Doctoral Dissertation

Development and Evaluation of the Child Vaccination Chatbot Based on a Real-time Consultation Messenger Service

소아 예방접종 질의응답 챗봇 개발 및 평가

August 2020

Seoul National University
Graduate School of Nursing
Yeong Joo Hong

Development and Evaluation of the Child Vaccination Chatbot Based on a Real-time Consultation Messenger Service

지도교수 김 정 은

이 논문을 간호학박사 학위논문으로 제출함

2020년 4월

서울대학교 대학원
간호학과 간호학 전공
홍 영 주

홍영주의 간호학박사 학위논문을 인준함

2020년 6월

위 원 장	채 선 미	(인)
부 위 원 장	박 연 환	(인)
위 원	공 현 중	(인)
위 원	이 제 호	(인)
위 원	金 고 은	(인)

Abstract

The decrease in children's vaccination rates resulted in outbreaks of vaccine-preventable diseases. The child vaccination chatbot developed in this study can be used as a tool to promote immunization through the provision of reminders and real-time consultation messenger service. The aim of this study was to develop and evaluate a child vaccination chatbot based on the information-motivation-behavioral skills(IMB) model and to evaluate the effectiveness of the chatbot. Based on the IMB model, a real-time consultation messenger service chatbot was developed to provide answers to questions about children's vaccinations. The chatbot was used by the participants of this study to evaluate its effects based on changes in the measurements of vaccination information, motivation, self-efficacy, and vaccination behavioral intention variables. This study is divided into two parts the development and evaluation of the chatbot. The developed child vaccination chatbot went through the stages of evaluation in accordance with the software development life cycle. Then, the developed chatbot was used by the participants in this study. The participants of this study were parents who were raising children from 0 to 35 months old and those whose children expected to be vaccinated within three months. The experimental group included 34 participants, and the control group had 31 participants. The ages of children were similar in both groups. During the 12 weeks of the

research, the participants were provided with vaccination schedule reminder alarms, a real-time consultation messenger service, information about vaccinations and motivation boosters. Also, vaccination information, motivation, self-efficacy, and vaccination behavioral intention variables were measured every four weeks.
The experimental group that used the chatbot scored higher for vaccinaion information, motivation, self-efficacy, and vaccination behavioral intention than the control group. Based on the results, it is assumed that the child vaccination chatbot provided useful and prompt information to parents raising children who needed to be vaccinated. The child vaccination chatbot increased vaccination motivation, self-efficacy, and vaccination rates by providing necessary information to parents.

Keywords: Child, Vaccination, Text Messaging, Remote Consultation, Real Time, Chatbot
Student Number: 2017-33887

Table of Contents

List of Tables

List of Figures

Ⅰ. Introduction

1. Background

Child vaccination is a means of promoting health that significantly affects the prevention of infectious diseases and the development of infants and toddlers. The World Health Organization's Strategic Advisory Group of Experts on Immunization recommends separate management of individual vaccination records (World Health Organization, 2017). Since the 1990s, developed countries have registered and managed vaccination records online. The Korean government registered its vaccination records and managed them online since the year 2000 based on the 1983. Act on Registration of Vaccination can be confirmed in article 21 of the Infectious Diseases Prevention Act (Cho, 2008).

According to the "2018 Children's Regular Vaccination Rate" released in 2019, 96.8% of children were vaccinated by the 12 months of age. However, there was a decrease in vaccination rates as children grew older, with 94.7% for the children 24 months old and 88.3% for the children 72 months old (KCDC, 2019). The factors affecting the reduction in vaccination rates include various social demographic factors (Park et al., 2013), as well as parental factors. Parents' health beliefs have a direct impact on their children's vaccination since children are not able to determine their health behavior during their

developmental stages. Therefore, it is crucial to provide timely vaccination-related information to parents so that injections can be carried out on schedule and to prevent missing vaccinations (Bang et al., 2012).

With the recent proliferation of smartphones, 70% of the world's population is expected to use them by 2020. At least 50% of smartphone users are expected to use mobile-based health applications (Cisco Visual Networking Index, 2016). Health information provided in mobile form has a significant impact on changes in people's health behaviors (Zhao J et al., 2016). A study of media channels through which parents obtain parenting information found that 59% used personal media, followed by acquaintances (20%), institutions (16.4%), and mass media (4.6%) (Min et al., 2014).

Parents raising children are using analog-style vaccination "Child Vaccination Notebooks" for information on child vaccination records. In other words, vaccination-related information provided to parents raising children is still being provided unilaterally by health centers, hospitals, and clinics. Most parents obtain vaccination information from similar channels. Although technologies are being developed that can conveniently implement health care via mobile devices, beyond web-based media, forms that use IoT and other new technology to exchange information in real-time are not available. The disadvantages of traditional methods may include inaccurate records, loss of vaccination notebooks, and moving away, which may lead to missed vaccinations (Nam et al., 2017; Korea Centers for Disease Control and

Prevention press release, 2011). Also, even if you use health applications on a smartphone, the level of use may be low due to dissatisfaction with what the program provides or inconvenience in the registration and installation process (Wang et al., 2011).

Given this, a new type of vaccination management may be necessary. A chatbot might be one way to supplement the existing method. The advantage of a chatbot is that it can mutually communicate vaccination-related knowledge in real-time. In particular, the application of mutual communication techniques concerning child vaccination may have a positive effect on vaccination decision making (Heiss, Carmack, & Chadwick, 2015; Humiston & Rosenthal, 2005). Hence, this study presents a chatbot, which allows questions and answers in real time. Unlike typical applications, chatbots do not require a complicated installation process. It can conveniently provide vaccination-related knowledge in a daily conversation style. It also has the advantage of providing users with easy access and allowing them to exchange accurate information consistently in real-time (National Information Society Agency, 2018).

However, despite the importance of vaccination management for children, research on vaccination has been limited to studies on vaccination awareness and satisfaction, and on its status and related factors (Kim, 2008; Ko, 2012; Park, 2010; Lee & Yang, 2017). Few studies have been conducted using chatbots. While research on and applications of chatbots has been carried out in various areas of society, its adoption in health-related fields is still in its infancy.

Parents tend to search for parenting information through multiple media. They also share and trust the experience of parents raising children similar to their children's age (Lazarsfeld Paul, Berelson, & Gaudet, 1944). There is the potential to increase the communicability of education if parents use technical means such as chatbots in child-rearing (Wong-Villacres et al., 2019). Hence, providing vaccination information through a chatbot could serve as social motivation for parents raising children of similar ages. Furthermore, breaking away from the existing method and providing real-time data via a chatbot customized to children's developmental stages could contribute to the successful implementation of child vaccination by giving parents convenience without time and space constraints. Acquiring vaccination information based on a chatbot is expected to contribute to higher vaccination rates because relevant information will be provided more effectively than the ways that have been available so far.

Based on the theory that information, motivation, and behavioral skills related to one's health behavior are a crucial factor in the performance of health activities, this study seeks to develop a child vaccination guidance chatbot, evaluate its effectiveness, and ultimately induce changes in users' behaviors through the implementation of vaccination. This study uses the chatbot that has not been previously applied in the vaccination field and applies a new method to vaccination information communication. Thus, it is expected that the groups using the chatbot will have better access to information than

those that do not, and that obtaining information through the chatbot will be useful.

2. Purpose

The purposes of this study are as follows:

1) To develop the Real-time consultation messenger service chatbot for vaccination questions and answers, information-motivation-behavioral skills(IMB) model was used.

2) To allow parents to apply the developed chatbot, and evaluate the effect on the score changes for vaccination information, motivation, self-efficacy, and vaccination behavioral intention.

3. Definition of Terminology

1) Chatbot's for child vaccination

Brennan (2006) defined a chatbot as "an artificial structure designed to communicate with humans using natural language." According to Lee and Jo (2003), "Chatbot is an interactive agent that means artificial intelligence-based communication software, which allows users to communicate with each other and receive the necessary information."

In this study, a chatbot is a system that accurately and consistently provides customized information based on children's ages in the form of text message answers to questions asked by parents with children subject to vaccination in the course of the implementation of vaccination schedule.

2) Vaccination information

Information refers to the factors directly related to the performance of health behaviors; and in the IMB model, information refers to the causes, symptoms and the degree of knowledge of the disease or health promotion activities (Fisher, J. D., & Fisher, W. A., 1992).

In this study, based on the results of the Literature Review and existing questions and answers (Q&A) analysis, scores were measured by means of the survey tools developed by the researchers based on

the information officially provided by the Korea Centers for Disease Control and Prevention.

In addition, a tool for measuring knowledge was corrected and supplemented with a total of 12 questions in terms of hepatitis A vaccination, inoculation timing and method, vaccination effect, and immunity maintenance period, as used in Park's (2010) article.

3) Vaccination motivation

In the IMB model, motivation refers to the belief and attitude of the outcome that an individual expects by performing health actions (Choi & Song, 2010). In this study, six individual motivation questions related to the vaccination against pertussis developed by Kim (2008) were modified and supplemented to match the study's purpose.

4) Vaccination self-efficacy

Self-efficacy means the perceived degree of confidence that an individual needs to successfully achieve a particular outcome of action (Bandura,1995). In this study, it refers to the score measured by a tool modified by Lee and Yang (2017) by referring to Ko's (2012) tool.

5) Vaccination behavioral intention

A prevention behavioral intention is an act taken by a person who believes to be healthy to detect or prevent a disease early before the symptoms appear for the purpose of preventing the disease (Ajzen, 1991).

The degree of a vaccination behavioral intention in this study refers to the individual's intention to voluntarily implement the practice of vaccination behavior for children. Based on the measurement items used in the preceding studies (Yoo et al., 2010; Han, 2011), the preventive action was measured based on the seven questions that were modified and supplemented the vaccination intention.

Ⅱ. Literature Review

In this study, the development and evaluation of the child vaccination chatbot based on a real-time consultation messenger service was conducted to provide accurate answers to the questions asked by parents who need child vaccination. This chapter, reviews existing research on off-line, online, and mobile-based child vaccination methods; the app and SNS functions applied to vaccination information; the concept of the question-and-answer system; and the chatbot technology. Also, the IMB theory conceptualizes behavior-related factors to maintain a self-management behavior.

1. Child's Vaccination Management

The National Immunization Program(NIP) is a Korean government funded project to provide free vaccinations in health centers and clinics to prevent infectious diseases. Currently, 17 types of vaccinations are provided free of charge (CDC, 2019). In Korea, vaccination certificates have been issued since the year 2000, but the revision of the School Health Act has increased the need for efficient management of persona lized vaccination schedules (Lee et al., 2009). After vaccination, a certificate is issued. However, in the private sector, vaccination reports and records are sometimes omitted (Kim et al., 2010).

Currently, vaccination-related information provided to parents

adheres to the off-line hand-written method, which is managed and provided unilaterally by individual health centers, hospitals, and clinics. This approach may result in missing vaccination schedules due to inaccurate records, loss of vaccination notebooks due to moving houses, etc. (Nam et al., 2017; Korea Centers for Disease Control and Prevention press releases, 2011).

As we live in the information era, the way parents can receive child vaccination information has evolved to a website that substitutes the Baby's notebook. However, parents can access the website only after undergoing complicated certification procedures. Moreover, the web-based method has time and space limitations for accessing information on child's vaccination (Kim et al., 2010).

Parents of the mobile generation prefer accessing vaccination information without time and space limitations (Kwon et al., 2010). Parents who are raising a child prefer to exchange information in real time using new technologies such as smartphones and IoT devices rather than using the existing analog-based "Child Vaccination Notebook."

Beyond the web-based information delivery method, a mobile application has been used since nine years ago. However, even a smartphone-based health application may have low levels of use due to unsatisfactory content or inconveniences during the subscription and installation process (Wang et al., 2011). A chatbot, on the other hand, has the advantage of not having a separate subscription procedure but also providing information as a private conversation on a 1:1 basis,

allowing knowledge to be transmitted in both directions in real time (Park, 2018). The characteristics of the existing methods of child vaccination management are as shown in Table 1.

Table 1. Conventional methods of children's vaccination records management

Conventional Information Delivery Method	Problems
Child Vaccination Notebook	Reduced reliability due to missing the child vaccination schedules (ex.: Errors in handwriting and losing the child immunization notebook)
KCDC website	Time and space restrictions on accessing the CDC website bulletin board and FAQ Takes time searching for the accurate information
Online (ex.: Moms' cafes)	Inaccurate information leading to distrust inchild vaccination Confusion due to inaccurate information

Note. KCDC = Korea Centers for Disease Control & Prevention

2. Providing Child's Vaccination Information Intervention and Vaccination Implementation

Child vaccination is an important and effective way to reduce disease and death in children. Vaccination is administered in all countries around the world and serves to save two to three million lives each year (WHO, 2016). In addition to reducing early mortality,

vaccinations are cost-effective and reduce health care costs (Ozawa, Mirelman, Stack, Walker, & Levine, 2012; WHO, 2018). Despite these advantages, however, many parents have overlooked the importance of vaccination or reduced the rate of vaccination due to reluctance to vac cinate their children because of concerns or doubts about vaccine safety and efficacy (Kaufman et al., 2018).

Ensuring that people have information and knowledge about their health is a key part of the United Nations's patient-centered care and human rights framework (Dwamena et al., 2012; Hill & Draper, 2011; Rodrigues-Osorio & Dominguez-Cherit, 2008; UN, 2008). The importance of providing adequate information abouti implementing child vaccinations can also be confirmed through previous research. Kauffman et al. (2018) believe that passing on information about child vaccinations to parents can improve parental awareness of vaccinations and improve vaccination rates.

Seven studies by Kaufman et al. (2018) with 3,004 participants showed that providing child immunization-related information or educational intervention for parents can be effective in improving vaccination performance. These documents confirm that provision of vaccination information to parents is an important factor in vaccination implementation of.

3. Chatbot

A chatbot is an artificial structure designed to communicate with humans using natural language (Brennan, 2006). The concept of a robot that communicates is used as a combination of *chat*—chatting, and *bot*—robot. A chatbot is an interactive agent (embodied conversational agent) that allows users to communicate information through a dialogue which combines big data with deep learning technologies to enable users to interact with it (Bicomore, Caruso, Clough-Gorr, & Heren, 2005). Text-based tools are applied in health care with a positive effect (Goldenhal, Portney, Stepe, Ghani, & Elimoottil, 2019). The use of a chatbot in the health sector could potentially increase access to health care and help manage the growing demand for health services (Hoermann, McCabe, Milne, & Calvo, 2017).

Unlike traditional applications, a chatbot allows users to quickly and accurately obtain information by communicating daily without requiring users to install software separately or figure out how to use it (Jo et al., 2017). A chatbot can be implemented on a variety of platforms, but basically chatbot interaction consists of an 'Intent' which stands for question's intention and 'Entity' and 'Context', which are used to provide a specific context for the question's intention (Park, 2018).

When building a chatbot, it is very important to determine which messenger platform to link to. Considering a global market share of social networking service (SNS) messaging platforms, Facebook and WhatsUp are in the lead. However, considering the platforms used by

most parents who raise their children in Korea, Kakao Plus Friend, which accounts for 94.4% of the domestic mobile messenger market share is the most widely used SNS platform (Kim, 2018). Kakao Plus's smart chatting service is largely divided into the frequently asked questions (FAQ) type and application programming interface (API) type. The FAQ type is a simple button-type bot that guides you by specifying a menu that can send a designated message according to your choice. On the other hand, the API type can be designed for questions through a separate development, and an automatic response service can be implemented through a registration process.

People access medical information online and find answers to their questions. Although related information can be obtained by entering questions and keywords in a search box, people tend to seek medical information from a publicly trusted organization. In Nadarzynski's et al. (2019) study, people tended to use a chatbot for minor health problems. Considering these points, health-related organizations that are trusted by the general public provide repeated trivial vaccination related answers in the form of Q&A. The Q&A system is similar to the FAQ type, but it is different in that it can provide information in real time by understanding the user's question intentions and presenting appropriate answers (Wang, Kraut, & Levine, 2015). The existing methods and characteristics of a chatbot intervention are shown in Table 2.

Table 2. Comparing methods of information provision by conventional documentation, websites and chatbots

	Conventional documentation methods	Websites	Chatbots
Information update speed	Slow	Real time	Real time
Providing information related to the context	No	No	Yes
Interaction	One-way interaction	One-way interaction	Two-way interaction providing customized information
Time-space constraints	Time-space constraints	Time-space constraint (sometimes)	Mobile based ubiquitous

4. Information-Motivation-Behavioral skills model

Based on the information-motivation-behavioral skills(IMB) theory, the study looked at changes in the knowledge of vaccination information, vaccination behavior motivation, self-efficacy and vaccination behavior skills of parents who raise children 0 to 35 months old. A chatbot was developed by using a social networking service(SNS) platform to evaluate its effectiveness so that information, motivation, and self-efficacy could affect each other and ultimately increase the vaccination intention.

According to the information-motivation-behavioral skills(IMB) model developed by Fisher et al. (2009), providing appropriate health behavior information results in increased motivation and improved self-efficacy, ultimately leading to changes in health behaviors. The IMB theory has conceptualized action-related elements to maintain self-care behaviors as information-motivation-behavioral skills (Fisher, J. D., & Fisher, W. A., 1992; Fisher, J. D., Fisher, W. A., & Shuper, 2009).

1) Information

Information means a elements directly related to the performance of health behaviors. In the IMB model, information refers to the degree of knowledge about the disease's cause and symptoms, and health promotion activities (Fisher, J. D., & Fisher, W. A., 1992).

2) Motivation

In the IMB model, motivation refers to beliefs about and attitudes to the outcomes that an individual expects by performing health activities (Choi & Song, 2010). Motivation, along with information, has a major impact on health behaviors.

3) Behavioral skills

In behavioral skills, information and motivation affect behavioral skills that indicate self-efficacy in the health performance and, ultimately, affect the promotion of health behaviors (Rye, 1998). In the IMB model, a health behavior refers to actions that promote or impair the current health condition (Fisher, W. A., Fisher, J. D., & Harman, 2003). Figure 1 presents the IMB model.

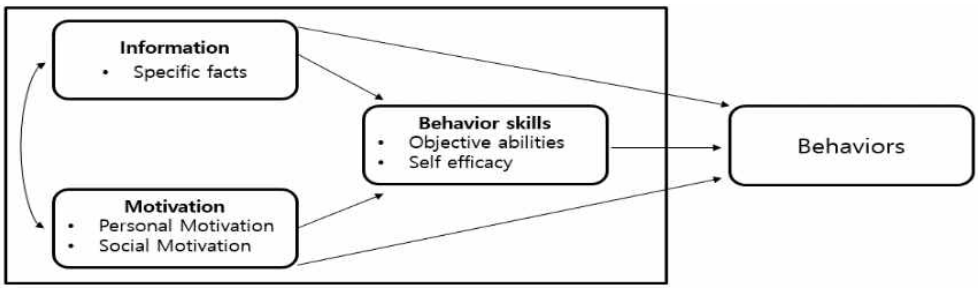


Figure 1. Information-Motivation-Behavioral skills model (Fisher, J. D., Amico, Fisher, W. A., & Harman, 2008)

First, the IMB model was applied to reduce the infection rate of the human immunodeficiency virus(HIV) (Cha, 2004; Carey & Kossmann, 1997; Fisher, J.D., & Fisher, W. A., 1992). Also, prior studies have demonstrated that preventive information, motivation and preventive action techniques in the IMB model are the determinants necessary for HIV prevention (Cha, 2004; Carey & Kossmann, 1997; Fisher, J.D., & Fisher, W. A., 1992).

In addition, the model is used in various health-related research such as "Development and Effectiveness Evaluation of Diabetes Self-management Mobile Application Based on the IMB Model" (Jeon, 2017), and "Parental Information, Motivation, and Behavioral Skills Correlate with Child Sweetened Beverage Consumption" (Goodell et al., 2012).

5. Turing test

In order to prove that the developed chatbot could perform a vaccination-related question-and-answer function, the Turing test was conducted at the end of the study. As the Turing test describes the criteria for intelligence in computing machinery and intelligence, it has been cited in numerous AI-related studies.

Turing (1950) proposed a criterion－the imitation game－to determine if a machine could demonstrate intelligent behavior. Turing's key question for conducting the test through the imitation game was if a machine could think. To answer this question, the concept of imitative play was presented. Looking specifically at the experiment that Turing

conducted, the experiment assumed that there were three participants: a man, a woman, and a questioner. They were isolated in different rooms, and to the questioner, the man and woman were known only as X and Y respectively. The questioner had to guess their gender by asking X and Y several questions. Turing assigned a computer the ma le role in the game, allowing the computer to imitate the man's language (Turing, 1950).

Ultimately, the computer's aim was to trick the questioner to believe it was a human being. The goal of the questioner was to distinguish who was a human and who was a machine. Turing argued that if the machine could fool the questioner, it should be considered intelligent (Turing, 1950).

The Turing test has been used as a key theory in the field of artificial intelligence until today.

Ⅲ. Theoretical Framework

1. Conceptual Framework

Based on the IMB model proposed by Fisher (2008), the theoretical framework used in this study consists of four elements: vaccination information, vaccination motivation, vaccination self-efficacy and vaccination behavioral intention. In the theoretical framework, vaccination information and motivation are correlated with each other and affect self-efficacy. Eventually vaccination information, motivation, self-efficacy affect the vaccination behavior intention. Figure 2 presents the conceptual framework.

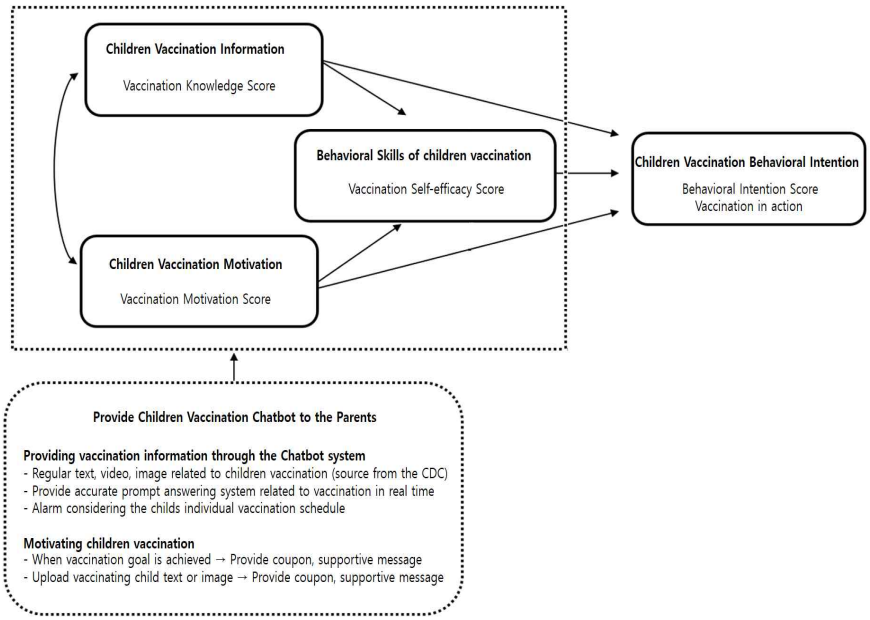


Figure 2. Conceptual Framework

2. Hypotheses

The research hypotheses are set based on the research model.

Hypothesis 1: There will be a difference in the child's vaccination information scores between the experimental and control groups.

Hypothesis 2: There will be a difference in the child's vaccination motivation scores between the experimental and control groups.

Hypothesis 3: There will be a difference in the child's vaccination self-efficacy(behavioral skills) scores between the experimental and control groups.

Hypothesis 4: There will be a difference in the child's vaccination behavioral intention scores between the experimental and control groups.

Ⅳ. Methodology

In this study, the development and evaluation of a chatbot, which provides answers to the questions that parents ask when implementing their child vaccination schedule, was conducted according to the system development life cycle. Subsequently, the developed chatbot was applied in the user environment. Its evaliation included two stages to assess the effect on vaccination information, motivation, self-efficacy(behavioral skills) and vaccination practice behavioral intention scores.

1. Development of the Child Vaccination Chatbot

The child vaccination Q&A chatbot in this study was developed according to the software development life cycle described by Bhattacherjee (2001) and Davis (1989). The cycle consists of analysis, design, implementation, and evaluation stages. Figure 3 shows the child vaccination chatbot development process.

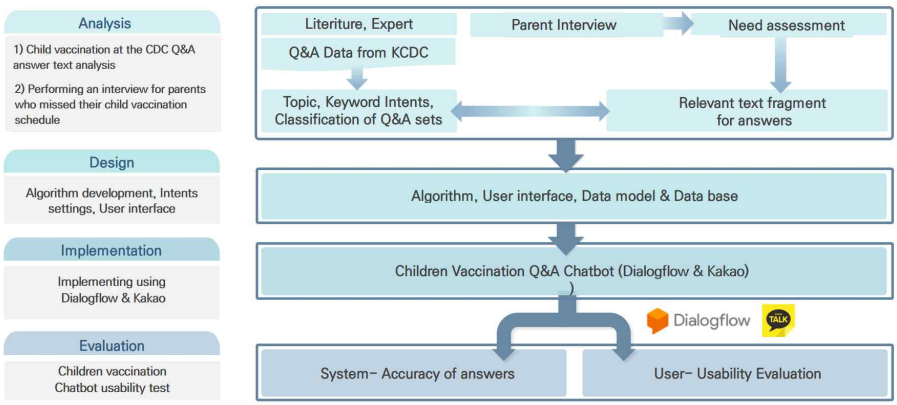


Figure 3. Child vaccination chatbot's development process

1) Analysis

Here, the function and information expected to be implemented in the child vaccination Q&A chatbot are decided. First, text analysis of the Korea Center for Disease Control(KCDC) child vaccination Q&A was conducted. The text data were collected from the KCDC National Vaccination Bulletin Board through the "Act on Prevention and Management of Infectious Diseases." Based on the vaccination research report and the Q&A bulletin board the text in the Q&A was classified with those in the same category. Classifying by questions regarding vaccination schedule information, vaccination medication information, vaccination side-effect information and so on.

Second, the analysis of requirements for parents raising children eligible for child vaccination was conducted. For this, individual intervi ews were conducted with six parents who were raising children eligible for child vaccination to understand the needs of the caregivers. Interviewees were parents who had once or twice experienced missed their child vaccinations. In the user demand definition stage, the essential functional elements of the chatbot were defined based on the collected information.

The following are the functions reflected in the chatbot derived through the interviews: a vaccination notification function, specific information on vaccinations, vaccination precautions, public health centers and hospitals information, sharing information with parents raising children, and the way of boosting motivation through chatbot.

The interviews stopped when repeating themes started to appear in the interviews and no new ideas or opinions were voiced. Interviews were conducted in a memo-and-record manner. The interview questions are presented in Table 3.

Table 3. Interview questions

1. How do you access your child vaccination information?
2. What kind of data do you expect to provide to chatbot users?
3. What information do you think you need when you receive child vaccination information using a chatbot?
4. What are the factors that motivate immunization in using a child vaccination chatbot?
5. What gives you confidence in the vaccination process when using a child vaccination chatbot?
6. Does the following context summarize what was discussed today?

2) Design

In this study, Kakao Plus Friend platform, which is used by 94.4% of the Korean population (Kim, 2018), was used to deliver a chatbot intervention program for the child vaccination chatbot based on a real-time consultation messenger service. Kakao Plus Friend platform, which provides a smart chat API type function, enables users to send texts, share photos, and upload videos. The information on child vaccination is provided based on 1:1 customization by setting an algorithm appropriate for each child by considering their age, without exposing the counseling contents. Diverse platforms such as IBM

Watson Conversation, Assistant Google, Dialogflow, and Chatfuel—the chatbot platform for Facebook—are tend to be used to build a chatbot system.

In the first testing stage, the dialogue content of the initial chatbot was constructed using Dialogflow supported by Google. Dialogflow is a program that can apply natural language learning for chatbot implementation (Reyes, 2019). Natural language processing utilizes the Dialogflow services and could be linked with Kakao i Open Builder. It linked the extracted contents from the child vaccination guidelines and literature analysis provided by the Korea Centers for Disease Control and Prevention. In Dialogflow, keywords for 17 targeted infectious diseases and 17 types of vaccines suggested by the KCDC website were included. The keywords added included: finding nearby health centers, vaccination schedules, national designated vaccinations, other vaccinations, and information regarding vaccination medical institutions.

A data base(DB) space was prepared to enable the contents of the intent entered in Dialogflow to be stored in Cloud Firestore. Cloud Firestore is a cloud-hosted, non-relational database management system(NoSQL) that can be accessed from iOS, Android, and web devices. The development of the chatbot system implemented the essential functions derived from the user demand surveys as algorithms. By inputting the ‘intent‘ that maps the user's speech and software, some contents were designed to be equipped with an artificial intelligence(AI) learning module for natural language processing. The image of the child vaccination chatbot based on Kakao

Plus Friend is shown in Figure 4.

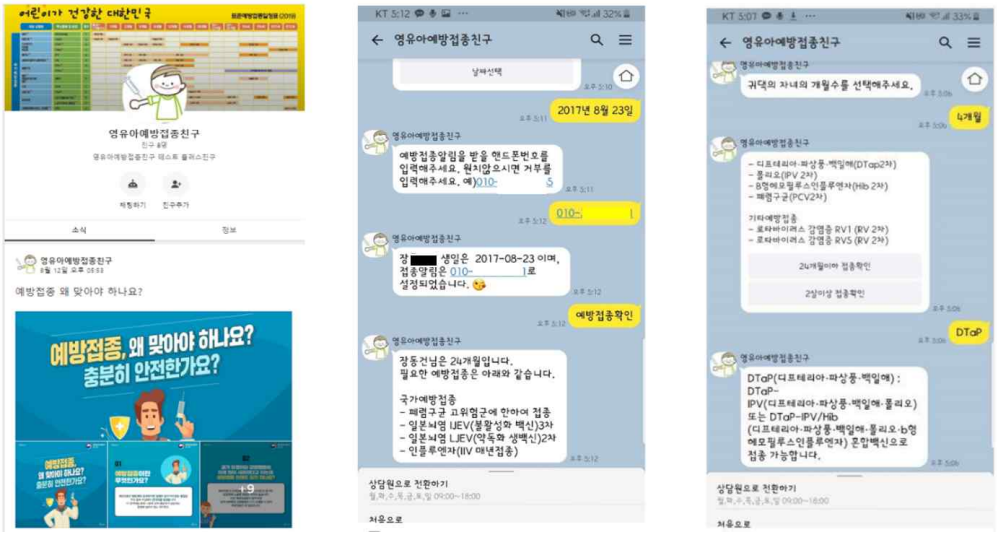


Figure 4. Image of Kakao Plus Friend child vaccination chatbot

3) Implementation

The account for the Kakao Plus Friend Administrator Center (https://center-pf.kakao.com/login) named Child Vaccination Friend was set up on the platform. Furthermore, “Research Participation Method” and “Study Participation Agreement” documents were automatically sent when recruiting the participants for the study when they pressed the Add Friend button. If the study participants agreed to participate in the study, they were registered, and a survey was sent to the 1:1 chat room. The structure of the chatbot for child vaccination in this study is shown in Figure 5. A child vaccination chatbot service scenario is shown in Table 4.

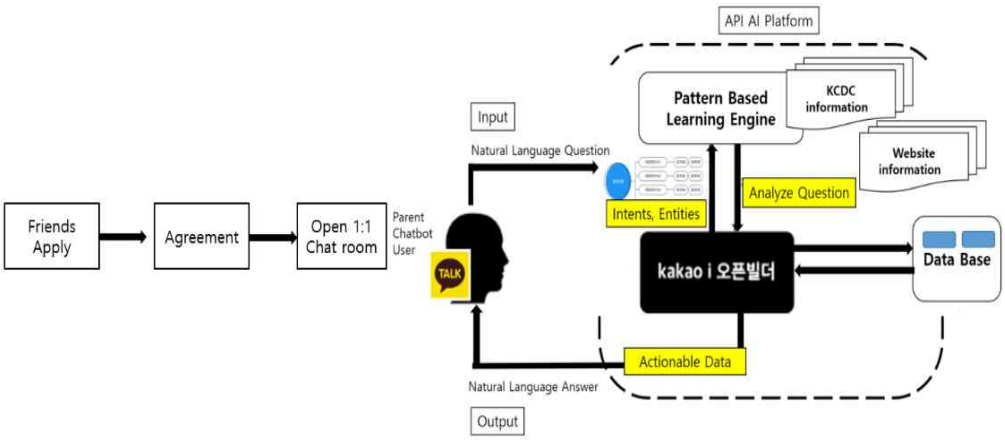


Figure 5. Conversational architecture of the child vaccination chatbot

Table 4. Child vaccination chatbot's services scenario

1. A guardian adds a friend through the Kakao Plus Friend platform and starts the child vaccination chatbot.
2. Enter your child's name and age.
3. Respond in real time to inoculation information corresponding to the age of the child.
4. If the immunization date is imminent, a notification message is to be sent one week in advance.
5. Provide information related to vaccinations (ex.: measles).
6. Immunization related information articles, newsletters, webtoons, images are sent weekly.
7. You can check your child's vaccination history.
8. Send a message of encouragement and a coupon when a vaccination certificate is uploaded to motivate the guardian to continue to vaccinate their child.
9. Show the locations where vaccination could be carried out such as community healthcare centers and medical institutions close to the current location of the child.

4) Evaluation

Five experts in the medical informatics field and six parents targeted for child vaccination were recruited. After they used the child vaccination Q&A chatbot for one week, evaluation was conducted. For the purposes of evaluation, the experts who participated in this study majored in medical or nursing informatics and possessed research experience in the field. The parents who participated in this study were raising their first child who had to be vaccinated.

The chatbot's performance was evaluated by using a revised version of the tool which was originally devised by (Lee et al., 2011). The aim was to evaluate cognitive immersion and intention to use mobile applications. In previous studies, the tool's the tool was Cronbach's alpha ranged between 0.79 and 0.88. It consists of nine questions in total. The questions asked users about chatbot's usefulness, expectations, satisfaction, and their intention to use it continuously. The perceived chatbot's usefulness refers to the chatbot's effectiveness perceived by its users. Also, the users were asked if the chatbot met their expectations after they used it. Satisfaction with the chatbot refers to the degree of satisfaction that the users felt after using the chatbot. Question items refers to asking intentions if the users were willing to continue to use the chatbot in the future. After using the chatbot, to enhance the chatbot's functionality, the users' opinions were collected by means of open-ended questions.

2. Evaluation of Child Vaccination Chatbot

1) Study design

Based on the information-motivation-behavioral skills model a life-cycle, reflected child vaccination chatbot was developed. In order to identify the effects of parental vaccination information, vaccination motivation, vaccination self-efficacy, and vaccination behavioral intention, a quasi-experimental research design(Post-only) was applied. According to DeCarlo (2018), a study design without a pre-test is used to remove the possibility of test effects when exposure to a research questionnaire could affect the results. Therefore, this study assumed that if the experts knew the questions about measuring vaccination knowledge in advance, testing effects could occur. Hence, the pre-test was omitted. It was assumed that the experimental group and control group sought vaccination related information in a similar pattern, since the method of searching for such information is currently limited to the analog method. Consequently, pre-tests was not conducted because it was expected that prior knowledge, motivation, self-efficacy, and vaccination intentions were similar.

In addition, in previous studies the effect of the online-based education program was the highest after the first month of the program's use. After that, as the survey was conducted after 1, 3, 6, and 12 months, the effect decreased (Patrick et al., 2011). Therefore, the experimental group's responses were measured after Week 4, Week

8, and Week 12 of using the chatbot. Similarly, the control group's responses were measures after Week 4, Week 8, and Week 12 of their participation in the study. Table 5 shows the research design of the study.

Table 5. Research design of the study

Group	Intervention	Post-test (after 4 weeks)	Post-test (after 8 weeks)	Post-test (after 12 weeks)
Experimental group	X	E1	E2	E3
Control group		C2	C3	C4

Note. CV = Child Vaccination
X: Child Vaccination Chatbot
E1, E2, E3: CV information, CV motivation, CV self-efficacy, CV behavioral intention
C1, C2, C3, C4: CV information, CV motivation, CV self-efficacy, CV behavioral intention

2) Research participants

The research participants were provided with a sufficient explanation of the study and its method. The research participants were the parents raising children from 0 to 35 months old who required vaccina tion in accordance with the law on the prevention and management of infectious diseases in the Republic of Korea. The selection and exclusion criteria for research participants were as follows.

(1) Selection Criteria

① Parents raising children from 0 to 35 months old, as specified by the law on the prevention and management of infectious diseases in the Republic of Korea.

Parents raising children who were expected to be immunized within three months.

Parents who understood the survey and were able to respond.

② Parents raising their first child.

③ Those who understood the purpose of this study and agreed to participate in writing.

④ Kakao Talk app users.

(2) Exclusion Criteria

① Parents engaged in the health and medical field.

② Parents raising more than one child.

③ Those unable to read or communicate in Korean.

④ Those who did not understand the aim of this study or refused to participate.

To estimate the sample size required for this study, G*Power analysis was performed (Faul, Erdfelder, Lang, & Buchner, 2007). The required sample size was calculated as 21 persons per group (power = 0.80, effect size (ES) = .3, alpha = .05) based on ANOVA. The dropout rate was estimated to be about 25% based on the previous studies. As a result, in this study, 35 participants were recruited for the

experimental group and 34 for the control group.

3) Study instruments

In this study, the evaluation of the effectiveness of the chatbot program included the measurements of vaccination information, motivation, and self-efficacy behavioral intention scores as variables.

(1) Vaccination information

In order to verify the content validity of the 12 questions of the first selected measurement tool, five experts were requested to provide their views. These included a pediatrician, a researcher at the Vaccination Management Division of the KCDC, a professor at a nursing college, and two doctors at a nursing college.

Furthermore, for a week in September 2019, 12 parents who were awaiting their child's vaccination were asked to verify the content validity. In total, five copies of a completed content validity verification survey were collected. Content validity index(CVI) was calculated based on the CVI score presented by Lynn (1986). As a result, 12 questions with the CVI index of 80% or more were selected, and three questions were revised and supplemented based on the experts' opinions on the conceptual framework and content validity. Questions with difficult or ambiguous meanings were revised and simplified based on the experts' opinions.

Twelve questions in total consists of yes or no questions regarding

vaccination. Correct answers to each question score one point. A higher correct answers' rate stands for the higher level of child vaccination information.

(2) Vaccination motivation

Six questions from the pertussis vaccination individual motivation measurment tool developed by Kim (2008) were revised and supplemented according to the purpose of this study. The reliability of the original tool was Cronbach's alpha = .82. The survey tool was used after verifying the content validity by the experts and then supplementing it. In this study, the Cronbach's alpha value = .82.

(3) Vaccination self-efficacy

Self-efficacy (behavioral skills), which stands for parents being able to successfully carry out their children's vaccination schedules, was measured by revising and supplementing the self-efficacy tool in relation to the implementation of the rotavirus vaccination (Lee & Yang, 2017). In this study, self-efficacy refers to the degree of self-confidence that child vaccination can be successfully implemented. This score was measured by five questions modified by Lee and Yang (2017) with the reference to the tools developed by Ko (2012). The original tool's Cronbach's alpha = .91. In this study, the Cronbach's alpha = .85.

(4) Behavioral intention to vaccinate

Preventive action is an action taken by a person who is believed to be healthy to detect or prevent the disease in an early stage before the symptoms appear for the purpose of preventing the disease (Ajzen, 1991). Therefore, the meaning of preventive action in this study refers to the individual's intention to voluntarily implement their child's vaccination schedule. Based on the metrics used in the previous studies by Yeon et al. (2010) and Han (2011), seven questions were used to revise and supplement the measurement for the intention of vaccination. In this study, the Cronbach's alpha = .94.

(5) Turing test

Turing's (1950) study, cited in numerous AI-related studies, describes the criteria for intelligence in the computing machinery and intelligence field. He argued that the criterion based on an entity could be considered intelligent, whether human or machine, depends on whether the entity passes the Turing test (Turing, 1950). The Turing test has remained the only tool to measure machine intelligence. Hence, this study used the artificial intelligence test used in previous studies.

To summarize the Turing test, in a separate place, an interviewer interacts with a person A and a computer B within a predetermined time period. If the interviewer cannot distinguish between the human and the computer through conversations with A and B, or if the computer is thought to be a human by the interviewer, the computer is considered to be intelligent (Park, 2018). Since the Turing test

exists only as a theory and there is no actual measurement tool, four questions were constructed based on the Turing test theory. In this study, after using the non-face-to-face chatbot for 12 weeks, the participants were asked a question whether the conversation felt like a conversation with a person or a machine.

4) Data collection

After the approval of the Seoul National University's Institutional Review Board (No. 2002/001-008), the participants were recruited onlin e via Mom Cafe's (http://cafe.naver.com/ttokks) bulletin board and SNS operated by Mom Cafe's members. The recruitment process took two weeks from January 30 to February 15, 2020. Parents raising their first child scheduled to be immunized were targeted. Also parents who were not employed in the medical sector were recruited as participants. A sufficient explanation of the purpose and method of using a chatbot for child vaccination was provided in writing to those who agreed to participate in this study. Additional explanations were provided by phone if necessary.

In order to secure homogeneity between the experimental group and the control group, parents who raised their first child and whose children were younger than 35 months were recruited on a first-come, first-served basis. In order to evenly distribute the participants to the experimental group and control group, children of a similar age were placed in pairs in the experimental group and control group. The

experiment group and the control group were randomly assigned. The survey was sent to the members of both groups individually via Kakao Talk using their mobile numbers.

Upon the consent to participate in this study, a chatbot link was sent to the experimental group and a child vaccination paper leaflet was sent to the control group. The research program's content was delivered through Kakao Plus Friends, which was operated in a private mode for research purposes. At the end of Week 4, Week 8 and Week 12 of of using the child vaccination Q&A chatbot, the participants were asked to evaluate it by taking a mobile survey (http://forms.gle/byhoq725xYkWBNcn8). The post-response survey was automatically saved on Google Survey Drive when the participants completed it via a mobile link.

5) Ethical considerations

This study was conducted after the approval by the Seoul National University's Institutional Review Board (IRB). I explained this study's purpose, method, content, and procedures to the research participants before starting the research. The participants could withdraw from participating in this research at any time. It was explained to them that their withdrawal from the study would not cause any personal disadvantages to them. Also, they were advised that their confidentiality was guaranteed by ensuring that data processing procedures prevented any personal identification. The study was

conducted after obtaining the participants' voluntary consent for participation. It was stated that there was no penalty for withdrawing from the study even after the research started.

All materials are kept confidential. Only the researcher could access the collected personal information. The collected data was not used for any purpose other than the purpose of this research. When logged in, it was stored in an encrypted notebook, and the documented data was stored in lockable drawers. To prevent personal information from being exposed, research data marked with serial numbers excluding personally identifiable information was permanently stored based on the Seoul National University Research Ethics Guidelines. The consent documents and recorded files will be stores for three years, after which they will be discarded. The transferred data will also be destroyed when the purpose of collection is achieved. This study is a minimum risk study, with few physical, mental, social, legal, or economic risks to its participants Furthermore, participation in this study does not have any effect on the health of its participants.

6) Data analysis

The collected data were analyzed by using the SPSS/WIN 21.0.

(1) The general characteristics of the participants were analyzed by using descriptive statistics including frequency, percentage, average and standard deviation.

(2) For the homogeneity test for the experimental group and the

control group, Pearson's chi-square test (Pearson's x^2) was used through chi-square analysis and independent t-test. The results of 'Knowledge','Motivation','Self-efficacy' and 'Behavioral Intention' were analyzed by repeated measures ANOVA.

Ⅴ. Results

1. Development of the Child Vaccination Chatbot

1) Requirement analysis

(1) Analysis of required items

Requirement analysis was conducted on parents who had missed or delayed their children's vaccination schedules at least once before their participation in this study. The mean age of the interview participants was 31.5 years. Among the participants, seven (70%) were women and three (30%) were men.

The following are the requirement themes extracted as meaningful from the child vaccination chatbot requirements.

Theme 1. Automatic notifications by a text-based system

For automatic notifications of child vaccination schedules and channels for receiving answers to inquiries, a non-face-to-face text-based system was preferred. Examination of the channels through which children's vaccination-related information was accessed showed that people received notifications through text messages from hospitals, online search, phone calls, and schedules written in children's vaccination notebooks. Most parents raising their first child were in

their mid-20s and 30s and were familiar with using mobile texts. Parents in their 30s belonged to a generation familiar with mobile text-based information rather than information shared during face-to-face meetings or landline phone calls, and wanted to obtain vaccination information in real time.

Theme 2. Real-time delivery of information via the chatbot

The interviews showed that the participants wanted the information to be delivered via the chatbot in real time. Although details about vaccination were also important, parents wanted information on how to deal with a child having a fever or an adverse reaction to a drug after the vaccination to be provided via the chatbot. For example, there was a demand for information on the criteria for determining when to go to the hospital in case of a low-grade fever, and how to cope with it at home. In the interviews, the participants commonly stated that accurate information was quickly provided via mobile texts in real time.

It was suggested that the chatbot should contain the following functions: provide information on adverse reactions to vaccination, relieve worries about vaccinating very young children, provide vaccination information on changes in the latest infectious disease types, provide information on the benefits and disadvantages of vaccination, provide guidance on the next vaccination schedule, have a separate guidance for premature babies, provide reliable information from professional medical personnel, share information on vaccine

manufacturing issues(including vaccination issues regarding heavy metals), provide information on live vaccines, and link vaccination records from overseas to the domestic records, and have a notification function.

Theme 3. Delivering reliable information through the chatbot

The interviews showed that the respondents wanted to receive reliable information through the chatbot. The participants were asked the following questions: What information do you think is necessary when receiving child vaccination information through the chatbot? What do you think motivates you to vaccinate your child when using the child vaccination chatbot? What factors give you confidence in the vaccination implementation process when using the child vaccination chatbot?

Interviewees said there was a lot of information online regarding child vaccinations. However, often that information was provided by non-experts and was shared in online cafes and blogs that did not have a reference to a reliable source. They said that finding different answers from different information sources created confusion in the implementation of vaccination schedules. Parents wanted to receive validated, standardized information in a way that allowed them to interact in real time.

Theme 4. Chatbot provides customized information based on the child's age

Interview results showed that the participants wanted a chatbot to provide customized information tailored to the number of weeks of their child's age. Parents could miss vaccinating their child at the appropriate time, because vaccination schedules differ based on the number of weeks that passed after birth. Also, the vaccination schedule for the same vaccine varies from the first to the fourth injection. To reduce the chance of missed vaccinations, the participants wanted to receive customized information based on their children's age in weeks.

Theme 5. Induced motivation for a child's vaccination through the chatbot

The results showed that the participants needed a chatbot function to motivate caregivers to vaccinate their children. When they vaccinated their children, they wanted to share the experiences with other caregivers as a peer group and to receive encouragement via the chatbot. If people could actively share positive information through social networks and receive positive feedback, they could enjoy the practice instead of feeling it as their duty.

Theme 6. Identifying the cause of missing vaccinations

Most children's vaccinations are scheduled from children's birth to when they become 23 months old. During that period, when vaccination schedules are relatively tight, parents are interested in vaccinating their children. However, after their children reach 23 months of age, the intervals between vaccinations become longer and more irregular. This causes delays.

For example, vaccination schedules for diphtheria are often divided into multiple stages, including the first, second, third, fourth, and the fifth. This may cause confusion. The respondents also stated that in the event of unforeseen epidemics such as COVID-19 there they were anxious if it was correct to vaccinate their child or if their child was exposed to more danger by visiting a health clinic. Thus, the respondents sometimes failed to vaccinate their children at the right time. In order to implement the six subject matters extracted through the analysis of interview contents, the function of the child vaccination chatbot was extracted and defined through literature review. Table 6 demonstrates the relationships between the child vaccination chatbot's functions and themes.

Table 6. Relationships between the child vaccination chatbot's functions and themes

Themes	References	Functions
Real-time delivery of vaccination information Reliable sources of information Customized information according to the age of the child	Korea Centers for Disease Control and Prevention (KCDC) Immunization Guides https://nip.cdc.go.kr/irgd/index.html	CV information Providing real-time information Providing reliable information
Text-based system	Dialogflow, Kakao Talk, Telegram, Kakao Plus Friends	CV communication
Motivation and engagement functions	Sharing health behavior experiences and expressing empathy for the experiences of others (Funnell et al., 2009).	CV motivation CV self-efficacy CV behavioral intention

Note. CV = child vaccination

2) Implementation

(1) Child vaccination information extraction

The three medical documents and the KCDC research reports used to extract information on child vaccination in this study are presented in Table 7. According to the analysis of the status of those who missed vaccinations and how to manage them, parents living abroad had a higher rate of missing vaccinations. The need was identified for reminder services for caregivers to alert them when a vaccination was missed.

Table 7. References used for the chatbot's contents

Categories	References
2017 vaccination counseling casebook	Department of Vaccination Management at the KCDC
Analysis and management of missed opportunities for vaccination	KCDC, Industrial-Academic Cooperation Group of Chungnam National University
Development of ontology for social big data (SBD) classification for childhood vaccinations	SBD trend analysis based on health and welfare issues in 2016
National immunization policy awareness and satisfaction trend	"Weekly Health and Disease," Vol. *8* No. 28 KCDC
KCDC's child vaccination website	Vaccination information search site https://nip.cdc.go.kr/irgd/index.html

(2) Chatbot development process

In this study, the chatbot artificial intelligence platform was used which was provided by Google called Dialogflow and entered possible conversational units for the child vaccination chatbot one by one. Dialogflow is available free of charge. It provides 180 API requests per minute, and supports Korean language natural processing, making it easy to search for data. Machine-learning is enabled in Dialogflow based on the data entered. It provides many example sentences related to vaccination and allows natural language processing in various situations. The content entered in Dialogflow can be accessed through input conversations using multiple languages and messenger devices. The input conversations can be linked to Python, Telegram, Twitter, and Facebook. In this study, I was able to connect it with Telegram

to operate the chatbot's question and answer function. The chatbot development process is shown in Figure 6.

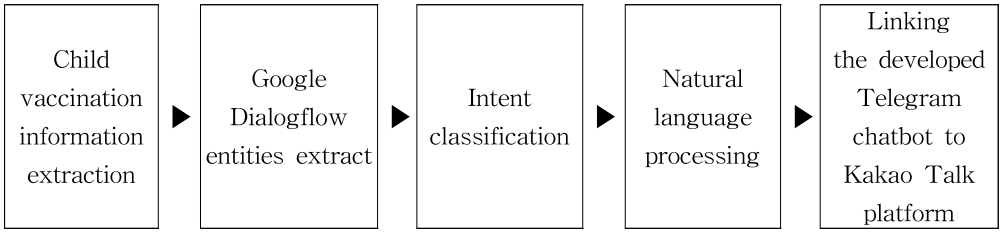


Figure 6. Chatbot's development process

First, an agent was created in Dialogflow, followed by an entity (individual piece of information conveyed in a sentence) and intent (intention of the sentence and answer processing). The intent is the unit of conversation in which words were exchanged once. In the previous design stage, 17 infectious disease keywords and 17 vaccine-related keywords presented as standard on the KCDC's vaccination help website were set as the criteria for the entity. The number of questions and answers that could be presented for each infectious disease and vaccine was manually entered into the intent. The screenshot classifying the intent in Dialogflow is shown in Figure 7. The screenshot of manually entering the keywords and answers for child vaccination is presented in Figure 8.

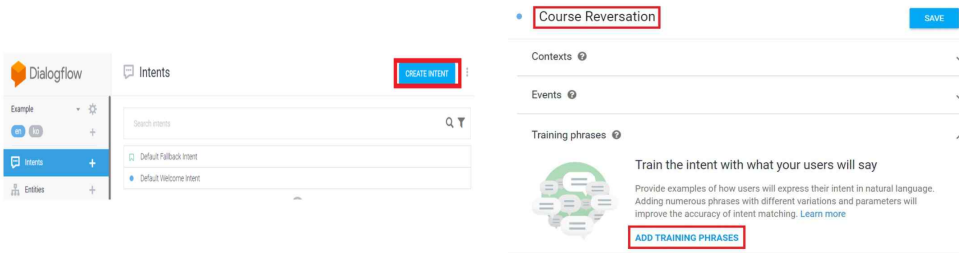


Figure 7. Google dialogflow intent classification

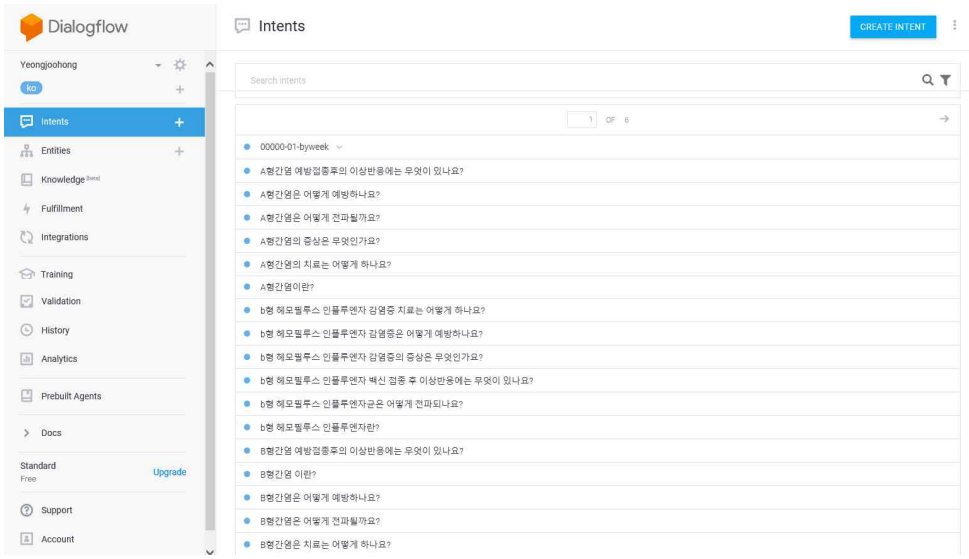


Figure 8. Child vaccination chatbot's main keyword text input

An entity is a tool that can extract key information from the natural language entered. It means identifying the intent of the natural language entered by the user and making a judgment. In other words, it is the function of specifying the natural language entered as a parameter to output the appropriate response based on the input value even within the same intent.

There were 233 main queries about the child vaccination chatbot.

The value of the synonym queries entered in each training phrase was set at an average of 10 for each question. More than 2,330 main queries were manually entered into Dialogflow during the initial chatbot creation phase. The output values of the responses to manually entered intents could be tested by a simulation. Thus, the input values were checked one by one during the development phase to ensure that there were no errors.

Dialogflow is designed to perform machine learning for natural language processing. If you enter various queries, it is intended to return the confidence level value so that similar query patterns can be recognized as the same intention. In other words, it indicates how reliable the value is that derives from matching the user conversation with intent. If Dialogflow performs machine learning and the intents are paired 100% with the actual example sentences, it gives a value of 1.0. On the other hand, if there are various forms of user questions that do not correspond to the predicted values of machine learning, matching accuracy is reduced, and the confidence score lowerd.

The confidence score was set randomly, assuming that there was an intent matched with a certain threshold. Once the threshold was set, the values below it could be considered as not having an accurately matched intent. Therefore, a fallback intent and exempted corresponding queries were manually entered. The criterion called a critical point is was the threshold for machine learning classification and could be adjusted to the desired form.

Since information related to vaccines and the number of weeks were

crucial components for the chatbot, it was believed that its reliability would decrease if there were errors. Thus, intent matching and response thresholds were raised to provide more accurate responses. It was found during the development process that it was impossible to create all possible queries because there were so many different languages that people could speak. Thus, it was structured to provide expected answers by reducing the threshold by roughly matching user conversations and intents as much as possible. The screenshot for entering synonym queries in Dialogflow is as shown in Figure 9, and the example answer for hepatitis B is as in Figure 10.

Example: What is hepatitis B?

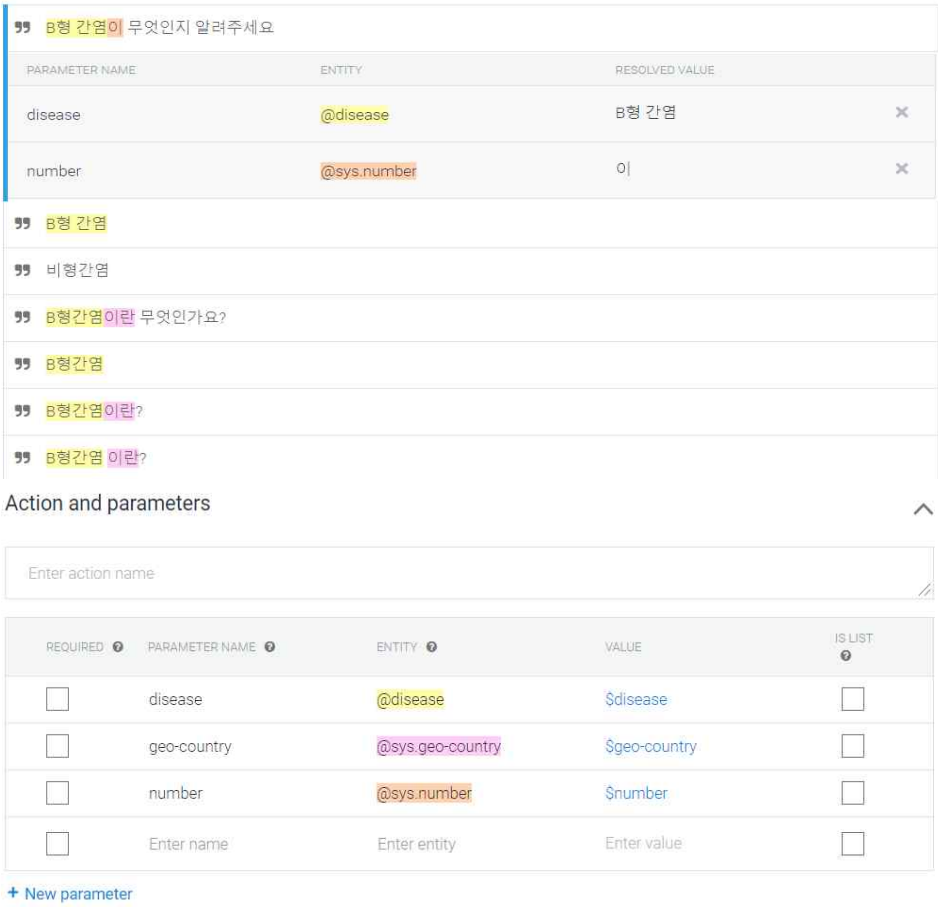


Figure 9. Child vaccination chatbot's synonym queries sample

Figure 10. Child vaccination chatbot's answer sample

(3) Implementing an interface

The developed Dialogflow chatbot was linked to Kakao Talk, which has nearly 100% of the domestic market share. In order to use the chatbot for child immunization in KakaoTalk, the user key and content were received and the answers from Dialogflow were delivered. After developing the chatbot in Dialogflow, a web server was used to implement Kakao Talk services. Figure 11 shows Dialogflow intent training phrases.

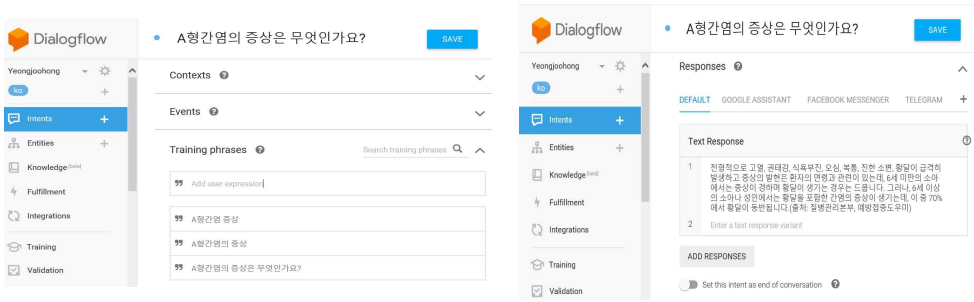


Figure 11. Google dialogflow intent training phrases

In the intents, training phrases could be entered into the chatbot. The responses constitute content output.

Training phrases automatically allow Dialogflow to learn sentences by entering actual child's vaccination-related data to understand the users' intention, even if they are not correct. Figure 12 shows the Dialogflow and Kakao Talk platform integration.

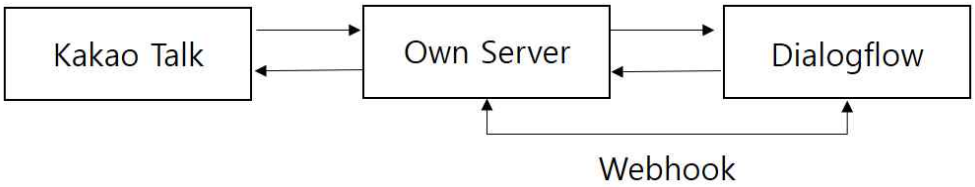


Figure 12. Google dialogflow and kakao talk platform integration

When a research participant added a friend through a mobile application, he or she could use automatic response chatting with other research participants registered on the chatbot's administrator page in Kakao Plus Friend's manager center. Kakao Plus Friend was set up in the API form(a type which provides questions and required specific answers through separate development. If a question is asked outside the developed scope, it could be entered by the chatbot's manager manually. Repeated questions could be continuously added to the intents, and supplementary processes could be repeated so that the answers could be made in the form of automatic responses via the chatbot. Figure 13 shows the screenshot of Kakao Talk's managing administrator page.

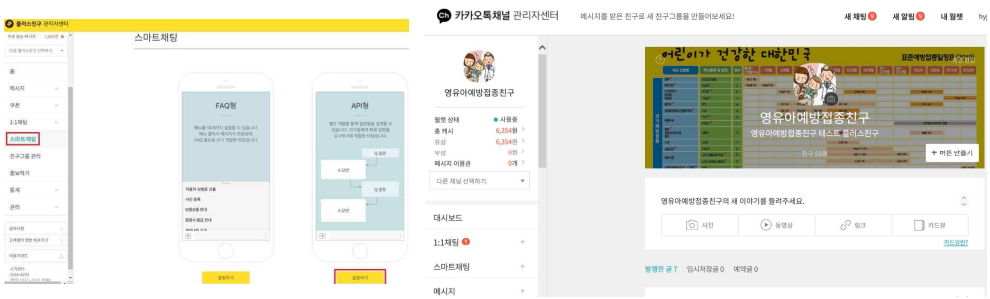
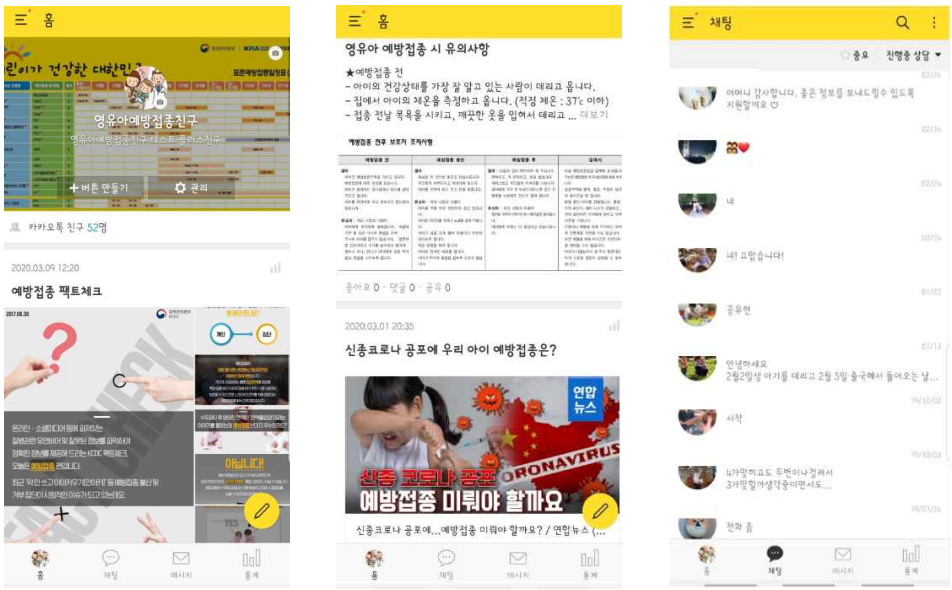


Figure 13. Screenshot of Kakao Talk's managing administrator page

(4) The chatbot's main screen's basic functions for research participants

Based on the child vaccination chatbot's main menu developed in this study, information on vaccination can be regularly received. A shared screen was designed to communicate and share information with other parents through the main menu of the child vaccination chatbot board. The chatbot's main screen was designed to allow users to click the like button on the other users' comments and increase sympathy and solidarity for vaccination. Figure 14 shows the screenshot of the child vaccination chatbot's program application.



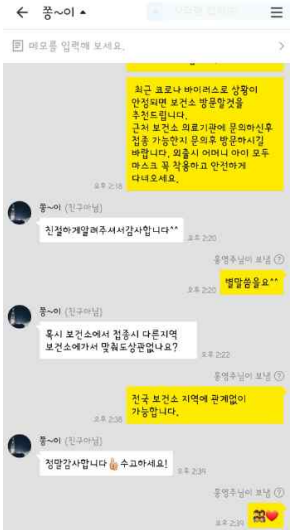
Main screen of the child vaccination chatbot

Provides updated information periodically (ex.: "How to Safely Vaccinate Your Child During the Outbreak of COVID-19?")

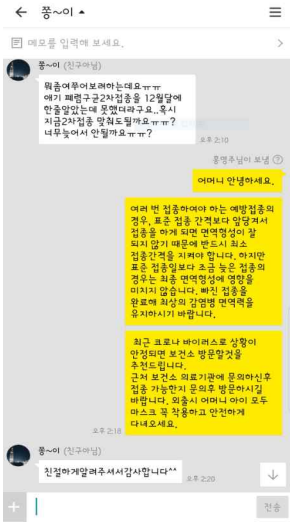
Real-time child's vaccination Q&A

Figure 14. Screenshots of the Child vaccination chatbot's program application

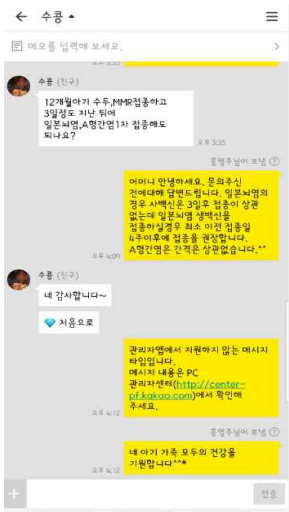
(5) Child's vaccination chatbot based on the real-time consultation messenger service



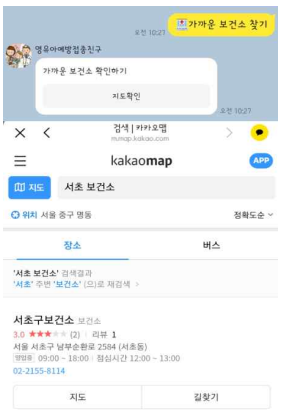
Immunization inquiries about COVID-19



Inquiries regarding delay in the second inoculation against pneumococcal infection



Chickenpox, MMR, Japanese encephalitis, and hepatitis A vaccination related inquiries



Searching for child's vaccination public health center function

1st and 2nd questionnaire sending function

Sending coupons according to vaccination practices

Figure 15. Screenshots of the child vaccination chatbot's Q&A

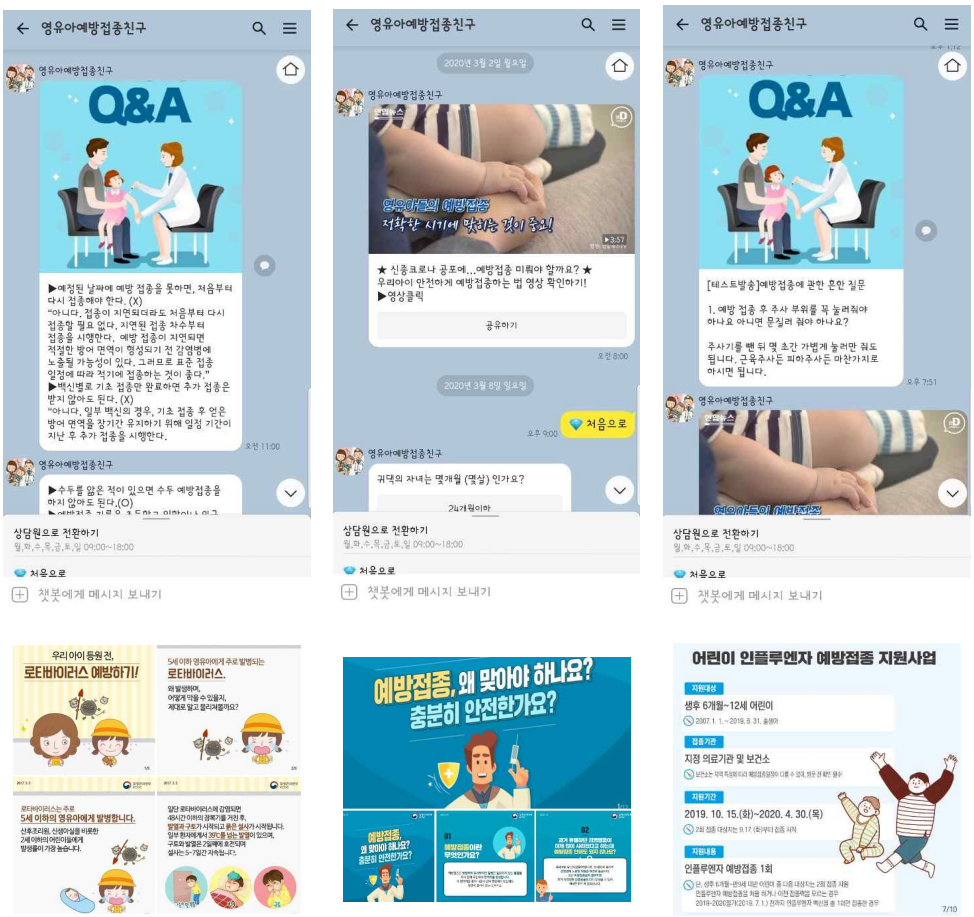


Figure 16. Screenshots of providing information on child's vaccination through the chatbot

2. Usability test of the child vaccination chatbot

1) Usability test

(1) Child vaccination chatbot usability test by professionals

The actual usability test was carried out according to the service procedures and the tasks. The participants were conducted in seven different stages of the task, followed by the usability evaluation task based on the service procedures. The seven tasks are described below.

The usability was conducted in two different groups. Five experts in medical information and six parents, who expected to vaccinate their children, were asked to use the child vaccination Q&A chatbot for one week. After that the usability test was conducted. More specifically, the participants in the usability test were the researchers who majored in medical and nursing information subjects and had research experience in the respective fields, and the parents who were raising their first child. The participants in this study conducted a usability test at the end of Week 4, Week 8, and Week 12 of using the completed chatbot. The usability test was based on the tool developed by Lee (Lee et al., 2011). The tool was initially used to assess cognitive immersion and use intention of mobile applications.

The seven tasks were as follows: (1) talk to the chatbot, (2) enter the child's age in weeks, (3) ask questions about diseases, (4) ask questions about vaccinations, (5) request a child's vaccination schedule, (6) request information on medical institutions for vaccinations, and (7)

questioning if the participant can distinguish the national vaccination items and etc. Each task was carried out by using the chatbot. A total of nine questions on the 5-point scale were evaluated with tools developed by Lee et al. (2011). Also feasibility questions from the Peter Morville's honeycomb model was additionally asked to the professional users (Kang, 2017). The questionnaire which contains detailed tasks using the chatbot follows in (Table 8).

Table 8. Chatbot feasiablity questions from the Peter Morville's honeycomb model

Category	Questionnaire which contains detailed tasks using the chatbot
Accessible	- Is it easy chating with a Child vaccination chatbot? - Do you think you have enough information to use the chatbot service?
Desirable	- Does the chatbot service offer differentiated features? - Can you easily understand the menu name, icons, and buttons provided by the chatbot service?
Credible	- Are the chatbot's responses reliable? - Do you think chatbot service is responding properly?
Findable	- Can you find what you are looking for in the chatbot? - Can you easily see the features of each menu in the chatbot? - Is the chatbot question menu convenient?
Useful	- Do you find the features that chatbot services offer useful? - Does the chatbot offer different services depending on the question? - Is the chatbot interoperable with other services? (ex: Link to the website of the Korea Centers for Disease Control and Prevention)
Usable	- Is it easy to recognize the instructions in the introduction of the chatbot? - Can I easily share various information through a chatbot? - Can you quickly and easily access information about infant vaccinations?

(2) Usability test result by professionals

The detailed results of the usability test were as follows. The questions on perceived usefulness, the degree to which the child vaccination Q&A chatbot was seen as useful to provide adequate assistance to the users, yielded the following results. On the 5-point scale, the rate of answering 'I think Chatbot helped me get the information I needed' was 4.7 on average. For 'I think the Chatbot is useful,' the mean was 4.6. It indicates the user's perception of the expected of the child vaccination Chatbot and the inconsistency or inconsistency with the results through actual use. For 'The benefits I received through the Q&A Chatbot were better than expected,' the mean was 4.5. For the question about the overall satisfaction level recognized for the use of the child vaccination Chatbot, the mean was 4.5. A total of three questions asked about the intention to continue using the child vaccination Chatbot. Among them, the mean was 4.5 for 'I will continue to use the Q&A Chatbot.' The results of the usabil ity test of the child vaccination chatbot are as shown in (Figure 17).

Figure 17. Usability test of the child vaccination chatbot by parents

(3) Pros and cons of the child vaccination chatbot and points for improvement

Based on the content derived from the performance evaluation, the dialogue algorithm and the contents of the child vaccination chatbot were supplemented and applied for the participants in the experimental group. The information was visualized, and the questions and answers rewritten in accessible language to make them easier to understand for parents unfamiliar with vaccination-related terms and information. Table 9 shows the pros and cons of the child vaccination chatbot based on the questions, points for improvement, and the overall satisfaction level.

Table 9. Advantages and disadvantages of the child vaccination chatbot and suggested improvement points

Category	Improvements in pediatric immunization chatbots
Child's vaccinations medical institutions search function	Ability to automatically search for nearby medical institutions based on the users' current location
Detailed menu of the child's vaccination chatbot	Need to add a detailed menu of the child vaccination chatbot Need to emphasize the tab "Confirm my Vaccination List" and "Find the Nearest Available Vaccination Location" menus
Information on child's vaccines' side effects	Easy explanations about vaccines' side effects that can be understood by non-experts
Priority notifications when a vaccination is delayed	When a vaccination schedule is delayed and several inoculations are needed at once, care providers would like to know the vaccination priority. Detailed information regarding vaccines which should not be administered together is needed

(4) Test content by date

Starting February 1st, 2020, the chatbot was used for a total of 12 weeks by the experimental group. Services provided to the subjects included the following: notifications about a child vaccination schedule one week prior to the vaccination; regularly providing information related to vaccinations; providing articles related to vaccinations, news letters, webtoons, and weekly images; sending encouraging messages; sending coupons when child was vaccinated and the information was uploaded to the chatbot; and providing directions to nearby vaccination centers and medical institutions. Answers to inquiries about

vaccinations were provided in real time. In the case of the control group, freely searching the internet was allowed for a total of 12 weeks and a vaccination information leaflet was provided just once during the first week of the study notifying about the vaccination schedule.

2) Chatbot usability test by parents

(1) Perception of the chatbot users' performance in each session

To analyze the chatbot users' perception of its performance in each session, a within-subject repeated measures ANOVA was performed. The results showed that the mean value increased from the first (M=4.01, SD=.63) to the second (M=4.08, SD=.71) and the third (M=4.34, SD=.69) sessions. This was statistically significant (F=3304.685, p=.000). In particular, the post-test results showed that there was a statistically significant difference in the means between the first and third sessions, indicating that the users' awareness of the usefulness of the chatbot increased as the sessions progressed. The results of the ANOVA analysis of the parent users' perception of the chatbot's performance are shown in Table 10. The results of the ANOVA analysis of the experimental group's perception of the chatbot's performance are shown in Table 11.

Table 10. Results of the usability test's repeated measurement ANOVA analysis

Variable	Group	Phase 1		Phase 2		Phase 3	
		Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*
Usability test	Parent user	4.01	0.63	4.08	0.71	4.34	0.69

Table 11. Statistical significance of the repeated measurement variance analysis

Variable			*SS*	*df*	*MS*	*F*	*p*
Usability test	Within group	Lag score	1442.819	1	1442.819	3304.685	.000
		Error	11.788	27	.437		

3. Evaluation of the child vaccination chatbot's effects

1) Homogeneity test of the experimental and control groups

This study intended to empirically verify the child vaccination chatbot's effect. The study was conducted by forming a group(control group) that did not experience using the chatbot and a group (experimental group) that did. In the case of the experimental and control groups, additional measurements were conducted after Week 4, Week 8, and Week 12.

Participants in the experiment consisted of subjects from the control group (n=34) who did not experience the chatbot, and the experimental group (n=35) who experienced the chatbot. At week 8, one person in the control group and four people in the experimental group dropped out from the experiment. In order to increase the internal validity of the post-design of the non-equal control group, the control group and the experimental group should be composed of homogeneous groups. For the demographic characteristics of 'gender','number of children's months', and 'parent age', a sub-sample was selected so that the experimental group and the control group consisted of homogeneous groups. Therefore, one control group was excluded in this process. Finally, a total of 63 control groups and 31 experimental groups were used for analysis.

Table 12 shows the general characteristics of the participants and the homogeneity test of the study subjects. In the case of gender, the chi-square analysis showed that the experimental group and the control group were homogeneous(x^2=3.65, p=.056). For the age (in months) of the child, the average age(in months) for the control group was 17.50, and the experimental group was 16.10. In addition, the difference in the number of months was not statistically significant (t=.452, p=.653), indicating that the experimental group and the control group were homogeneous. The control group was 36.75±9.15 years old, and the experimental group was 34.19±4.35 years old. However, this difference in the number of months of age was not statistically significant (t=1.409, p=.164). It was found that the experimental group

and the control group were homogeneous groups. In summary, it can be said that the control group and the experimental group were composed of homogeneous groups in terms of gender, number of children months, and age of parents.

Table 12. General characteristics of the participants and the homoge neity test

Characteristics	Categories	Experimental group n(%)	Control group n(%)	x^2 or t	p
Gender of the Chatbot User	Male	5 (16.1)	12 (37.5)	3.65	.056
	Female	26 (83.9)	20 (62.5)		
Age(Month) of the child		16.10±13.17	17.50±11.43	.452	.653
Age of the parent		34.19±4.35	36.75±9.15	1.409	.164

Note. * Multiple choice, SD = Standard deviation

2) Verification of the hypotheses

Hypothesis 1: There will be a difference in the child's vaccination information scores between the experimental and control groups.

As a result of independent sample t-testing of the scores of the control group and the experimental group against the difference in the vaccination information score, the average of the experimental group (M=6.13, SD=2.63) compared to the control group (M=3.34, SD=2.55) at the first time point It was found to be higher, which was statistically significant (t=-4.27, p=.000). At the second time point, the experimental group (M=8.29, SD=2.15) showed a higher mean than the control group (M=4.44, SD=2.06), which was statistically significant (t=-7.26, p=.000). Also, at the 3rd time point, the mean of the experimental group (M=8.74, SD=1.70) was higher than that of the control group (M=3.88, SD=2.14), which was also statistically significant (t=-10.00, p=.000). Since the experimental group using the chatbot had a higher level of knowledge than the control group, the research hypothesis 1 was confirmed. The result of analyzing the information level of the experimental group and the control group by t-test is shown in (Table 13, 14).

Table 13. Scores of child vaccination knowledge in the experimental and the control group (N=63)

Variable	Group	Post-test 4wks Mean±SD	Post-test 8wks Mean±SD	Post-test 12wks Mean±SD
Knowledge	Exp(n= 31)	6.13±2.63	8.29±2.15	8.74±1.70
	Con(n= 32)	3.34±2.55	4.44±2.06	3.88±2.14

Exp=Experimental group, Con=Control group

Table 14. Knowledge comparison between Chatbot intervention group & control group Post-test using t-test

Variable	Phase	t	*p*
Knowledge	1st(4wks)	-4.27	<.001
	2nd(8wks)	-7.26	<.001
	3rd(12wks)	-10.00	<.001

Hypothesis 2: There will be a difference in the child's vaccination motivation scores between the experimental and control groups.

As a result of independent sample t-testing of the scores of the control group and the experimental group for the difference in the vaccination motivation score, the average of the experimental group (M=2.83 SD=.83) compared to the control group (M=2.17, SD=.77) at the first time point Was found to be higher, which was statistically significant (t=-3.28 p=.002). The experimental group using chatbots showed higher motivation than the control group. At the second time point, the experimental group (M=3.21, SD=.57) showed a higher mean than the control group (M=2.28, SD=.45), which was statistically significant. (t=-7.19, p=.000). Also, at the 3rd time point, the mean of the experimental group (M= 3.63, SD=.38) was higher than that of the control group (M=2.45, SD=.56), which was also statistically significant (t=-8.81 p=.000). In other words, the experimental group using chatbot appeared to have a higher motivation than the control group, so the research Hypothesis 2 was confirmed. The result of analyzing the moti vation level of the experimental group and the control group by t-test is shown in (Table 15, 16).

Table 15. Scores of child vaccination motivation in the experimental and the control group (N=63)

Variable	Group	Post-test 4wks Mean±SD	Post-test 8wks Mean±SD	Post-test 12wks Mean±SD
Motivation	Exp(n= 31)	2.83±0.83	3.21±0.57	3.63±0.38
	Con(n= 32)	2.17±0.77	2.28±0.45	2.45±0.56

Exp=Experimental group, Con=Control group

Table 16. Motivation comparison between chatbot intervention & control group post-test using t-test

Variable	Phase	t	*p*
Motivation	1st(4wks)	-3.28	.002**
	2nd(8wks)	-7.19	<.001
	3rd(12wks)	-9.81	<.001

Hypothesis 3: There will be a difference in the child's vaccination self-efficacy(behavioral skills) scores between the experimental and control groups.

In order to verify the research hypothesis 3, as a result of independent t-testing of the scores of the control group and the experimental group against the difference in the vaccination self-efficacy score, the experimental group (M=3.22 SD=.68) compared to the control group (M=2.66, SD=1.23) at the 4 week time point. 0.68) was found to be higher, which was statistically significant (t=-2.26, p=.028). The experimental group using chatbots showed higher self-efficacy score than the control group. At the 8 week time point, the experimental group (M=3.59, SD=.34) showed a higher mean than the control group (M=2.66, SD=1.26), which was statistically significant (t=-7.74, p=.000). Also, at the 12 weeks time point, the mean of the experimental group (M=3.76, SD=0.34) was higher than that of the control group (M=2.43, SD=0.82), which was also statistically significant (t=-8.47, p=.000). In other words, the experimental group using the chatbot showed a higher average of self-efficacy than the control group. Therefore, the study Hypothesis 3 was confirmed. The result of analyzing the motivation of the experimental group and the control group by t-test is shown in (Table 17, 18).

Table 17. Scores of child vaccination self efficacy in the experimental and the control group (N=63)

Variable	Group	Post-test 4wks Mean±SD	Post-test 8wks Mean±SD	Post-test 12wks Mean±SD
Self efficacy	Exp(n= 31)	3.22±0.68	3.59±0.34	3.76±0.34
	Con(n= 32)	2.66±1.23	2.66±1.26	2.43±0.82

Exp=Experimental group, Con=Control group

Table 18. Self efficacy comparison between chatbot intervention & control group post-test using t-test

Variable	Phase	t	*p*
Self efficacy	1st(4wks)	-2.26,	.028**
	2nd(8wks)	-7.74	<.001
	3rd(12wks)	-8.47	<.001

Hypothesis 4: There will be a difference in the child's vaccination behavioral intention scores between the experimental and control groups.

In order to verify the research hypothesis 4, as a result of independent t-testing of the scores of the control group and the experimental group for the difference in the vaccination behavioral intention score, the experimental group (M=4.22 SD=.98) compared to the control group (M=2.69, SD=1.32) at the 4 week time point. 0.98) was found to be higher, which was statistically significant (t=-5.23, p=.000). At the 8 week time point, the experimental group (M=4.64, SD=0.48) showed a higher mean than the control group (M=2.64, SD= 1.09), which was statistically significant (t=-9.48, p=.000). Also, at the 12 week time point, the mean of the experimental group (M=4.71, SD=0.41) was higher than that of the control group (M=2.76, SD= 1.07), which was also statistically significant (t=-9.65, p=.000). In other words, it was found that the experimental group using the chatbot had higher child vaccination behavioral intention than the control group. Therefore, the research hypothesis 4 was also confirmed. The results of t-test analysis of child vaccination behavioral intention of the experimental and control groups are shown in (Table 19, 20).

Table 19. Scores of child vaccination behavioral intention in the experimental and the control group (N=63)

Variable	Group	Post-test 4wks Mean±SD	Post-test 8wks Mean±SD	Post-test 12wks Mean±SD
Behavioral Intention	Exp(n= 31)	4.22±0.98	4.64±0.48	4.71±0.41
	Con(n= 32)	2.69±1.32	2.64±1.09	2.76±1.07

Exp=Experimental group, Con=Control group

Table 20. Behavioral intention comparison between chatbot intervention group post-test using t-test

Variable	Phase	t	*p*
Behavioral Intention	1st(4wks)	-5.23	<.001
	2nd(8wks)	-9.48	<.001
	3rd(12wks)	-9.65	<.001

3) Turing test results

When asked, "Having used the Chatbot for 12 weeks, did it feel like you were talking to a person on the Chatbot platform?" 25.71% of the respondents agreed, saying that it felt like talking to a person. At the same time, 74.29% of the respondents disagreed, saying that it felt like talking to a machine. Figure 18 shows the results of the survey.

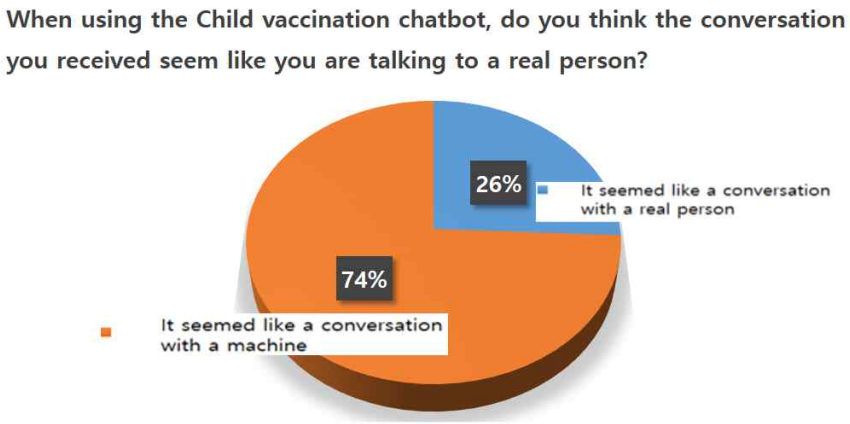


Figure 18. Child vaccination chatbot's Turing Test results

This is no more less than the 30% pass rate needed for the Turing test, but it is close. The following questions were asked to determine which parts of the chatbot could be improved to make it more human-like and to accurately communicate child's vaccination information. When asked in an open-ended question which part of the conversation made it feel like they were talking to a person, the respondents mentioned that it did not feel dry like a book. Although

the answers were fixed, the way the answers were given was not plain or unemotional. The information was conveyed in a kind manner. Looking at the results derived from the open-ended questions, most respondents referred to the manner of speech as the point that made it feel like talking to a person.

The machine which can think, as defined by the Turing test, refers to a machine with conversation skills that are indistinguishable from humans. Giving accurate answers like machines is not necessarily a factor that makes them feel like they were human. This was reflected in the respondents' answers to the question if the conversations with the chatbot were human-like. The experimental group that used the chabot not only considered accuracy of the answers, but also emotional elements, such as a soft tone, humor, and emoticons, when assessing if their conversations with the chatbot felt like talking to a human. When too detailed and accurate answers were given, they felt that they were machine-like.

On the other hand, research participants responded that the conversation with the chatbot seemed like talking to a machine when they did not receive expected responses—for example, when the chatbot answered that it could not understand and told the respondents to ask again. The respondents also mentioned that the answers felt unemotional. Unlike conversations with real people, conversations with the chatbot provided predetermined answers. That could be one of the reasons why the conversations felt unemotional.

The respondents also mentioned that vaccination-related terms were

difficult, some terms were in english, which could have been explained in a more accessible manner. Moreover, answers containing a lot of information which came out all at once in a single speech bubble.

When the respondents were asked in an open-ended question what improvements could be made to continuously improve the chatbot, the answers were as follows: usage of a natural tone, providing specific answers to questions, and giving short but frequent answers rather than sharing too much information at once. One of the suggestions was to include cute baby illustration icons rather than just plain words or phrases. Also, the following phrases, for example, could be included: "It's been a month since our baby was born. Today is a BCG vaccination day!" The respondents wanted a softer tone with an emoticon at the end of the sentence, and preferred a sympathetic emotional element with a comment-like response in the middle of the conversation. Some respondents suggested to provide answers in a second or two, considering the time needed to think, rather than answ ering immediately. Also, preventing irrelevant answers could lead to a more natural conversation.

Ⅵ. Discussion

In this study, the child vaccination chatbot's intervention was provided through the SNS platform to parents raising their first child who needed vaccinations. Based on IMB model, the real-time consultation messenger service chatbot was developed for vaccination-related questions and answers. In the study, the participants were asked to apply the developed chatbot. Then, the chatbot was evaluated and the changes in scores for vaccination information, motivation, self-efficacy, and vaccination behavioral intention were measured.

The child vaccination chatbot had a significant effect on increasing the amount of vaccination-related information, parents' motivation to vaccinate their children, vaccination self-efficacy, and parents' intention to vaccinate their children. However, the effect of improving self-efficacy over time was not significant. Therefore, this chapter focuses on the results of the hypotheses tests on the effects of the child vaccination chatbot.

1. Development of the Child Vaccination Chatbot

In this study the child vaccination chatbot was developed based on the Kakao Talk's platform to enable parents to receive information about vaccinations via a familiar platform. Kakao Talk SNS platform is used by 98% of parents in South Korea. There were 44.417 millions of Kakao Talk users in the second quarter of 2019 (Maeil Business News Korea, 2020). It has the largest number of users in South Korea.

The Kakao Talk platform can deliver a real-time one-to-one messenger service and can also link to other services such as Kakao Plus Friends. Some of the characteristics of Kakao Talk is that it can be used habitually; it is convenient; and can be used to interact each other. Moreover, it can promote social networking and emotional exchanges among members (Choi & Kim, 2013). Research on health promotion based on Kakao Talk has been recently conducted actively, and the effects have been proved in previous study by Park (2018). The effects of the chatbot on health promotion was proved in this study.

In this study, parents who missed a vaccination schedule were interviewed to derive the functional needs which could be applied in the chatbot. Also, the intervention delivery method was designed by using the SNS platform. Through Kakao Plus Friend Service, when the vaccination date was imminent, notification messages were automatically sent, and weekly information related to vaccinations, articles related to vaccinations, newsletters, webtoons were regularly provided. It also included provided information about the nearest vaccination health center

and medical institutions' location. However, the most important motivational factor in increasing child vaccinations is providing accurate information promptly.

Chatbot development was based on the software development life cycle described by Davis (1989) and Bhattacherjee (2001). The necessary data were collected through prior research on vaccination for children at the Korea Centers for Disease Control and Prevention. Parents who missed a child's vaccination expressed high demand for information on vaccinations to be provided continuously. Based on the details derived from the interviews, the question-and-answer algorithm was updated to meet the users' needs while the research was conducted. According to Wang et al. (2011), if a user download a mobile application with unsatisfactory content that was repeated and was not updated continuously, the user would discontinue using the application.

Based on the reflecting the environmental background new types of updated information were needed. For example, adding questions to the chatbot regarding the COVID-19 infection was required. It was not possible to predict COVID-19 before the study commenced. COVID-19 occurred during the chatbot intervention period. In the face of the pandemic, parents expressed fears and concerns about their children's vaccinations. Therefore, they used the chatbot to search for information on how to vaccinate their children safely during the pandemic. The KCDC announced that children's vaccinations could be carried out safely even during the pandemic. This information was shared in real-time Q&A sessions.

Thus, it was found that providing personalized real-time information based on the child's age and life cycle, and reflecting environmental changes was essential. It was important to notify the upcoming vaccination schedule. Therefore, the provided information should reflect the current environment changes, provide credible real time personalized information, so that parents can be assured to safely implement the child vaccination.

2. Child Vaccination Chatbot's Application and its Effects

The results of this study showed that vaccination information (knowledge), motivation, self-efficacy, and behavioral intention of the parents using the child vaccination chatbot had significant effects in boosting vaccination. The experimental group that used the child's vaccination chatbot also scored higher on vaccination information, motivation, self-efficacy, and behavioral intention than the control group that maintained using the existing information delivery method.

When raising a child, parents ask numerous questions about precautions before, during, and after the vaccination and how the information varies with each vaccination. Most often, parents look for answers to their questions about child's vaccination on the Internet. However, it is difficult to find specific information based on the child's age. Nadarzynski et al. (2019) stated that in order to provide information through AI-based intervention, the opinions of users and

health care professionals must be reflected to maximize the effect. Based on that study, this study used standardized data provided by the KCDC for the chatbot's responses. As demonstrated by previous studies, providing reliable information based on the mobile chatbot, which is easy for users to access, can have a positive effect on vaccination motivation.

The key motivator for maintaining the participation is providing social rewards. Previous research has shown it is helpful to express empathy when people post comments or posts photos (Eyal, 2013). When the participants posted a photo completing the vaccination, a message of encouragement and coupons were sent to motivate them. One method of motivating people is praising them. This is a simple but powerful reward method in which positive values can be motivational factors (Veplanken, 2006). As demonstrated by the previous study, rewards, showing interest, responding and leaving comments using positive language affects motivation for vaccinating children.

Jones (2013) showed that providing mobile-based information was effective in enhancing self-efficacy. Similarly with the previous study, the group that used the child vaccination chatbot also showed higher self-efficacy scores. Increased vaccination self-efficacy scores mean that the parents have the confidence to successfully implement the essential vaccination schedule.

The information-motivation-behavioral skills model developed by Fisher et al. (2009), stated that when information related to health

behavior is provided properly, it motivates people to behave in a healthy manner. Furthermore, as self-efficacy improves it results in changes in the health behavior. As mentioned in Fisher's et al. (2009) study it was found that as motivation and self-efficacy of parents using a chatbot increased, vaccination behavioral intention also increased in the experimental group. The increase was higher than in the control group.

3. Child Vaccination Chatbot's Turing Test

In this study, the Turning test was performed at the end of Week 12 of chatbot's use. The test demonstrated that 74.29% of the respondents said the conversations with the chatbot felt like talking with a machine. Since 1950, There there have been numerous attempts to pass the test. In 2014, Eugene Goostman chatbot passed the Turing test. However, no other chatbots or computer programs have yet passed the test (Warwick & Shah, 2016). According to previous studies, in order to compensate for the disadvantages of text-oriented web programs, it is better to limit the length of the text of the contents of the program, and use more images and video materials to reduce users' boredom and increase contents' readability (Kwon, 2015). In order to use chatbots continuously and effectively, these factors must be considered and developed.

Health-related questions are endless in the health care sector, and

medical personnel have to answer the same questions repeatedly. However, if a chatbot, can provide human-like real-time conversations, based on reliable and accurate information, it can reduce the time and costs for many people. Health and medical personnel can automate answers to repetitive questions, so that they can focus more on productive tasks. Artificial intelligence(AI) can replace humans. It can also give people time to efficiently handle repetitive questions.

4. Limitations of the Study

First, in this study, a pre-test was excluded in order to eliminate the test effects, when the results of the study are influenced by the e xposure of the study's participats to the variables in advance. Thus, in selecting the experimental group and the control group, efforts were made to form homogeneous groups.

Second, COVID-19 pandemic originated December 2019. This pandemic was not expected to occur durign the research period(from November, 2019 to May, 2020). Thus, inquiries on how to safely vaccinate children during pandemic were not foreseen in advance. At the beginning of the study, the chatbot's vaccination question and ans wer algorithm lacked a scenario to respond to the vaccination questions related to the outbreak of COVID-19. Therefore, a response scenario for these inquiries was created and added to the chatbot. The chatbot regularly provided information for parents that used it on how

to vaccinate their children safely.

Third, since the control group also completed online surveys on vaccination regularly, it was possible that the online surveys had a positive effect on the control group's vaccination-related attitudes and behaviors by evoking memories of the vaccinations.

5. Significance of the Study in Nursing

1) Nursing Practice

Children are unable to decide their health behaviors. Thus, their health behaviors are mainly decided by parents. Therefore, parents' health beliefs have a direct effect on their childrens' vaccination. Until now, the information on vaccinations has been standardized. Users have had to find the necessary information in a large amount of information. However, in this study, the customized child vaccination chatbot based on a real-time consultation messenger service was newly used based on the child's age. This contributed to the reduction in response time to repeated questions in medical institutions and clinics and to the efficient provision of in-depth customized information on each subject. This study can be applied to community nursing practice in social distance situations during COVID-19 pandemic.

2) Nursing Research

The application of the child vaccination chatbot, developed based on the information-motivation-behavioral model, was more efficient in finding vaccination information, motivating users, achieving self-efficacy, and enhancing vaccination behavioral intention than the existing methods of obtaining information. The chatbot will contribute to successful implementations of children's vaccinations by providing real-time information, personal motivation, and social motivation to increase confidence and convenience of parents. Ultimately, it is expected that the chatbot will provide empirical examples that can be used in promoting children's vaccinations.

3) Nursing Education

Parents tend to search for parenting information through various media. They tend to actively share and trust the experiences of other parents raising children of similar age (Lazarsfeld Paul, Berelson, & Gaudet, 1944). Therefore, accurate information provided by a chatbot could be shared by parents who raise children of similar ages with others. It will be an opportunity for parents to learn vaccination related knowledge through the information provided by chatbot.

6. Implications

Based on these results, the followings are suggested for the future studies:

First, long-term follow-up research to monitor the effects of the child's vaccination chatbot is needed. Second, based on the respondents' opinions collected after the Turing test, it is suggested that the child vaccination chatbot can be upgraded based on the continued research. Third, additional research is needed to find out how economically effective the chatbot can be and how it can complement what people have been doing. In addition, follow-up research is needed on areas where time can saved by using the chatbot.

Ⅶ. Conclusion

1. Conclusion

Based on the information-motivation-behavioral skills model the child vaccination chatbot was developed. In order to identify the effects of vaccination information that parents have, parents' motivation to vaccinate their children, self-efficacy, and vaccination behavioral intention a quasi-experimental research design was applied.

The participants of the study were parents who raised children from 0 to 35 months old and those who raised children expected to be vaccinated within three months. There were 35 participants in the experi mental group and 34 participants in the control group. The children's ages were similar in both groups.

The research was carried out from February, 2020 to May, 2019.. The measurements were taken after Week 4, Week 8 and Week 12. SPSS statistical software was used for data analysis.

First, in order to ensure homogeneity of the experimental and control groups, the ages of children and parents were not statistically different between the two groups. In order to increase the internal validity of the post-design of the non-equal control group, the control group and the experimental group should be composed of homogeneous groups. For the demographic characteristics of 'gender','number of children's

months', and 'parent age', a sub-sample was selected so that the experimental group and the control group consisted of homogeneous groups.

Second, the experimental group that used the chatbot scored higher for vaccination information than the control group. As a result of independent sample t-testing of the scores of the control group and the experimental group against the difference in the vaccination information score, the average of the experimental group (M=6.13, SD=2.63) compared to the control group (M=3.34, SD=2.55) at the first time point It was found to be higher, which was statistically significant (t=-4.27, p=.000). At the second time point, the experimental group (M=8.29, SD=2.15) showed a higher mean than the control group (M=4.44, SD=2.06), which was statistically significant (t=-7.26, p=.000). Also, at the 3rd time point, the mean of the experimental group (M=8.74, SD=1.70) was higher than that of the control group (M=3.88, SD=2.14), which was also statistically significant (t=-10.00, p=.000).

Third, the experimental group that used the chatbot was more motiv ated than the control group. The control group and the experimental group for the difference in the vaccination motivation score, the average of the experimental group (M=2.83 SD=.83) compared to the control group (M=2.17, SD=.77) at the first time point Was found to be higher, which was statistically significant (t=-3.28 p=.002). The experimental group using chatbots showed higher motivation than the control group. At the second time point, the experimental group (M=

3.21, SD=.57) showed a higher mean than the control group (M=2.28, SD=.45), which was statistically significant. (t=-7.19, p=.000). Also, at the 3rd time point, the mean of the experimental group (M=3.63, SD= .38) was higher than that of the control group (M=2.45, SD=.56), which was also statistically significant (t=-8.81 p=.000).

Fourth, the experimental group that used the chatbot scored higher in self-efficacy than the control group. The experimental group (M= 3.22 SD=.68) compared to the control group (M=2.66, SD=1.23) at the 4 week time point. 0.68) was found to be higher, which was statistically significant (t=-2.26, p=.028). The experimental group using chatbots showed higher self-efficacy score than the control group. At the 8 week time point, the experimental group (M=3.59, SD=.34) showed a higher mean than the control group (M=2.66, SD=1.26), which was statistically significant (t=-7.74, p=.000). Also, at the 12 weeks time point, the mean of the experimental group (M=3.76, SD=.34) was higher than that of the control group (M=2.43, SD=.82), which was also statistically significant (t=-8.47, p=.000). In other words, the experimental group using the chatbot showed a higher average of self-efficacy than the control group.

Fifth, the experimental group that used the chatbot scored higher for vaccination behavioral intention than the control group. The experimental group (M= 4.22 SD=.98) compared to the control group (M= 2.69, SD= 1.32) at the 4 week time point. 0.98) was found to be

higher, which was statistically significant (t=-5.23, p=.000). At the 8 week time point, the experimental group (M=4.64, SD=.48) showed a higher mean than the control group (M=2.64, SD=1.09), which was statistically significant (t=-9.48, p=.000). Also, at the 12 week time point, the mean of the experimental group (M=4.71, SD=.41) was higher than that of the control group (M=2.76, SD=1.07), which was also statistically significant (t=-9.65, p=.000).

Based on the results, it is assumed that the child vaccination chatbot provides useful and prompt information for parents raising children who need to be vaccinated. The child vaccination chatbot increased vaccination motivation, self-efficacy, and vaccination rates by providing necessary information for parents.

References

Cho, I. S. (2008). An overview and preparation of Korean pediatrician according to the expansion of national immunization program coverage. Korean Journal of Pediatrics, 51(12), 1275-1281.

Ko, K. M. (2012). The impact of health campaigns on the public's awareness & behavior regarding cervical cancer. *Seoul: Ewha Womans University.*

Kwon, K. D., Yoon, L. T., Eeok, C. W., Bae, P. S., & Hyun, O. D. (2010). Smart Phone Opening the Future. CEO Information, 0 (741), Samsung Economics Research Institute (SERI).

Kwon, E. J. (2015). Development and Evaluation of Information Support Program for Spouses of Women with Breast Cancer Using Mobile Phone, *Doctoral dissertation, Seoul National University.*

Kim, S. M. (2008). A study on pertussis immunity state and influencing factors for adult pertussis vaccination in healthcare-workers, *Inha University, Inchon.*

Kim, C. S., Bae, G. R., Lee, Y. K., & Kim, M. J. (2010). A Study on the Immunization information Mobile Services using the Smart-Phone. Journal of the Korea Institute of Information and Communication Engineering, 14(11), 2521-2526.

Nam, H. J., Lee, S. G., Jeon, S. Y., Om, J. E., & Park, K. S. (2017). Investigation of Children with No Vaccinations Recorded on the National Immunization Registry Information System. Journal of

the Korean Society of Maternal and Child Health, 21(3), 176-181.

Min, J. W., Kwon, M. K., & Yoon, J. Y. (2014). An Analysis on Parents' Using Child Caring Information and Measures to Increase the Availability.

Park, M. B., Kim, C. B., & Joo, H. S. (2013). Factors influencing on influenza vaccination coverage. The Journal of the Korea Contents Association, 13(4), 300-311.

Park, M. W., (2018). Development of SNS platform based healthy lifestyle coaching program and effectiveness evaluation, [Doctoral dissertation], *Seoul National University.*

Park, J. J. (2018). A development of Chatbot for emotional stress recognition and management using NLP. The Transactions of The Korean Institute of Electrical Engineers, 67(7), 954-961.

Park, J. H. (2011). A study on mothers' knowledge, health beliefs and children's hepatitis A vaccination rate. *Unpublished master's thesis, Ewha Womans University, Seoul.*

Bang, S. H., Yoo, A. R., Cho, S. Y., Choi, I. S., Kim, S. W., & Jeong, Y. (2012). Human papillomavirus vaccination status and related factors among some female college students. *Journal of The Korean Society of Maternal and Child Health,* 16(2), 186-194.

Wang, B. R., Park, J. Y., & Choi, I. Y. (2011). Influencing factors for the adoption of smartphone healthcare application. *The Journal of the Korea Contents Association*, 11(10), 396-404.

Yoo, S. W., Park, K. H., & Na, E. Y. (2010). The effect of

psychological reactance and fear of influenza A (H1N1) message on the preventive behavioral intention. *Korean J Journal Commun Stud,* 54(3), 27-53.

Lee, D., Yi, M. Y., Choi, J., & Lee, H. (2011). Measuring the mobile user experience: conceptualization and empirical assessment. SIGHCI 2011 Proceedings. Paper, 3, 2011.

Lee Seung-ik, & Jo Sung-bae (2003). A Web-based Conversational Agent. Journal of Computing Science and Engineering: Transactions on Computing Practices and Letters, 9(5) 530-540.

Lee, S. H., & Yang, S. J. (2017). Factors associated with Rotavirus vaccination behavior among mothers of infants: using the health belief model. *Journal of Korean Public Health Nursing*, 31(1), 34-46.

Lee et al. (2009). Evaluation of Data Error, Completeness, Timeliness of National Immunization Registry in Korea. Journal of Korean Society of Maternal Child Health, 13(2), 135-144.

Jeon, E. J. (2017). Development and effectiveness evaluation of diabetes self-management mobile application based on imb model [Doctoral dissertation]. *Seoul: Univ. of Seoul National.*

Jo, J. Y., Ki, Y. G., Chang M. Y., and Kang, M. L. (2017). The AI Chatbot using Chatscript and Control Topic Sequence Algorithm, 1884-1886.

Korea Center for Disease Control Press Release (2011.06.24) Hepatitis A Prevention Tips, Disease Control Division Immunization Management Division

Cha, D. P. (2004). Understanding AIDS preventive behaviors among university students. *Journal of Korean Association for Advertising and Public Relations*, 6(3), 137-160.

Choi, M. J., & Kim, W. G. (2013). An exploratory study on use motivation, evaluation and selection of SNS mobile marketing services focused on the "KakaoTalk PlusChingu". *The Korean Journal of Advertising and Public Relations, 15*(2), 85-110.

Han, K. H. (2011). The impact of health belief components on the effectiveness of women's cancer prevention campaigns: A cross-national examination towards Korean and Japanese women. *Korean Journal of Advertizing and Public Relations, 13*(2), 377-412.

Ajzen, I. (1991). The theory of planned behavior. Organizational behavior and human decision processes, 50(2), 179-211.

Bandura, A. (1995). Exercise of personal and collective efficacy in changing societies. Self-efficacy in changing societies. Self-efficacy in changing societies, 1-45.

Bhattacherjee, A. (2001). Understanding information systems continuance: an expectation-confirmation model. MIS quarterly, 25(3), 351-370.

Brennan, K. (2006). The managed teacher, emotional labour, education, and technology. Educational Insights, 10(2), 55-65.

Carey, M. J., & Kossmann, D. (1997). On saying "enough already!" in SQL. In J. Peckham(Ed.), Proceedings of the 1997 ACM SIGMOD international conference on Management of data (pp.

219-230). New York: ACM.

Cisco Visual Networking Index (2016). Global Mobile Data Traffic Forecast Update, 2015 - 2020, San Jose, CA: Cisco.

Choi, S. Y., Song, M. S. (2010). Behavior change theories in diabetes selfmanagement: a conceptual review. Perspectives in Nursing Science, 7(1), 1e9.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS quarterly, 13(3), 319-340.

DeCarlo, M., Crenshaw, C., Fominaya, A., Parsons, A., Secret, M., & Stewart, M. (2019). Open textbooks and student learning in social work research methods: Results from a mixed-methods and student-engaged pilot project.

Dwamena, F., Holmes Rovner, M., Gaulden, C. M., Jorgenson, S., Sadigh, G., Sikorskii, A., & Beasley, M. (2012). Interventions for providers to promote a patient-centered approach in clinical consultations. In M. Holmes-Rovner (Ed.), Cochrane Database of Systematic Reviews. Chichester, UK: John Wiley & Sons, Ltd.

Eyal, N. (2013). Hooked: How to Build Habit-Forming Products is a guide to building habit-forming technology.

Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G* Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behavior research methods, 39(2), 175-191.

Fisher, J. D., & Fisher, W. A. (1992). Changing AIDS-risk behavior.

Psychological Bulletin, 111(3), 455-474.

Fisher, J. D., Amico, K. R., Fisher, W. A., & Harman, J. J. (2008). The information-motivation-behavioral skills model of antiretroviral adherence and its applications. Current HIV/AIDS Reports, 5(4), 193-203.

Fisher, J. D., Fisher, W. A., & Shuper, P. A. (2009). The information - motivation - behavioral skills model of HIV preventive behavior. Emerging theories in Health promotion practice and Research, 2, 21-64.

Fisher, W. A., Fisher, J. D., & Harman, J. (2003). The information-motivation-behavioral skills model: A general social psychological approach to understanding and promoting health behavior. Social psychological foundations of health and illness, 22, 82-106.

Funnell, M. M., Brown, T. L., Childs, B. P., Haas, L. B., Hosey, G. M., Jensen, B.,& Siminerio, L. M. (2009). National standards for diabetes selfmanagement education. Diabetes care, 32(Supplement 1), S87-S94

Goldenthal, S. B., Portney, D., Steppe, E., Ghani, K., & Ellimoottil, C. (2019). Assessing the feasibility of a chatbot after ureteroscopy. mHealth, 5, 8.

Goodell, L. S., Pierce, M. B., Amico, K. R., & Ferris, A. M. (2012). Parental information, motivation, and behavioral skills correlate with child sweetened beverage consumption. Journal of nutrition education and behavior, 44(3), 240-245.

Heiss, S. N., Carmack, H. J., & Chadwick, A. E. (2015). Effects of interpersonal communication, knowledge, and attitudes on pertussis vaccination in Vermont. Journal of Communication in Healthcare, 8(3), 207-219.

Hill, S., & Draper, M. (2011). A new conceptual framework for advancing evidence informed communication and participation. In S. Hill (Ed.), The Knowledgeable Patient: Communication And Participation in Health (pp.12-26). Chichester, UK: Wiley Blackwell.

Hoermann, S., McCabe, K. L., Milne, D. N., & Calvo, R. A. (2017). Application of synchronous text-based dialogue systems in mental health interventions: systematic review. Journal of medical Internet research, 19(8), e267.

Humiston, S. G., & Rosenthal, S. L. (2005). Challenges to vaccinating adolescents: vaccine implementation issues. The Pediatric infectious disease journal, 24(6), S134-S140.

Jones, J. M., Lewis, F. M., Griffith, K., Cheng, T., Secord, S., & Walton, T., et al. (2013). Helping her heal-group: A pilot study to evaluate a group delivered educational intervention for male spouses of women with breast cancer. Pscyho - Oncology, 22 (9), 2102-2109.

Kang, H. J., & Kim, S. I. (2017). Evaluation on the Usability of Chatbot Intelligent Messenger Mobile Services-Focusing on Google (Allo) and Facebook (M messenger). Journal of the Korea Convergence Society, 8(9), 271-276.

Kaufman, J., Ryan, R., Walsh, L., Horey, D., Leask, J., Robinson, P., & Hill, S. (2018). Face-to-face interventions for informing or educating parents about early childhood vaccination.

Kevin Warwick & Huma Shah (2016) Can machines think? A report on Turing test experiments at the Royal Society, Journal of Experimental & Theoretical Artificial Intelligence, 28:6, 989-1007, DOI: 10.1080/0952813X.2015.1055826

Lazarsfeld Paul, F., Berelson, B., & Gaudet, H. (1944). The People's choice. New York: Duell, Sloan, and Pearce.

Lynn, M. R. (1986). Determination and quantification of content validity. Nursing Research, 35(6), 382 - 385.

Min, J. W., Kwon, M. K., & Yoon, J. Y. (2014). An Analysis on Parents' Using Child Caring Information and Measures to Increase the Availability. Korea Institute of child care and education.

Nadarzynski, T., Miles, O., Cowie, A., & Ridge, D. (2019). Acceptability of artificial intelligence (AI)-led chatbot services in healthcare: A mixed-methods study. Digital health, 5, 1-12.

National Information Society Agency. (2018). 2018 report of the digital divide.

Ozawa, S., Clark, S., Portnoy, A., Grewal, S., Brenzel, L., & Walker, D. G. (2016). Return on investment from childhood immunization in low-and middle-income countries, 2011 - 20. Health Affairs, 35(2), 199-207.

Patrick, K., Calfas, K. J., Norman, G. J., Rosenberg, D., Zabinski, M.

F., Sallis, J. F., et al. (2011). Outcomes of a 12-month web based intervention for overweight and obese men. Annals of Behavioral Medicine, 42 (3), 391-401.

Rodriguez-Osorio, C. A., & Dominguez-Cherit, G. (2008). Medical decision making: paternalism versus patient-centered (autonomous) care. Current opinion in critical care, 14(6), 708-713.

Reyes, R., Garza, D., Garrido, L., De la Cueva, V., & Ramirez, J. (2019, October). Methodology for the Implementation of virtual assistants for education using Google Dialogflow. In Mexican International Conference on Artificial Intelligence (pp. 440-451). Springer, Cham.

Rye, B. J. (1998). Impact of an AIDS prevention video on AIDS-related perceptions. Canadian Journal of Human Sexuality, 7(1), 19 - 30.

Turing, A. M. (1950). Computing machinery and intelligence-AM Turing. Mind, 59(236), 433-434.

Verplanken, B. (2006). Beyond frequency: habit as mental construct. Br J Soc Psychol, 45(Pt 3), 639-656.

Wang, Y. C., Kraut, R. E., & Levine, J. M. (2015). Eliciting and receiving online support: using computer-aided content analysis to examine the dynamics of online social support. Journal of medical Internet research, 17(4), e99.

World Health Organization. (2017). Guidance for the development of evidence-based vaccination-related recommendations. Strategic

Advisory Group of Experts on Immunization. Geneva: World Health Organization.

World Health Organization (2016). Immunization coverage fact sheet. Retrieved from www.who.int/mediacentre/factsheets/fs378/en/ (accessed 11 October 2016).

Wong-Villacres, M., Evans, H., Schechter, D., DiSalvo, B., & Kumar, N. (2019, January). Consejero automatico: chatbots for supporting Latino parents' educational engagement. In Proceedings of the Tenth International Conference on Information and Communication Technologies and Development (pp. 1-5).

Zhao, J., Freeman, B., & Li, M. (2016). Can mobile phone apps influence people's health behavior change? An evidence review. Journal of medical Internet research, 18(11), e287.

Korea Center for Disease Control (2019). Vaccination information search site. Retrieved from https://nip.cdc.go.kr/irgd/index.html

Kakao Plus Friend's manager center. Retrieved from https://center-pf.kakao.com

KakaoTalk in its 10th year has nearly all S. Korean population connected Maeil Business News Korea, Retrieved from https://pulsenews.co.kr/view.php?year=2020&no=218180

Appendix 1. IRB review results

심의결과 통보서

수신

연구책임자	이름: 홍영주	소속: 간호대학 간호학과	직위: 박사과정
지원기관	해당없음		

과제정보

승인번호		IRB No. 2002/001-008	
연구과제명		소아예방접종 챗봇 개발 및 효과평가	
연구종류		학위 논문 연구 , 설문조사 , 면담(FGI 포함)	
심의종류		재심의	
심의일자		2020-01-30	
심의대상		설명문 및 동의서 또는 서면동의 면제사유서 , 재심의 답변서	
심의결과		승인	
승인일자		2020-01-30	승인유효기간 2021-01-29
정기보고주기		12개월	
심의의견		1. 심의결과 제출하신 연구계획에 대해 승인합니다. 2. 연구자께서는 승인된 문서를 사용하여 연구를 진행하시기 바라며, 만일 연구진행 과정에서 계획상에 변경사항(연구자 변경, 연구내용 변경 등)이 발생할 경우 본 위원회에 변경신청을 하여 승인 받은 후 연구를 진행하여 주십시오. 3. 유효기간 내 연구가 끝났을 경우 종료 보고서를 제출하여야 하며, 승인유효기간 이후에도 연구를 계속하고자 할 경우, 2020-12-29까지 지속심의를 받도록 하여 주십시오.	
검토의견	계획서 검토의견		
	동의서 검토의견		
	기타 검토의견		

2020년 01월 30일

서울대학교 생명윤리위원회 위원장

본 위원회가 승인한 연구를 수행하는 연구자들은 다음의 사항을 준수해야 합니다.

1. 반드시 계획서에 따라 연구를 수행해야 합니다.
2. 위원회의 승인을 받은 연구참여자 동의서를 사용해야 합니다.
3. 모국어가 한국어가 아닌 연구참여자에게는 승인된 동의서를 연구참여자의 모국어로 번역하여 사용해야 하며 번역본은 인증 및 위원회의 승인을 거쳐야 합니다.
4. 연구참여자 보호를 위해 불가피한 경우를 제외하고는 연구 진행중의 변경에 대해서는 위원회의 사전 승인을 받아야 합니다. 연구참여자의 보호를 위해 취해진 응급상황에서의 변경에 대해서는 즉각 위원회에 보고해야 합니다.
5. 위원회에서 승인 받은 계획서에 따라 등록된 연구참여자의 사망, 입원, 심각한 질병에 대하여는 위원회에 서면으로 보고해야 합니다.
6. 임상시험 또는 연구참여자의 안전에 대해 유해한 영향을 미칠 수 있는 새로운 정보는 즉각 위원회에 보고해야 합니다.
7. 위원회의 요구가 있을 때에는 연구의 진행과 관련된 사항에 관하여 위원회에 보고해야 합니다.
8. 연구참여자 모집광고는 사용 전에 위원회로부터 승인을 받아야 합니다.
9. 강제 혹은 부당한 영향력이 없는 상태에서 충분한 설명에 근거하여 연구참여자로부터 동의를 받아야 하며, 잠재적인 연구참여자에 대해서 연구 참여 여부를 숙려할 수 있도록 충분한 기회를 제공해야 합니다.

Appendix 2. IRB review results (Additional review on adding questionnaire)

심의결과 통보서

수신

연구책임자	**이름:** 홍영주	**소속:** 간호대학 간호학과	**직위:** 박사과정
지원기관	해당없음		

과제정보

승인번호		IRB No. 2002/001-008	
연구과제명		소아예방접종 챗봇 개발 및 효과평가	
연구종류		학위 논문 연구 , 설문조사 , 면담(FGI 포함)	
심의종류		변경	
심의일자		2020-05-25	
심의대상		연구결과정리양식 , 변경대조표 , 설문지(면담질문지)	
심의결과		승인	
승인일자		2020-05-25	승인유효기간 2021-01-29
정기보고주기		12개월	
심의의견		1. 심의결과 제출하신 연구계획에 대해 승인합니다. 2. 연구자께서는 승인된 문서를 사용하여 연구를 진행하시기 바라며, 만일 연구진행 과정에서 계획상에 변경사항(연구자 변경, 연구내용 변경 등)이 발생할 경우 본 위원회에 변경신청을 하여 승인 받은 후 연구를 진행하여 주십시오. 3. 유효기간 내 연구가 끝났을 경우 종료 보고서를 제출하여야 하며, 승인유효기간 이후에도 연구를 계속하고자 할 경우, 2020-12-29까지 지속심의를 받도록 하여 주십시오.	
검토의견	계획서 검토의견		
	동의서 검토의견		
	기타 검토의견		

2020년 05월 25일

서울대학교 생명윤리위원회 위원장

본 위원회가 승인한 연구를 수행하는 연구자들은 다음의 사항을 준수해야 합니다.

1. 반드시 계획서에 따라 연구를 수행해야 합니다.
2. 위원회의 승인을 받은 연구참여자 동의서를 사용해야 합니다.
3. 모국어가 한국어가 아닌 연구참여자에게는 승인된 동의서를 연구참여자의 모국어로 번역하여 사용해야 하며 번역본은 인증 및 위원회의 승인을 거쳐야 합니다.
4. 연구참여자 보호를 위해 불가피한 경우를 제외하고는 연구 진행중의 변경에 대해서는 위원회의 사전 승인을 받아야 합니다. 연구참여자의 보호를 위해 취해진 응급상황에서의 변경에 대해서는 즉각 위원회에 보고해야 합니다.
5. 위원회에서 승인 받은 계획서에 따라 등록된 연구참여자의 사망, 입원, 심각한 질병에 대하여는 위원회에 서면으로 보고해야 합니다.
6. 임상시험 또는 연구참여자의 안전에 대해 유해한 영향을 미칠 수 있는 새로운 정보는 즉각 위원회에 보고해야 합니다.
7. 위원회의 요구가 있을 때에는 연구의 진행과 관련된 사항에 관하여 위원회에 보고해야 합니다.
8. 연구참여자 모집광고는 사용 전에 위원회로부터 승인을 받아야 합니다.
9. 강제 혹은 부당한 영향력이 없는 상태에서 충분한 설명에 근거하여 연구참여자로부터 동의를 받아야 하며, 잠재적인 연구참여자에 대해서 연구 참여 여부를 숙려할 수 있도록 충분한 기회를 제공해야 합니다.

Appendix 3. Instructions for study participants

(IRB Approval document)

IRB No. 2002/001-008 유효기간: 2021년 01월 29일

연구참여자용 설명문(예방접종 대상 아동을 양육하는 부모용)

연구 과제명 : 소아예방접종 챗봇 개발 및 효과평가
연구 책임자명 : 홍영주(서울대학교 간호대학 박사과정)

이 연구는 소아예방접종 챗봇 개발 및 효과평가를 위한 연구입니다. 귀하는 모바일 메신저 사용이 가능하며, 8주 이내에 예방접종 대상 소아를 양육하고 있는 부모이기 때문에 이 연구에 참여하도록 권유받았습니다. 이 연구를 수행하는 서울대학교 소속의 홍영주 연구원 *(010-3905-5891)*이 귀하에게 이 연구에 대해 설명해 줄 것입니다. 이 연구는 자발적으로 참여 의사를 밝히신 분에 한하여 수행 될 것이며, 귀하께서는 참여 의사를 결정하기 전에 본 연구가 왜 수행되는지 그리고 연구의 내용이 무엇과 관련 있는지 이해하는 것이 중요합니다. 다음 내용을 신중히 읽어보신 후 참여 의사를 밝혀 주시길 바라며, 필요하다면 가족이나 친구들과 의논해 보십시오. 만일 어떠한 질문이 있다면 담당 연구원이 자세하게 설명해 줄 것입니다.

1. 이 연구는 왜 실시합니까?

본 연구는 소아예방접종 챗봇 개발 및 효과평가 연구입니다. 본 설문지의 목적은 챗봇을 통하여 부모들에게 실시간 소아 예방접종 정보제공, 개인적 동기 사회적 동기부여는 자신감을 증대시켜 부모들에게 편의성을 더해 소아 예방접종을 성공적으로 이행하는데 기여할 수 있을 것입니다. 궁극적으로 챗봇이 소아 예방접종 건강증진 분야에서 활용될 수 있는 실증적 사례를 제공하는데 목적이 있습니다.

2. 얼마나 많은 사람이 참여합니까?

모바일 메신저 사용이 가능하며, 예방접종 대상 소아를 양육하고 있는 부모 6명의 사람이 참여할 것입니다. 세부 대상자 조건은 다음과 같습니다.
소아예방접종 대상 자녀를 양육하는 부모(3명), 한번이라도 이전에 소아 예방접종을 일정대로 누락한 적이 있는 부모(3명) 대상 인터뷰을 실시하여 주 사용자인 12세이하 예방접종 대상 아동을 양육하는 보호자의 요구를 파악할 예정입니다.

3. 만일 연구에 참여하면 어떤 과정이 진행됩니까?

만일 귀하가 참여의사를 밝혀 주시면 다음과 같은 과정이 진행될 것입니다.

1) 사전에 연구자가 연구참여자에게 개별적으로 현장에서 접촉하여 연구목적, 방법을 설명하고, 연구 진행 기간 중 언제든지 참여를 거부할 수 있음과 개인식별이 되지 않도록 자료를 처리하여 비밀 보장될 것임을 안내받을 것입니다. 그리고 인터뷰에 참여하기 직전에 연구자가 대면하여 다시 한번 동일한 내용을 설명하고 연구 참여 중 언제든지 본인의 의사에 따른 연구 참여의 철회 가능성과 이로 인한 어떠한 개인적인 불이익도 발생하지 않음을 충분히 설명할 예정입니다. 연구 참여는 서면을 통한 자발적인 동의를 얻은 후 실시할 예정입니다. 인터뷰 과

Version 1.1(2020.01.30.) - 1 -

정은 녹음은 하지 않습니다. 중도에 참여가 불가피한 상황이 발생할 경우 자유롭게 의사를 밝혀도 되며, 본 연구에 참여 중단하여도 어떠한 불이익도 없음을 설명 및 명시할 예정입니다.

2) 귀하는 20분 정도 소아 예방접종 챗봇 구현시 필요한 기능 예방접종 이행을 위해 어떠한 기능들이 챗봇에 방영되면 좋을지에 대한 질문을 받을 것입니다.

3) 예상되는 인터뷰 질문 내용은 다음과 같습니다. (녹음은 진행하지 않습니다.)

- 자녀의 예방접종 관련 정보를 어떠한 경로로 접하고 있나요?
- 자녀의 예방접종 일정을 누락한 적이 있나요?
- 누락한 적이 있다면 어떠한 이유로 누락이 되었나요?
- 성공적인 예방접종 이행을 위해서 챗봇의 사용자에게 어떤 자료가 제공되기를 기대하나요?
- 본인이 챗봇을 이용하여 소아예방접종 정보를 제공받을 경우 어떠한 정보가 필요하다고 생각하나요?
- 본인이 소아예방접종 챗봇을 활용함에있어서 예방접종 동기부여를 해주는 요인은 무엇이라고 생각하나요?
- 본인이 소아예방접종 챗봇을 활용함에있어서 예방접종 이행과정에 자신감을 주는 요소는 무엇이라고 생각하나요?
- 오늘 토론되었던 것을 요약하였는데 잘 요약이 되었습니까?

4. 연구 참여 기간은 얼마나 됩니까?

약 20분 소요될 것입니다.

5. 참여 도중 그만두어도 됩니까?

예, 귀하는 언제든지 어떠한 불이익 없이 참여 도중에 그만 둘 수 있습니다. 만일 귀하가 연구에 참여하는 것을 그만두고 싶다면 담당 연구원이나 연구책임자에게 즉시 말씀해 주십시오. 그만두는 경우 모아진 자료는 중도 탈락 시 수집된 자료의 폐기를 원하시면 즉시 폐기됩니다. 그러나 폐기를 원하시지 않는다면 중도 탈락 이전 자료는 연구 자료로 사용됩니다.

6. 부작용이나 위험요소는 없습니까?

소아예방접종 챗봇 개발 및 효과평가를 위한 것으로 연구로 부작용이나 발생하는 위험은 없습니다.

7. 이 연구에 참여시 참여자에게 이득이 있습니까?

귀하가 이 연구에 참여하는데 있어서 직접적인 이득은 없습니다. 그러나 귀하가 제공하는 정보는 부모들의 소아예방접종 이행에 도움을 줄 수있는 챗봇의 개발 및 발전 방향을 모색하는데 도움이 될 것입니다.

IRB No. 2002/001-008 유효기간: 2021년 01월 29일

동 의 서 (연구참여자 보관용)

연구 과제명 : 소아예방접종 챗봇 개발 및 효과평가
-Evaluation of the Development and Efficacy of the Child Vaccination Chatbot-
연구 책임자명 : 홍영주(서울대학교 간호대학 박사과정)

1. 나는 이 설명서를 읽었으며 담당 연구원과 이에 대하여 의논하였습니다.
2. 나는 위험과 이득에 관하여 들었으며 나의 질문에 만족할 만한 답변을 얻었습니다.
3. 나는 이 연구에 참여하는 것에 대하여 자발적으로 동의합니다.
4. 나는 이 연구에서 얻어진 나에 대한 정보를 현행 법률과 생명윤리위원회 규정이 허용하는 범위 내에서 연구자가 수집하고 처리하는 데 동의합니다.
5. 나는 담당 연구자나 위임 받은 대리인이 연구를 진행하거나 결과 관리를 하는 경우와 법률이 규정한 국가 기관 및 서울대학교 생명윤리위원회가 실태 조사를 하는 경우에는 비밀로 유지되는 나의 개인 신상 정보를 확인하는 것에 동의합니다.
6. 나는 언제라도 이 연구의 참여를 철회할 수 있고 이러한 결정이 나에게 어떠한 해도 되지 않을 것이라는 것을 압니다.
7. 나의 서명은 이 동의서의 사본을 받았다는 것을 뜻하며 나와 동의받는 연구원의 서명이 포함된 사본을 보관하겠습니다.

연구참여자 성명	서 명	날짜 (년/월/일)
동의받는 연구원 성명	서 명	날짜 (년/월/일)

IRB No. 2002/001-008 유효기간: 2021년 01월 29일

동 의 서 (연구자보관용)

연구 과제명 : 소아예방접종 챗봇 개발 및 효과평가
-Evaluation of the Development and Efficacy of the Child Vaccination Chatbot-
연구 책임자명 : 홍영주(서울대학교 간호대학 박사과정)

1. 나는 이 설명서를 읽었으며 담당 연구원과 이에 대하여 의논하였습니다.
2. 나는 위험과 이득에 관하여 들었으며 나의 질문에 만족할 만한 답변을 얻었습니다.
3. 나는 이 연구에 참여하는 것에 대하여 자발적으로 동의합니다.
4. 나는 이 연구에서 얻어진 나에 대한 정보를 현행 법률과 생명윤리위원회 규정이 허용하는 범위 내에서 연구자가 수집하고 처리하는 데 동의합니다.
5. 나는 담당 연구자나 위임 받은 대리인이 연구를 진행하거나 결과 관리를 하는 경우와 법률이 규정한 국가 기관 및 서울대학교 생명윤리위원회가 실태 조사를 하는 경우에는 비밀로 유지되는 나의 개인 신상 정보를 확인하는 것에 동의합니다.
6. 나는 언제라도 이 연구의 참여를 철회할 수 있고 이러한 결정이 나에게 어떠한 해도 되지 않을 것이라는 것을 압니다.
7. 나의 서명은 이 동의서의 사본을 받았다는 것을 뜻하며 나와 동의받는 연구원의 서명이 포함된 사본을 보관하겠습니다.

연구참여자 성명	서 명	날짜 (년/월/일)
동의받는 연구원 성명	서 명	날짜 (년/월/일)

Appendix 4. Recruitment documents for research participants

IRB No. 2002/001-008 유효기간: 2021년 01월 29일

연구참여자 모집 문건

다음과 같은 연구에 참여하실 분을 모집합니다.

연구 과제명

소아예방접종 챗봇 개발 및 효과평가

-Evaluation of the Development and Efficacy of the Child Vaccination Chatbot-

연구 책임자명

홍영주(서울대학교 간호대학)

연구 목적 : 본 연구는 소아예방접종 챗봇 개발 및 효과평가를 위한 연구입니다. 본 설문지의 목적은 챗봇을 통하여 부모들에게 실시간 소아 예방접종 정보제공, 개인적 동기 사회적 동기부여는 자신감을 증대시켜 부모들에게 편의성을 더해 소아 예방접종을 성공적으로 이행하는데 기여할 수 있을 것입니다. 궁극적으로 챗봇이 소아 예방접종 건강증진 분야에서 활용될 수 있는 실증적 사례를 제공하는데 목적이 있습니다.

참여자 선정조건 :

인터뷰 대상자 선정 기준은 다음과 같다.

① 소아예방접종 대상 자녀를 양육하는 부모(3명)

② 한번이라도 이전에 12세이하 소아 예방접종 일정을 누락한 적이 있는 부모(3명)

온라인 설문지 대상자의 선정 기준은 다음과 같다.

① 대한민국 국가 감염병의 예방 및 관리에 관한 법률에 적용되는 0세에서 만4세 예방접종 대상 자녀를 양육하는 부모에 해당하며, 질병관리본부에서 지정하는 '어린이예방접종' 일정상 8주이내 예방접종 스케쥴을 앞두고 있는 자녀를 양육하는 부모

② 본 연구의 목적을 이해하고 참여를 서면으로 동의한 자

③ 부모 설문지 내용을 이해하고 스스로 응답이 가능한 자

④ 카카오톡 앱 사용자

온라인 설문지 대상자의 제외 기준은 다음과 같다.

① 보건의료분야에 종사하고 있는 부모

② 한글을 읽지 못하거나 의사소통이 불가능한 자

③ 본 연구의 의도를 이해하지 못하고 참여를 거부한 자

④ 8주 이내에 질병관리본부에서 지정하는 '어린이예방접종' 일정이 없는 자

Version 1.1(2020.01.30.)

참여 내용 :

1) 인터뷰 (1회 약20분 소요)

한번이라도 예방접종 일정을 누락한 부모를 면담하여 어떠한 점을 도움을 주면 예방접종 이행률을 높일 수 있는지 질의 한다. 인터뷰 내용에서 추출되는 기능을 챗봇기능에 반영한다. 간단한 인터뷰를 실시하고 필요한 경우 메모하며 기록하는 방식으로 진행한다.

2) 설문지 (8주간 챗봇 사용: 총3회 온라인 설문지를 작성, 각각 10-15분 소요)

설문지는 핸드폰 또는 태블릿을 이용하여 제공된 링크를 통해 접속하여 설문지를 작성하고 제출하는 방식으로 진행됩니다. 연구참여자들에 대한 동의과정은 설문지 응답 이전 단계에 웹링크 https://forms.gle/8Lctfc7PkBThEZij9에 접속시 온라인 동의서를 읽고 동의 표시 버튼을 누른 후 실시됩니다. 웹링크에서 설문참여 동의과정을 읽고 '동의함' 버튼을 선택한 연구참여자만 설문조사를 진행합니다. 연구참여자의 동의하에 설문을 시작한 이후에도 언제든지 어떠한 불이익이 없이 참여 도중에 설문을 그만둘 수 있습니다. 연구 참여 도중 설문을 그만두고 싶다면, 언제든지 본 설문조사 화면의 우측 상단의 '중단하기' 버튼을 눌러 설문을 중단할 수 있으며, 이를 설문 시작 전에 미리 공지합니다. '동의하지 않음' 버튼은 선택할 경우 설문이 자동으로 종료될 예정입니다.

연구에 8주간 참여해야 하며 총 3회, (1회당 10분-15분) 소요되는 온라인 설문지를 작성하게 될 것입니다. 총3회 설문을 모두 완료하지 못하였더라도 불이익은 없습니다.

- **연구참여 동의 후 온라인 설문조사 1차**
- **중재 적용 4주 후 온라인 설문조사 2차**
- **중재 적용 8주 후 온라인 설문조사 3차**

참여기간 및 장소

1) 기간 : IRB 승인 일 이후 ~ 2020년 5월 31일

2) 장소 :(인터뷰) 서울대학교 간호대학 제2 연구동 308호, (설문지) 온라인

참여 시 사례

인터뷰 참여 사례: 인터뷰는 총 1회 진행되며, 참여하는 6명의 연구참여자에게는 5,000원 상당의 음료 쿠폰이 발송될 예정입니다.

설문지 참여 사례: 8주간 총3회 온라인 설문지를 작성하게되고, 설문지는 각각10-15분 소요됩니다. 귀하의 연구 참여시 감사의 뜻으로 (참여자 사례비 40,000원)을 지급할 예정입니다. 만약, 총3회 설문을 모두 완료하지 못하였더라도 각 회차의 비용을 고려하여 참여자 사례를 지급할 예정입니다. (1회당 약13,300원)

IRB No. 2002/001-008 유효기간: 2021년 01월 29일

참여 방법 : 작성한 모든 설문 자료는 익명이 보장되며, 설문 결과는 순수 연구 목적 외에는 사용하지 않을 것을 약속드립니다. 본 연구는 자발적 참여에 의해 진행되며, 중도에 참여를 철회하여도 아무런 불이익이 없음을 알려드립니다. 진행연구와 관련하여 참여를 희망하거나 의문이 있는 경우 언제든지 연구자에게 문의할 수 있습니다.

성의 있고 솔직한 답변을 부탁드리며, 연구에 참여하여 주셔서 진심으로 감사합니다.

본 연구의 내용에 관한 문의는 다음 연구 담당자에게 하십시오.

이름: 홍영주 전화번호: 010-3905-5891

Version 1.1(2020.01.30.)

Appendix 5. Korean questionnaire

설문지

□ 인적 사항 현황

※ 해당되는 문항 답지에 √표로 체크하여 주십시오.

● 영유아 예방접종 질의응답 Chatbot 개발 성능 평가

항 목	매우 그렇지 않다	그렇지 않다	보통이다	그렇다	매우 그렇다
1) 나는 질의응답 Chatbot이 필요한 정보를 얻는데 도움을 주었다고 생각한다.					
2) 나는 질의응답 Chatbot이 유용하다고 생각한다.					
3) 질의응답 Chatbot을 통해 내가 받은 혜택은 내가 기대했던 것 이상이었다.					
4) 전반적으로 질의응답 Chatbot을 이용해본 결과, 대부분 내가 기대했던 것보다 더 좋았다.					
5) 질의응답 Chatbot을 통해서 충분한 정보와 서비스를 제공받을 수 있었다.					
6) 나는 전반적으로 질의응답 Chatbot에 만족한다.					
7) 나는 향후 질의응답 Chatbot을 계속해서 사용할 의도가 있다.					
8) 나는 일상생활에서 질의응답 Chatbot을 사용하려고 노력할 것이다.					
9) 나는 질의응답 Chatbot을 지속적으로 사용할 것이다.					

● 영유아 예방접종 질의응답 Chatbot 적용 후 효과평가

1. 지식

※ 다음은 양육하고있는 자녀의 예방접종관련 지식에 대한 문항입니다. 귀하의 생각을 가장 잘 나타내는 곳에 √표로 체크해 주십시오.

항 목	예	아니오	모르겠다
1) 예방접종이 지연되었을 때에는 처음부터 다시 접종한다.(X)			
2) 수두를 앓은 적이 있으면 수두 예방접종을 하지 않아도 된다.(O)			
3) 백신접종 후 2~3일간은 주의 깊게 관찰해야 한다.(O)			
4) 예방접종 기록은 초등학교 입학이나 외국 유학을 떠날 때 필요하다.(O)			
5) 여러번 접종해야하는 B형간염 예방접종은 동일 제조사 백신으로 접종해야 한다.(X)			
6) 일본뇌염 사백신으로 기초접종한 경우라도 추가접종은 생백신이 가능하다.(X)			
7) 임신이나 수유시 모든 예방접종은 금기이다.(X)			
8) 일본뇌염 예방접종은 매년 여름철 모기 발생 전에 해야 한다.(X)			
9) 독감(인플루엔자)예방접종을 하면 감기에 걸리지 않는다.(X)			
10) B형간염 엄마로부터 출생한 신생아의 예방 접종비와 검사비는 국가에서 전액 부담한다.(O)			
11) 백일해는 2,4,6개월 3차 접종만을 한다.(O)			
12) 홍역은 1차 2차 접종을 해야하며 접종시기는 12~15개월, 만4~6세이다.(O)			

2. 동기

※ 다음은 부모가 자녀의 예방접종을 성공으로 수행할 수 있는 행동 동기에 대한 문항입니다. 귀하의 생각을 가장 잘 나타내는 곳에 √표로 체크해 주십시오.

항 목	여러번 경험함	단 한번 경험함	기억 안남	경험 없음
1) 근래 매스컴에서 간염이나 독감,폐렴 등 영유아 예방접종에 대해 언급하는 것을 들은 적이 있다.				
2) 근래 매스컴에서 감염병(예: 홍역, 간염)에 대해 보고하는 것을 들은 적이 있다.				
3) 근래 논문이나 의학서적 등을 통해 영유아 예방접종에 대한 것을 읽은 적이 있다.				
4) 근래 주변 사람들을 통해 영유아 예방접종의 필요성에 대해 들은 적이 있다.				
5) 근래 주변에서 감염병에 감염된 사례를 들은 적이 있다.				
6) 정보의 출처는 모르나 근래 영유아 예방접종이 필요하다는 사실을 알게 되었다.				
7) 자녀의 예방접종을 수행할 수 있도록 격려 동기부여 받은 적이 있다.				
8) 예방접종 일정에 따른 알림과 예방접종 정보를 주기적으로 받은 적이 있다.				

3. 행위기술(자기효능감)

※ 다음은 부모가 자녀의 예방접종을 성공으로 수행할 수 있는 행위기술(자기효능감) 자신감 정도에 대한 문항입니다. 귀하의 생각을 가장 잘 나타내는 곳에 √표로 체크해 주십시오.

항 목	전혀 그렇지 않다	그렇지 않다	그렇다	매우 그렇다
1) 나는 자녀의 예방접종 일정을 기억할 수 있다.				
2) 나는 자녀의 예방접종을 해당 기간에 모두 받을 수 있다.				
3) 나는 비용이 들더라도 자녀에게 필요한 예방접종은 모두 받을 수 있다.				
4) 나는 시간을 내서라도 정기적으로 자녀의 예방접종을 이행할 수 있다.				
5) 나는 자녀가 주사 맞는 것을 두려워하더라도 예방접종을 받을 수있게 한다				

4. 예방접종 행위의도

※ 예방접종 질의응답 Chatbot을 사용하, 귀하의 예방행위(의도)와 관련하여 아래 문항에 동의하는 정도를 각 항목별로 해당하는 곳에 √표로 표시해 주십시오.

항 목	전혀 그렇지 않다	그렇지 않다	그렇다	매우 그렇다
1) 나는 자녀의 예방접종 정보를 추가적으로 탐색할 의향이 있다.				
2) 나는 자녀의 감염병 예방과 관련하여 의료진과 상담할 의향이 있다.				
3) 나는 자녀의 감염병 예방을 위하여 정기적으로 예방접종을 할 의향이 있다.				
4) 나는 예방접종 대상 자녀를 양육하는 다른 부모에게 예방접종을 권유할 의향이 있다.				
5) 나는 자녀의 예방접종 일정에 맞게 예방접종을 시행할 의향이 있다.				
6) 나는 자녀의 예방접종 일정을 기억할 수 있다.				
7) 나는 자녀의 예방접종 일정에 맞게 예방접종을 시행 하였다.				

5. Turing test(Turing test)

1. 지금까지 소아예방접종 Chatbot 플랫폼을 이용하시면서 주고받는 대화가 사람과 대화하는 것 같습니까?

① 예(사람과 대화 같다)　　② 아니오(기계와 대화 같다)

2. (☞ 예:라고 대답한 경우) 사람과 대화하는 것 같다면 어떠한 부분(예를 들어주시면 좋습니다) 사람과 대화한다는 생각을 느낌을 주나요?

간략서술형 _____

3. (☞ 아니오: 라고 대답한 경우) 기계와 대화하는 것 같다면 어떠한 부분(예를 들어주시면 좋습니다) 기계와 대화한다는 생각을 느낌을 주나요?

간략 서술형 _____

4. 어떠한 부분이 개선이 되면 사람과 대화하는 것처럼 자연스러울까요?

● **일반 특성**

< 다음은 자녀의 일반 특성과 예방접종 에 한 질문입니다. 문항을 읽고 해당되는 곳에 체크해 주십시오.>

1. 자녀는 몇 개월 입니까? _____개월

2. 자녀의 성별은?
   ① 남 ② 여

3. 자녀는 몇째입니까?
   ① 첫째 ② 둘째 ③ 셋째 ④ 넷째 이상

4. 자녀의 주 양육자는?
   ① 본인 ② 배우자 ③ 다른 가족구성원
   ④ 도우미 ⑤ 어린이집 ⑥ 기타

5. 자녀의 예방접종은 주로 어디서 하십니까?
   ① 보건소 ② 소아청소년과 ③ 종합/ 학병원 소아과
   ④ 소아과 제외한 기타 의원(내과,가정의학과,산부인과 등)

6. 자녀의 예방접종 여부는 주로 가 결정합니까?
   ① 본인 ② 배우자 ③ 다른 가족구성원
   ④ 도우미 ⑤ 어린이집 ⑥ 기타

7. 자녀의 예방접종을 할 때 방종 수첩을 가 지고 가십니까?
   ① 꼭 가지고 간다 ② 부분 가지고 간다
   ③ 안가지고 갈 때가 많다 ④ 안가지고 간다

끝까지 응답해주셔서 감사합니다.

국문초록

소아 예방접종 질의응답 챗봇 개발 및 평가

홍 영 주
서울대학교 대학원
간호학과
지도교수 김 정 은

아동은 발달 특성상 스스로 건강 행위를 결정할 수 있는 능력이 없어 부모에 의해, 건강 행위가 이루어지기 때문에, 부모의 건강 신념이 아동의 예방접종에 직접적인 영향을 미치게 된다. 따라서 자녀의 예방접종 누락을 방지하기 위해서는 예정된 일정대로 예방접종이 실시 될 수 있도록 부모에게 적시 적소에 예방접종 관련 정보를 제공하는 것이 매우 중요하다. 본 연구의 목적은 IMB(Information-Motivation-Behavioral skills) 모델을 기반으로 생애주기별 예방접종 질의응답 챗봇을 개발하고, 개발한 챗봇을 예방접종 대상 아동을 양육하는 부모에게 적용하여 예방접종 정보, 동기, 자기효능감, 예방행위의도 점수의 변화로 효과를 검증하는데 있다.

이에 챗봇을 경험하지 못한 집단(대조군)과 챗봇을 경험한 집단(실험군)으로 구성하여 연구를 진행하고자 하였다. 실험군, 대조군의 경우 연구 참여시 사전조사 후 4주, 8주, 12주 추가 측정을 시행하였다. 실험에 참여한 참가자는 챗봇을 경험하지 못한 대조군(n=34), 챗봇을 경험한 실험군(n=35)의 피험자로 구성되었다.

예방 접종 지식 점수 차이에 대하여 대조군과 실험군의 점수를 독립 표본 t-test한 결과 1차 시점에 있어서 대조군(M=3.34, SD=2.55)에 비하여 실험군(M=6.13, SD=2.63)의 평균이 더 높은 것으로 나타났으며 이는 통계적으로 유의미하였다(t=-4.27, p=.000). 2차 시점에 있어서 대조군(M=4.44, SD=2.06)에 비하여 실험군(M=8.29, SD=2.15)이 평균이 더 높은 것으로 나타났으며 이는 통계적으로 유의미하였다(t=-7.26, p=.000). 또한 3차 시점에 있어서도 대조군(M=3.88, SD=2.14)에 비하여 실험군(M=8.74, SD=1.70)의 평균이 더 높은 것으로 나타났으며 이 또한 통계적으로 유의미하였다(t=-10.00, p=.000).즉 챗봇을 이용한 실험군이 대조군에 비해 지식수준이 더 높은 것으로 나타났다.

예방 접종 동기 점수 차이에 대하여 대조군과 실험군의 점수를 독립 표본 t-test한 결과 1차 시점에 있어서 대조군(M=2.17, SD=.77)에 비하여 실험군(M=2.83 SD=.83)의 평균이 더 높은 것으로 나타났으며 이는 통계적으로 유의하였다(t=-3.28 p=.002). 챗봇을 이용한 실험군은 대조군에 비해 동기가 높은 것으로 나타났다. 2차 시점에 있어서 대조군(M=2.28, SD=.45)에 비하여 실험군(M=3.21, SD=.57)이 평균이 더 높은 것으로 나타났으며 이는 통계적으로 유의미하였다. (t=-7.19, p=.000). 또한 3차 시점에 있어서도 대조군(M=2.45, SD=.56)에 비하여 실험군(M=3.63, SD=.38)의 평균이 더 높은 것으로 나타났으며 이 또한 통계적으로 유의미하였다(t=-8.81, p= .000). 즉 챗봇을 이용한 실험군이 대조군에 비해 동기가 더 높은 것으로 나타났다.

예방 접종 자기효능감 점수 차이에 대하여 대조군과 실험군의 점수를 독립 표본 t-test한 결과 1차시점에 있어서 대조군(M=2.66, SD=1.23)에 비하여 실험군(M=3.22 SD=.68)의 평균이 더 높은 것으로 나타났으며 이는 통계적으로 유의하였다(t=-2.26, p=.028). 챗봇을 이용한 실험군은 대조군에

비해 자기효능감이 높은 것으로 나타났다. 2차 시점에 있어서 대조군(M=2.66, SD=1.26)에 비하여 실험군(M=3.59, SD=0.34)이 평균이 더 높은 것으로 나타났으며 이는 통계적으로 유의미하였다(t=-7.74, p=.000). 또한 3차 시점에 있어서도 대조군(M=2.43, SD=.82)에 비하여 실험군(M=3.76, SD=.34)의 평균이 더 높은 것으로 나타났으며 이 또한 통계적으로 유의미하였다(t=-8.47, p=.000). 즉 챗봇을 이용한 실험군이 대조군에 비해 자기효능감 점수 평균이 더 높은 것으로 나타났다.

예방접종 행위의도 점수 차이에 대하여 대조군과 실험군의 점수를 독립표본 t-test한 결과 1차 시점에 있어서 대조군(M=2.69, SD=1.32)에 비하여 실험군(M=4.22 SD=0.98)의 평균이 더 높은 것으로 나타났으며 이는 통계적으로 유의하였다(t=-5.23, p=.000). 2차 시점에 있어서 대조군(M=2.64, SD=1.09)에 비하여 실험군(M=4.64, SD=0.48)이 평균이 더 높은 것으로 나타났으며 이는 통계적으로 유의미하였다(t=-9.48, p=.000). 또한 3차 시점에 있어서도 대조군(M=2.76, SD=1.07)에 비하여 실험군(M=4.71, SD=0.41)의 평균이 더 높은 것으로 나타났으며 이 또한 통계적으로 유의미하였다(t=-9.65, p=.000). 즉 챗봇을 이용한 실험군이 대조군에 비해 행위의도가 더 높은 것으로 나타났다.

본 결과를 바탕으로, 소아예방접종 챗봇은 예방접종 대상 자녀를 양육하는 부모에게 필요한 정보를 신속 정확하에 제공하여 예방접종 동기를 증가시키고, 자기효능감을 증대시켜 궁극적으로 예방접종 이행률을 높일 수 있는 유용한 방법으로 활용될 수 있을 것이라고 생각한다.

주제어 : 소아, 예방접종, 질의응답, 모바일 상담, 실시간, 챗봇
학 번 : 2017-33887