

A development of video materials and chat bot system for
explanation of endoscopy

by

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Abstract

Background: A large part of explanation for endoscopy is repetitive task from the medical staff perspective. To reduce the labor of the medical staff, substitution of explanation by information technology is expected. This capstone project illustrated the process of video materials and chatbot system for endoscopy explanation and evaluated them with the medical staff and potential users.

Methods: We designed the intervention after collecting information from the medical staff by semi-systematic interviews and group meetings after mapping stakeholders. Some updates were executed for conventional explanation. Video materials were made with VYOND animation software. A rule-based chatbot system was developed with Dialogflow-cx on LINE. Usability, feasibility and technical stability were assessed by two potential users with a system usability scale and additional questionnaires. They were also assessed by the medical staff with non-systematic interviews.

Results: We developed 8 video materials and a chat system in accordance with information collected from the medical staff. Three video materials were evidence-based videos while five video materials were process-explanation videos. How to take care of low digital literacy patients was the largest concern. We developed a system separately taking care of low digital literacy patients and high literacy patients. Potential users valued the products as 90 points for system usability scale and they said that patients younger than 60 years old could use the system. The medical staff also evaluated the system as usable, feasible and technically stable.

Conclusion: We developed video materials and a chatbot system for endoscopy explanation. The feasibility, usability and technical stability was validated by two potential users and the medical staff. The system could be implemented in clinical settings in the future.

Keywords: video, chatbot, endoscopy

List of abbreviations

WHO	World Health Organization
SaaS	Service as a software

1. INTRODUCTION

1.1. Introduction

Colon cancer and gastric cancer are the second and third most frequent cause of cancer deaths in Japan ^[1]. To prevent colon cancer and gastric cancer deaths, each municipal government implements medical health checks for colon cancer and gastric cancer, which includes gastroscopy as well as fecal occult blood leading colonoscopy.^[2] Moreover, as the proportion of taking medical health check periodically is approximately 50%, while the number of the people taking medical health check is increasing, this is expected to increase ^[2].

As the government set a goal to reduce workload for the medical staff by 2024 ^[3], more efficient work is the key to increase the number of endoscopic tests while reducing labor. To tackle this problem, the government developed a task force and set a task shifting guidance focusing on task delegation in 2021 ^[4]. However, the World Health Organization (WHO) stated that innovation should be involved in task shifting discussion to maximize medical resources ^[5, 6]. Therefore, we should take innovation into consideration to increase the number of endoscopic tests with limited medical resources.

In line with this, simple and repetitive work can be potentially delegated to information technology tools and these tools could also be used to educate the medical staff. One example is routine explanation. According to a randomized control trial in Netherlands, computer-based explanation system for preparation of colonoscopy could reduce the hospital stay time while the satisfaction and quality of the preparation did not change ^[7]. In addition, video consent for colonoscopy could improve the patient's knowledge as well as satisfaction ^[8]. Also, audiovisual re-education via smartphone improved quality of preparation and patient's satisfaction in another randomized control trial ^[9]. Taking these evidences into consideration,

we estimated that video materials and simple computer-based explanation were useful for health intervention. As a computer-based explanation system, we could substitute the chatbot for patients' support on questions and answers ^[10]. However, as there were no Japanese video materials and computer-based explanation system validated by clinical trials, we started from a pre-prototype phase as a capstone project.

1.2. Objectives

Even though innovative tools can be useful and efficient, there are lots of barriers for them to be used in practice. In addition, the barrier varies from each stakeholder including the medical staff and patients. Therefore, understanding the expectations and barriers from several stakeholders is important before implementation.

The present study is a practice-based capstone project about a development of video materials and chatbot system for endoscopy explanation in a specialized hospital for endoscopy and digestive disease. As a pre-prototype phase of the development, we collected information from the medical staff, designed the intervention, developed the video materials and chatbot, and evaluated them with the medical staff and potential users.

Followings are objective of this project.

- To develop video materials and chatbot system to support explanation of endoscopy procedure aiming reduction of labor work as a pre-prototype phase.
- To evaluate the product in terms of the technical stability, feasibility and usability.

The outcome of this project may contribute to reduce the burden of repetitive explanation of endoscopic tests from the medical staff perspective and increase satisfaction of patients.

2. METHODS

We developed endoscopy explanation video materials and chatbot for a specialized hospital called Tsujinaka hospital Kashiwanoha. Around 25,000 endoscopic tests are executed per year on average in this hospital. At the hospital, explanation was executed by medical doctors, nurses and medical administrators in accordance with their roles (figure 1). As explanations after endoscopic tests vary depending on the result of the test, we focused on the process of explanation before the test. The intervention points were waiting time at the hospital for routine explanation and telephone inquiry from patients at home because they take less time from the medical staff.

In accordance with the WHO guideline for monitoring and evaluating digital health interventions, the goal of this capstone project was to demonstrate the usability/feasibility/technical stability^[11] of the explanation system for endoscopy. We divided the development process into 4 phases after stakeholder mapping.

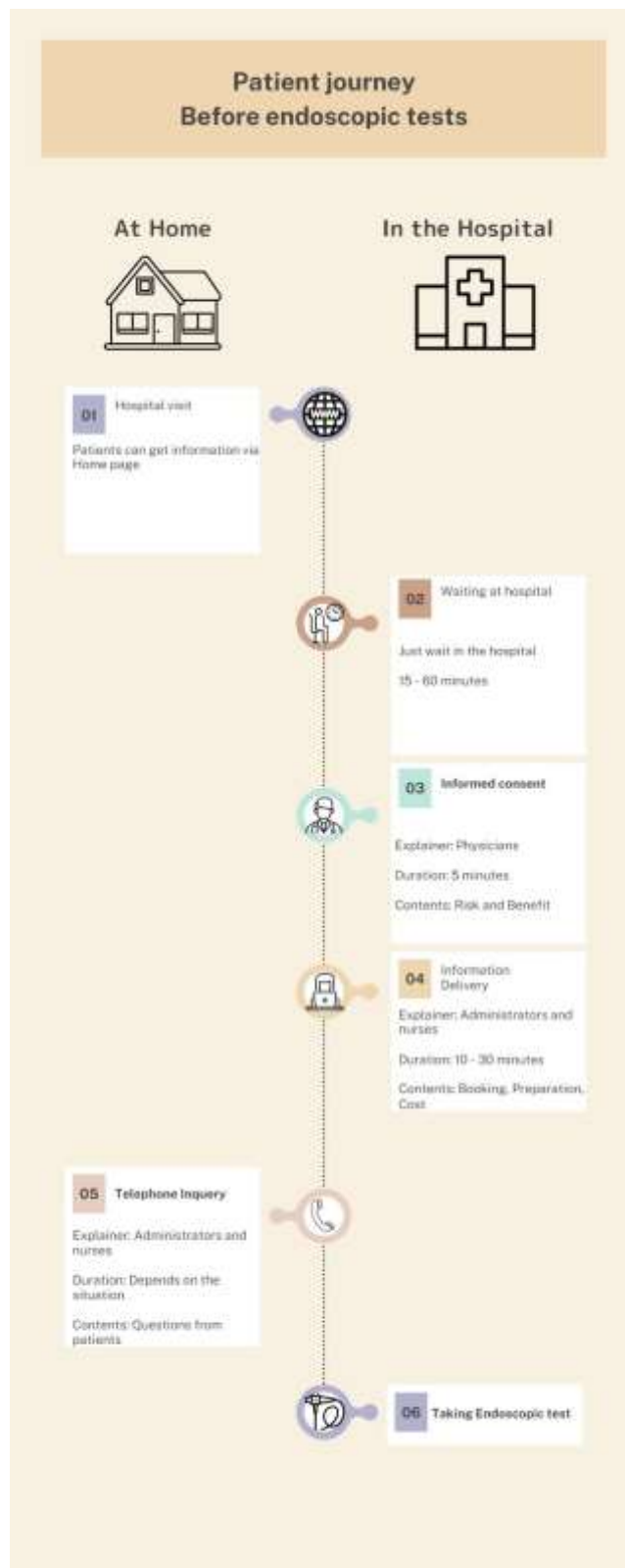


Figure 1: Explanation flow

2.1. Stakeholder mapping

As this was a pre-prototype project, we nominated stakeholders from the hospital except for two potential users. We consulted to the hospital manager on how to choose the members of the project. We identified three groups, a practitioner group, a manager group and a contents-approver group, from the hospital. The members of each group were as follows (figure 2).

- Practitioner group: Two medical administrators, two specialized nurses, two medical doctors, and one hospital manager in Tsujinaka hospital Kashiwanoha
- Manager group: Head of endoscopy, administrators, nurses, pharmaceutical, laboratory, and hospital manager in Tsujinaka hospital Kashiwanoha
- Contents-approver group: Hospital director, head of endoscopy, and hospital manager in Tsujinaka hospital Kashiwanoha
- Potential users: Two citizens without medical background



Figure 2:Stakeholder mapping

2.2. Development and evaluation

We developed in align with following 4 phases.

2.2.1. Collecting information and Designing the intervention

To design the intervention, we collected information from the practitioner group and the manager group.

We conducted interviews with the practitioner group, who directly explained instructions and obtained informed consent. The interview was in a semi-open style. In the interview, we asked about the priority of the contents, how to cater for the products in the patient journey and expectations for the project.

Apart from individual interviews, practitioner group meetings to collect information were also held periodically. The purpose of the meetings was to identify the timing of the intervention, expected contents and how to use the products. The meetings were held twice a month. In addition, we joined periodical management group meetings on a timely manner to collect information for human and financial resources and expectations from managers. After collecting information, we analyzed the qualitative data to describe the design of the intervention.

In the process to consolidate and synthesize the information obtained from the meetings, we identified potential barriers and a way to prevent them. With the identified barriers and preventive methods, we designed a detailed intervention.

2.2.2. Updating rules

To transition the endoscopic explanation process to a digital health process, based on the information obtained from phase 1, we identified which existing procedure, workflow and rules should be modified. The points were for simplification and were updated in accordance

with the latest guidelines or medical information. These amendment of rules and procedure were submitted to the management group meetings and were discussed and approved.

2.2.3. Developing materials and review

In accordance with the intervention design, we developed video materials and the chatbot.

All video contents were produced with scripts. Video materials were mainly divided into two categories, evidence-based videos and process-based videos. Evidence-based videos were mainly for physicians to explain the risks and benefits of the endoscopic tests, while process-based videos were for medical administrators and nurses to explain the preparation and process before and after endoscopic tests. Evidence-based video manuscripts were mainly made by one specialist with certification from the Japan Gastroenterological Endoscopy Society, and the process-based video manuscripts were mainly made by medical administrators and nurses based on the hospital rules.

The manuscripts received approval after being reviewed by the contents-approver group (the head of the endoscopic department, the hospital manager, and the hospital director). Video materials were developed with VYOND animation software(<https://www.vyond.com/>). The contents consisted of animation with typography.

Especially for evidence-based videos, we referred to a guideline from health care videos on YouTube ^[12]. We carefully considered pros and cons for each topic and showed conflict of interests in the videos.

The questions and answers were formulated by the medical administrators and nurses for the chatbot. The questions were based on actual questions coming from patients via telephone in usual practice. The system which was on the LINE platform used a rule-based response

system according to these questions and answers with Dialogflow-cx (<https://cloud.google.com/dialogflow/cx/docs>). Dialogflow-cx is a software as a service (SaaS) by Google Cloud Platform, which integrates several interfaces like LINE, Facebook and so on.

The video materials and chatbot were approved by the contents approvers after review.

2.2.4. Evaluation

Two people who were not in the medical field evaluated the chatbot system with video materials for feasibility and usability as potential users. They were women in their forties. Google Forms was used to evaluate the system. The evaluation score was the system usability scale in Japanese ^[13].

System usability scale was created in 1986 to evaluate the usability of a system. Evaluators answer ten questions and the score is valued between 0 and 100, where the higher the score, the higher the usability is. The score above 68.5 was regarded as a useful system ^[14, 15]. The assessment with system usability scale was conducted at a timely manner.

To assess feasibility, we added additional questions related to feasibility for people younger than 60 years old. For further usability assessment, we added questions on the requirement of functions and free comments (<https://forms.gle/CWPuNoiYkmiXxNAU7>).

Apart from the user's perspective, we collected opinions from the practitioner group with unstructured interviews and meetings to assess the feasibility and usability as well as technical stability. The questions were as follows:

- How was the quality of the contents?

- How was the consistency to the hospital rules?
- How was the usability in clinical practice?
- What is the barrier for the implementation?

Information from the interview was analyzed.

3. RESULTS

We developed video materials and chatbot and evaluated them

3.1. Collecting information and Designing the intervention

We decided to develop 5 process-based video materials and 3 evidence-based video materials using the information collected from individual interviews, practitioner meetings and manager group meetings (table 1). We chose videos in accordance with the frequency of the repetitive explanation.

Table 1: List of video materials

Process	Preparation	#1 Gastroscopy	https://www.google.com/url?q=https%3A%2F%2Fvimeo.com%2Fuser189274728%2Fgastroscopy-process&sa=D&sntz=1&usg=AOvVaw1G3wv9RhAsgfXPA0M4Fgc_
		#2 Colonoscopy	https://www.google.com/url?q=https%3A%2F%2Fvimeo.com%2Fuser189274728%2Fcolonoscopy-outline&sa=D&sntz=1&usg=AOvVaw0x15wOcc05wcLDXeqbdjLA
		#3 Preparation	https://www.google.com/url?q=https%3A%2F%2Fvimeo.com%2Fuser189274728%2Fmoviprep-full&sa=D&sntz=1&usg=AOvVaw1rRmQQIfYdtGfXqfIGdRbx
	Booking information	#4 Gastroscopy	https://www.google.com/url?q=https%3A%2F%2Fvimeo.com%2Fuser189274728%2Fbooking-gf&sa=D&sntz=1&usg=AOvVaw0P7M50p6jc4BhErywQqC49
		#5 Colonoscopy	https://www.google.com/url?q=https%3A%2F%2Fvimeo.com%2Fuser189274728%2Fbooking-colon&sa=D&sntz=1&usg=AOvVaw0ND1zTGQCkj7Q8dP-NgFeM

Evidence	Health check	#6 Gastroscopy	https://youtu.be/S3hK_Be81qE
		#7 Colonoscopy	https://youtu.be/6ma7wqBNxx8
	#8 Sedation		https://youtu.be/eDa1UGgT5Kk

3.1.1. Process-based video materials

One problem mentioned by medical administrators was the 30-minute explanation of one colonoscopy procedure and the 10-minute explanation of one gastroscopy procedure, both of which were time consuming and repetitive. Especially, the explanation of preparation for colonoscopy was complex and took time with paper-based instructions. Therefore, we decided to develop explanation videos for gastroscopy, colonoscopy and preparation for colonoscopy (Process-based video #1,2,3).

The interviews and meetings revealed that medical administrators use 3 minutes to collect patient's information from charts. We also decided to make videos for booking instruction, which can be viewed while medical administrators collect patients' information. As the instruction varied between gastroscopy and colonoscopy, we decided to develop a video for each one (Process-based video #4,5).

3.1.2. Evidence-based video materials

From physicians' comments, we identified that physicians were afraid of the carelessness coming from repetitive work. This could cause loss of accuracy on the explanations. Also, instead of using conventional informed consent, they wanted to use video-based informed consent to further reduce human resources. However, as the informed consent via computer-based explanation system had not been fully investigated, we decided that a video without verbal informed consent was out of scope in this project. Instead, we decided to develop videos to show the evidence of the benefits and risk for health check as general information for patients who want to know detailed information (Evidence-based video #6,7).

In addition, medical administrators and nurses were frequently asked questions and received complaints about sedation even though they did not have a deep knowledge on

sedation. Therefore, we decided to develop an evidence-based video material for sedation (Evidence-based video #8).

3.1.3. Questions and answers:

We also developed questions and answers for frequently asked questions. We identified questions and answers that are often asked by patients based on the opinions of the medical administrators and nurses. The most common questions were about food regulation and drug preparation.

3.1.4. Potential barriers and countermeasures:

- Rule update

Because of the complex and out-of-date process for preparation of endoscopy, we decided to change the rule for endoscopic procedure in the hospital before developing materials. Some materials and questions and answers were related to this change.

- Low digital literacy group

There was a large concern from the manager group about the feasibility of the system for elderly patients. To tackle this obstacle, we decided to divide patients into two groups, a high digital literacy group and a low digital literacy group (figure 3).

For the high digital literacy group, we would encourage them to use the chatbot and to watch videos before listening to the explanation from medical administrators. As general booking explanation takes 3 minutes, general explanation for colonoscopy takes 4 minutes and explanation for preparation takes 8 minutes, we can reduce the explanation time 15 minutes in total for the high digital literacy group.

As for the low digital literacy group, they would just watch booking instruction videos in front of medical administrators. We estimated that 3 minutes of labor work would be reduced for the medical staff.

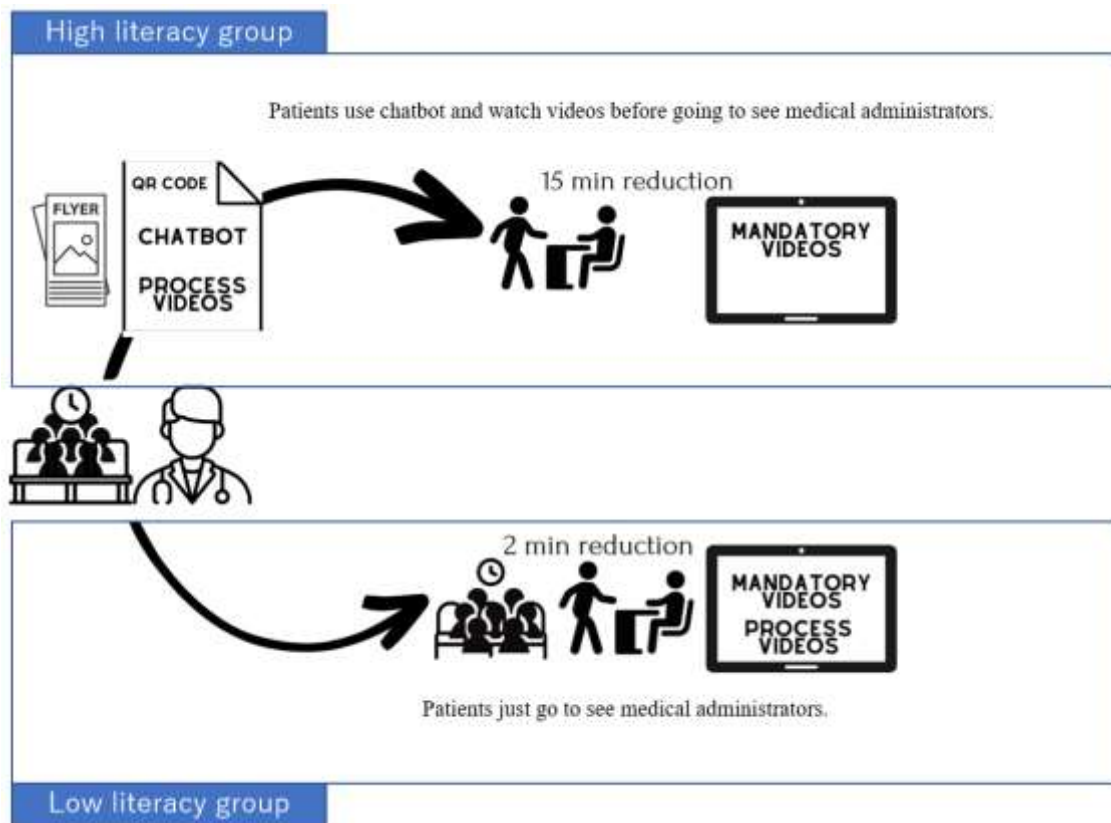


Figure 3: Design of the intervention

3.2. Updating rules

We identified three points that needed update for the endoscopic procedure. The purpose of the update was to simplify the explanation, to avoid confusion, and to reduce safety concerns.

The first point was about the preparation of medicine. We adopted the MoviPrep combination powder as a regular preparation drug and the way it is used was based on a standard method. However, a two-one method had been developed and adopted as a regular method in many hospitals because of the simple process and safety concern for dehydration. When we discussed this with the group, we concluded that we should update this point.

The second point was about the discontinuation of anti-diabetes medicine following a special diet. Through the preparation for colonoscopy, patients have to eat a special diet with 1100 kCal/day energy for the test. The conventional method indicated that a special diet should start from supper two days before the test date if the patients need administration for the test. For patients with diabetes, as the calorie of the special diet is low, they had to discontinue anti-diabetes medications two days before the test. This instruction frequently caused confusion because diabetes patients without administration should stop anti-diabetes medication the day before the test as the special diet started from breakfast the day before the test. When we reduced confusions, we could reduce the risk to patient safety. Therefore, we changed the rule for patients who need administration to start special diet the day before the test.

The last point was about life instruction at home after a polypectomy. We advised patients that they should avoid alcohol, trip, and exercise to prevent post-procedure bleeding from happening. In the course of the explanation, medical administrators and nurses often received questions on exercise and many patients were worried about usual activities like

athletic activities and physical labor. As there was no evidence on how physical activity affects the probability of bleeding after polypectomy, we changed the rule and instruction from exercise to heavy exercise like a marathon. This change could increase patient satisfaction.

These modification points were submitted to the manager group meeting and were discussed and approved.

3.3. Developing materials and review

We developed video materials and chatbot and they were reviewed by approvers.

3.3.1. Video materials

We developed the following video materials with VYOND animation software.

- Evidence-Based Gastroscopy Material

The aim of this material was to give information on the effectiveness and risks of gastroscopy for health checks. The manuscript was based on the following guideline and report: Management of screening endoscopy for population-based screening for gastric cancer, Survey on health check for gastric and colon cancer and endoscopy in 2021 [16, 17]

- Evidence-Based Colonoscopy Material

The aim of this material was to give information on the effectiveness and risks of colonoscopy for health checks. The manuscript was based on the following guidelines and report: Colonoscopy screening and surveillance guideline, A handbook of colorectal cancer 2021, Survey on health check for gastric and colon cancer and

endoscopy in 2021 ^[17-19].

- Evidence-Based Sedation material

The aim of this material was to give information on the effectiveness and risks of sedation for endoscopy as well as to educate medical staff such as medical administrators and nurses. The manuscript was based on the following guideline: Guideline for sedation of endoscopy (the second edition) ^[20].

- Process-Based Gastroscopy Material

The aim of this material was to give instructions on the preparation for gastroscopy. The manuscript was based on the hospital process manual.

- Process-Based Colonoscopy Material for general information

The aim of this material was to give information on the overview for colonoscopy. The manuscript was based on the hospital process manual.

- Process-Based Colonoscopy Material for preparation

The aim of this material was to give information on the preparation for colonoscopy. The manuscript was based on the hospital process manual.

- Process-Based mandatory Material for booking instruction

The aim of this material was to give instructions for booking process. The video will be used by the medical administrator for the first instruction while they collect patient's information from medical charts. The manuscript was based on the hospital process manual.

Each manuscript was reviewed by the contents approver and was approved.

3.3.2. Chatbot:

We made rule-based questions and answers on dialog flow-CX system and synthesized it to LINE. Some of the responses included video materials we created. We used a LINE rich menu (Figure 4-1,4-2) for quick access to start questions and answers as well as video materials and hospital home pages. We also developed brochures for instruction to patients (Figure 5)



Figure 4-1: LINE chatbot 1

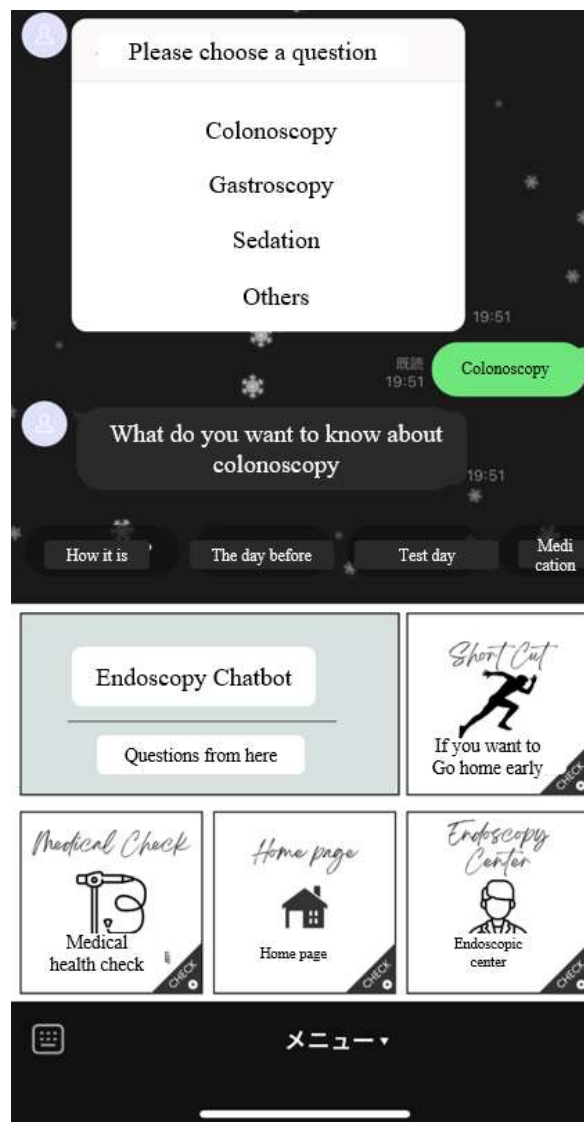


Figure 4-1: LINE chatbot 2



辻仲病院柏の葉

LINE チャットボット

「内視鏡の説明・疑問」を気軽に確認できます！
視聴で「病院滞在時間」を減らせます！

使用例

を押すと
案内開始

胃カメラ、大腸カメラは合わせて以下の動画を待ち時間で見ただくと、予約センターのご説明が理解できます。

大腸内視鏡検査にて内服する
**下剤
モビブレップ**

大腸カメラ優先説明
早く帰りたい方はこちらの動画を視聴してください。

胃カメラ優先説明
早く帰りたい方はこちらの動画を視聴してください。

動画を再生

視聴したい動画を選択すると自動で表示されます

YouTube

大腸内視鏡検査にて内服する
**下剤
モビブレップ**

モビブレップ20221122
治療法説明

ご自分の隙間時間に
何度でも自由に視聴可能！
そうすると
病院での説明時間を
短縮できます！

疑問に答える
チャットボット

早く帰宅したい方向け
説明動画

辻仲病院柏の葉
病院情報

簡単で便利!!
下記QRコードよりご利用ください

Figure 5: Brochure for LINE chatbot

These materials were intended to be used in two ways. For high digital literacy group, they would use the chatbot and watch videos with the simple instructions from brochure. They could reduce the time for instruction of endoscopy in person by approximately 15 minutes. For the low digital literacy group, they would not use chatbot and directly go to medical administrators and get instructions. They could reduce 3 minutes with video materials while medical administrators do other jobs.

4. DISCUSSION

This practice-based capstone project documented the development process of the videos and chatbot system to educate patients for endoscopy aiming to reduce the labor of the medical staff. The WHO guideline stated that there were steps from pre-prototype toward implementation ^[11]. In this project we assessed technical stability, feasibility, and usability as a pre-prototype by medical staff as well as potential users.

Overall, the system usability scale was 90 points and the unstructured interview for the medical staff showed technical stability and feasibility. A systematic review and meta-analysis revealed that the system usability scale of more than 68.05 points (SD 14.05) was a suitable threshold for usability scale ^[14]. Even though we thought the reminder was a useful function, one evaluator did not require a reminder.

We choose stakeholders before starting the project. Though the WHO guideline recommends the narrow down method to determine the stakeholders ^[21], the hospital manager decided the members in this project. As the size of the hospital was not large, we did not have to make a list to narrow down. This sense of resilience was positive to move the project forward promptly; however, it made the approval process unclear. For example, even though the contents approvers reviewed the manuscript, some explanations were modified after development of the videos, and this was time consuming.

As many of the YouTube videos related to healthcare were not qualified ^[22], YouTube created the guideline for health care videos. In the statement, science-based, objective and transparent and accountable were key for videos on health information ^[23]. In this project, we went through some reviews and approval process before the completion of the video development. From the perspectives of the medical staff and two potential users, the quality of the videos was satisfactory.

We also developed a rule-based chatbot system for questions and answers. Chatbot is

classified into rule-based and artificial intelligence (AI) chatbot. While rule-based chatbots do not improve their response themselves, they do not change answers and take less time for development ^[24]. A systematic review showed that there were mixed outcomes on the usefulness of AI chatbot ^[25]. As this project was small sized and targeted a small population, we developed a rule-based chatbot. However, one evaluator stated that if patients can directly ask questions, it could be more useful. This indicated that the AI chatbot could be more valuable to some people.

The nurses and administrators were not familiar with the evidence of sedation and the medical health check displayed in the videos. In this project, as we only included qualified medical doctors, some doctors might not be familiar with these evidences. In some fields, 20 years are expected for implementation of evidence ^[26]. The Japan council for quality health care stated that education, including the medical staff, is important to overcome the barrier of implementation of guideline treatments ^[27]. Qualified videos for patients may improve the quality of the medical staff because patients can judge the level of the medical staff from the videos. In this situation, the medical staff will be motivated to learn the new guidelines. This could also lead to the reduction of educational costs for the medical staff.

The most common concern from the manager level of the medical staff was about usability for the low digital literacy group, especially about elderly patients. Because of the aging society, half of outpatients in Japan were over 65 years old in 2021 ^[28]. According to a report in 2022 from a consulting company called Accenture Japan ^[15], the degree of digitalization for healthcare in Japan was the lowest among developed countries. This was due to the aging society in Japan and the universal health coverage with free access in Japan. This situation was a concern to the managers. Taking these situations into account, we provided two methods in accordance with the digital literacy level for each patient. This direction was accepted from the managers. In innovation theory, only 15.5% of citizens are

innovator or early adopter, which means that covering all patients for the first time is not feasible goal. Therefore, in later phases, we need to see the proportion of patients who can follow the high digital literacy strategy.

Though medical doctors expected informed consent using videos, a study from Taiwan reported that educational video-assisted informed consent for traumatic surgery was superior to a conventional one for patients' understanding and satisfaction ^[29]. However, as there is no evidence in Japan, whether video-assisted informed consent was qualified enough in Japan is unknown. Therefore, we focused on assisted materials mainly for medical administrators because of technical issues and ethical concerns.

4.1. Limitations

There were several limitations in this project. The most important point was the number of evaluators. We used the system usability scale, and the score was 90 points. As the minimum number of evaluators for the system usability scale is two evaluators ^[13], we showed some usability. However, because the external evaluators in this project were not patients and the number was the minimum, more evaluation using a larger number of people and patients is needed. Especially, both of the external evaluators were high digital literacy people; therefore, we need to consider people with different digital backgrounds. Qualitative check from medical staff is expected before the implementation because consistency of the explanation in the institution is important. After the implementation, more evaluation for the quality of contents and usability is needed from patients' perspective.

The second limitation was about unstructured interviews, meetings and analysis. As this was a capstone project and the time was limited, we executed a non-systemic method. The WHO guideline recommends using a framework for analysis to determine the claim and design. When we investigate this project further in the future, we need to identify the key

stakeholders and how to use framework to convince them to use this system. In this project, as the corporation with the manager level staff was important, logical framework could work well.

Lastly, we did not determine how to implement this product. Although, how to set brochures or tablets for this project at the hospital and modification of the homepage are important, we have not discussed it in the detail. In the implementation phase, such discussion must be included. In the future, we also need to specify how to collect information to improve the quality of this intervention and examine the effectiveness as well as to collect safety data of patients.

4.2. Conclusions

We developed patients' educational videos and a rule-based chatbot system to reduce the burden of the medical staff as a pre-prototype product. They showed strong technical stability and usefulness from the perspective of the medical staff and potential users.

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