals.

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CONFLICTS OF INTEREST

We declare no conflict of interest.

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