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Customer Discovery as the First Essential Step for Successful Health Information Technology System Development

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Objectives: Customer discovery (CD) is a method to determine if there are actual customers for a product/service and what they would want before actually developing the product/service. This concept, however, is rather new to health information technology (IT) systems. Therefore, the aim of this paper was to demonstrate how to use the CD method in developing a comprehensive health IT service for patients with knee/leg pain. **Methods:** We participated in a 6-week I-Corps program to perform CD, in which we interviewed 55 people in person, by phone, or by video conference within 6 weeks: 4 weeks in the United States and 2 weeks in Korea. The interviewees included orthopedic doctors, physical therapists, physical trainers, physicians, researchers, pharmacists, vendors, and patients. By analyzing the interview data, the aim was to revise our business model accordingly. **Results:** Using the CD approach enabled us to understand the customer segments and identify value propositions. We concluded that a facilitating tele-rehabilitation system is needed the most and that the most suitable customer segment is early stage arthritis patients. We identified a new design concept for the customer segment. Furthermore, CD is required to identify value propositions in detail. **Conclusions:** CD is crucial to determine a more desirable direction in developing health IT systems, and it can be a powerful tool to increase the potential for successful commercialization in the health IT field.

Keywords: Telerehabilitation, Health Services Needs and Demand, Qualitative Research, Entrepreneurship

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I. Introduction

Technological advancements provide developers in the health information technology (IT) field opportunities to improve healthcare services. However, it is still challenging to determine the kind of health IT system to design as well as the target users for the product/service. More importantly, there is no guarantee of a successful implementation of the designed system. Developers in the health IT field may easily fall into the trap of believing that others will love their products/services but may end up developing a product that no one wants to buy. Identifying customer needs at the early stage of development could save time and money and increase the possibility of a successful implementation.

The development process for medical products consists of five stages: concept, design, testing and trials, production, and deployment [1]. Several studies have proposed methods to help develop systems related to health IT. Park et al. [2] conducted interviews to assess potential users' needs for a tele-health surveillance system. Shah et al. [3] proposed multidisciplinary thematic seminars (MdTS) as a method to reflect user needs in system specifications in the development of health information systems. Taylor proposed design thinking and service design as an approach to design sustainable telehealth services [4]. Flores-Vaquero et al. [5] proposed the product-service system approach (PSS) to develop a telehealth smartphone application. Lastly, Dhillon et al. [6] proposed interview studies to design a web-based telehealth system for the elderly.

These studies proposed methods that involved users in the development process because engaging users or customers in the process could help develop successful health IT products and services. However, they focused mainly on specific designs at the design stage rather than determining the right customer at the early concept stage. Most importantly, none of the approaches are especially tailored for developers who want to commercialize their health IT systems.

Thus, we would like to introduce the customer discovery (CD) approach, which is a method to determine customers' actual needs focusing on understanding customers' preferences, buying preferences, and problems before developing a product [7]. CD is the first step of the customer development model, which is a way of testing the assumptions about the understanding of customers in the real marketplace enabling entrepreneurs to strengthen the focus of the product development as well as their marketing activities to build successful startups [8,9]. While entrepreneurs widely practice the CD process, the concept is still new to researchers and developers in the health IT field. Therefore, the aim of this study was to demonstrate the ways to use the CD method in developing a rehabilitation device with a comprehensive health IT service.

II. Methods

We participated in an I-Corps program organized by the Korea Innovation Center Washington DC. The objective of the I-Corps curriculum is to move academic research to commercialization using CD [10-13]. The program lasted 6 weeks, 4 weeks in the DC metro area, the United States and 2 weeks in Daejeon, Korea, consisted of interviewing mainly patients with leg pain and medical professionals, and was supervised by mentors who are experts in the bio-medical startup field. The study was strictly carried out under the ethical guidance of the program, which was in accordance with the Declaration of Helsinki. Informed consent was obtained from all participants, who were all aware of the nature of the study. We broke down the CD process into eight simplified steps (Figure 1).

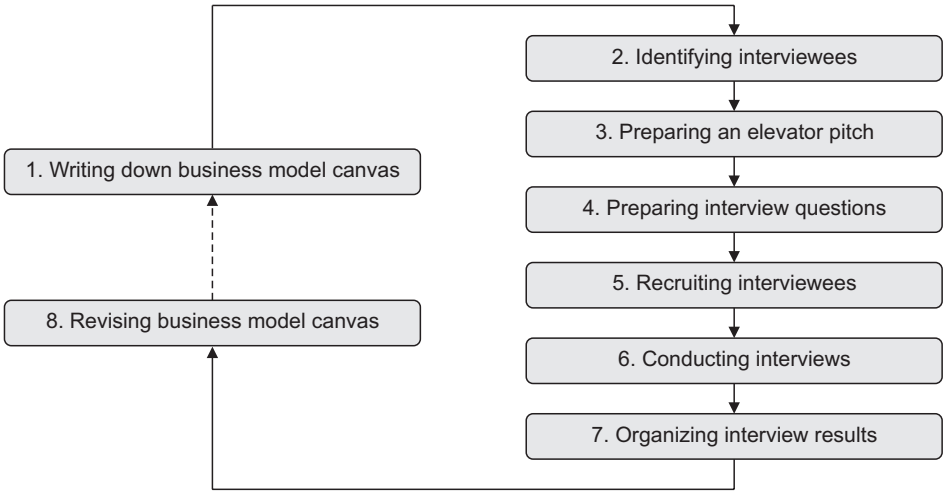

Figure 1. Breakdown of the customer discovery process.

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1. Writing down the Business Model Canvas

The first task was to complete the business model canvas which consisted of a hypothesis until validated. This program focused on the first two things that a business must identify: customer segments and the value propositions that the product can provide them.

2. Identifying the Interviewees

The next step was to identify people to interview. Potential customers include direct users of the product, payers who pay for the product, and influencers who recommend the product and are involved in making purchase decisions.

3. Preparing an Elevator Pitch

We then prepared to deliver an elevator pitch, which is a 30-second speech to convince people to let us interview them. As strangers, we wanted to establish credibility by introducing our affiliation and clearly state our aim to conduct market research rather than to sell a product. We then asked for a small amount of time (10–15 minutes) and told them we would greatly appreciate their responses. Meanwhile, we wanted to appeal to them that we could potentially help solve their problems. If they were contacted by email, we provided similar information in a written format.

4. Preparing the Interview Questions

Next, we prepared the interview questions. We started by asking how they were injured and the treatment they received. To know their pain points, we asked questions such as "How helpful is the current treatment," "What has been the most painful time since you got injured," "What do you dislike the most about being injured," and "What are the challenges you encounter because of the injury?". We also asked them to suggest solutions by asking questions like, "If there is anything that could help you, what would it be?"

We needed different sets of interview questions depending on the interviewees. When interviewing professionals, we asked questions like "Where in patient care are you involved?" Similar to our questions for patients, we asked "How could patient care be improved?" Shifting the focus to the flaws of the health system and not to the person himself/herself was useful to avoid professionals becoming defensive about their work.

5. Recruiting the Interviewees

There are two approaches to recruit interviewees: cold calling and warm calling. Cold calling involves contacting strangers with whom we have no social connection by either telephone, email, or drop-in visit [14]. Warm calling involves contacting someone we know or someone we have been referred to [15]. We were introduced to potential interviewees by mentors and preceding interviewees.

6. Conducting the Interviews

Here, we did not want to talk about our product or technology but instead listen to the interviewees with the assumption that they are experts in their own field and therefore know the problems best. It was also helpful to show interest through body language by maintaining good eye contact. Thus, if there were two interviewers, one would be the main interviewer and the other would take notes. If there was only one interviewer, the interviewee was asked politely if the conversation could be recorded on a cell phone.

7. Organizing the Interview Results

The goal is to identify related customer segments and their needs. We transcribed audio recordings or completed the written notes as much as possible. We organized the content into "What we thought," "What we learned," and "What we are doing next" and highlighted key findings. Then, we grouped similar interviewees together and tried to generalize their characteristics and needs.

8. Revising the Business Model Canvas

We came up with a few possible business models, and we decided which customer segment to proceed with. Here, we considered not only customer needs but also whether our ability or technology that we have was enough to provide a solution, whether the market size was attractive enough, or whether the model could generate sustainable revenue. Although the selection process could sometimes be subjective, it was still supported with evidence.

III. Results

Our initial product was inspired by pain caused by using crutches for a long time and the inconvenience of climbing stairs. We developed a hands-free crutch alternative leg brace that helps reduce leg pain with a weight-bearing function, recycles energy to make walking easier, detects motion and assists walking to make it more smooth and natural and is customized to each individual using 3D printing. We then identified customer segments as "Patients with leg pain or patients with leg injuries" and identified five key value propositions: 'pain relief,' 'convenience,' 'customization,' 'natural walking,' and 'recycled energy' (Table 1).

Table 1. Customer segments and value propositions before customer discovery

		Value propositions				
		Pain relief	Convenience	Customization	Natural walking	Recycle energy
Customer segments	I. Patients with leg pain	✓	✓	✓	✓	✓
	II. Patients with leg injury	✓	✓	✓	✓	✓

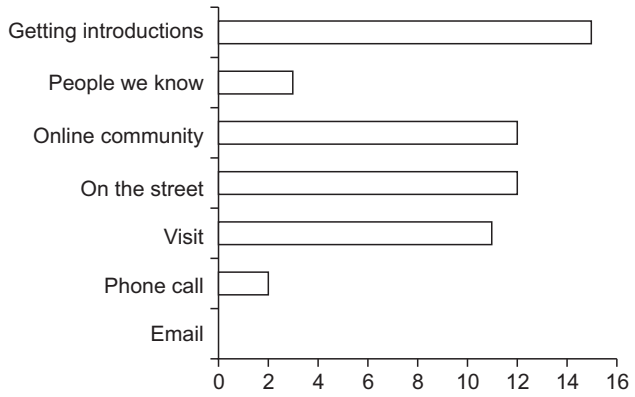

Figure 2. Number of interviewees recruited using different approaches.

The approaches that we used to search for contacts were online resources including organization websites, LinkedIn, and social media. We also sent cold emails; however, they had a low response rate of one response for every 10 emails sent, for instance. We also learned that subjects were also more unlikely to participate in telephone surveys. Therefore, we conducted cold visits, which worked well for visiting medical device shops and worked better for small physical therapy clinics rather than big rehabilitation hospitals. We also approached strangers at the mall or public areas. Figure 2 summarizes the number of interviewees we recruited from each approach.

We assumed that patients with knee/leg injuries could be potential customers. We thus looked for people using crutches, canes, knee braces, or wheelchairs. We also looked for those who needed walking assistance including veterans, obese people, elderly people with knee pain, and patients with rheumatoid arthritis and cerebral palsy. Doctors and physical therapists are experts and may have a key influence by prescribing or recommending medical devices to patients. In addition, interviewing vendors may provide a better understanding of the products available in the market or what customers look for. Other people potential interviewees include family doctors, medical researchers, chiropractors, or physical trainers, from whom patients seek help for alternative treatments. Throughout the program, we recruited 55 interviewees from different professions (Table 2), seven of which were in Korea.

Table 2. Interviewees

Type	Interviewees	Number of interviewees
Experts	Orthopedic doctor	5
	Physical therapist	5
	Chiropractor	1
	Physical trainer	1
	Physician	2
	Professor/researcher in medical field	3
	Pharmacist/medical device vendor	6
Patients	Patients with injury	13
	Patients with chronic pain	13
	War veteran	2
Others	Insurance broker	1
	Other complimentary information	3
Total		55

We summarized the interview results into two main general findings: one presenting different opinions of using knee braces for pain relief and the other presenting current problems among practitioners that could lead to new opportunities to alleviate pain.

1. Controversy of using Knee Braces

Our hypothesis was the weight-bearing function of a knee brace could potentially relieve knee pain. We learned that using a device is believed to be safer than pharmaceuticals and more preferable for pain relief from a doctor's point of view. However, interview results with orthopedic doctors showed that the weight-bearing feature of a knee brace is useful for protecting injured body parts but not particularly for relieving pain. Although the knee brace that corrects faulty alignment and decreases mechanical load on patients' knees can help treat osteoarthritis, the use of knee braces is controversial because they may further weaken the knee muscles. Doctors and chiropractors sometimes prescribe knee braces, but physical therapists do not. Doctors also expressed that patients are concerned about the convenience and aesthetic

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Table 3. Customer segments and value propositions after customer discovery

		Value propositions								
		Pain relief	Weight-bearing	Convenience	Customization	Aesthetic	Natural walking	Recycle energy	Speed recovery	Rehab exercise
Customer segments										
I	Chronic pain from job	✓				✓				✓
	High impact sports	✓				✓				✓
	Osteoarthritis	✓				✓				✓
	Veteran	✓				✓				✓
II	Sport injury		✓	✓		✓			✓	✓
	Accident injury		✓	✓		✓			✓	✓
	Fall accident		✓	✓		✓			✓	✓
III	Rheumatoid arthritis			✓		✓	✓	✓		✓
	Cerebral palsy			✓		✓	✓	✓		✓

aspects of wearing a knee brace which corresponds with the finding that patients had concerns using an assistive device outdoor because they did not want to appear like a disabled person.

2. New Opportunity to Alleviate Pain: Rehab Exercises and Patients' Compliance

Both orthopedic doctors and physical therapists agree that strengthening muscles through rehab exercises is the key to relieve chronic pain and to a speedy recovery for certain types of musculoskeletal injuries. We learned that the job of physical therapists is to manage patients' pain and adjust the difficulty of the exercises accordingly. They try to motivate patients during the sessions; however, they have no control over patients at home. The major challenge of physical therapists is that patients miss appointments and do not perform home exercises resulting in a less effective treatment. A chiropractor also faces similar challenges with patients not following instructions at home. From a personal trainer, we learned that exercise can be an alternative to medicine for alleviating pain; however, people do not seek help from a personal trainer because they are not aware that a personal trainer can help them.

Through the interviews, we identified customer segments I and II, formed a new customer segment III, and determined new value propositions (Table 3).

Customer segment I consists of patients with chronic pain from demanding jobs which involve standing or climbing for a long period; patients who engage in high-impact sports such as running, skiing, or mountain climbing and patients with osteoarthritis including war veterans. We found that there is a need for pain relief and rehab exercises in this customer segment.

We learned that customer segment II needs a weight-bearing feature for protection and wants a speedy recovery to return to work or sports, which can be achieved by physical therapy, and wants convenience when using mobility aid devices.

Customer segment III is patients with rheumatoid arthritis and cerebral palsy. We identified that they need a mobility aid device to help them walk naturally and to make walking easier and need regular physical rehabilitation treatment.

For now, we assume that aesthetic is common among all the segments, and we did not find enough information about the needs for customization. Further research is needed to clarify these two value propositions.

IV. Discussion

After identifying the possible customer segments, we had to select only the one customer segment that would make the best business model. Although we can satisfy the need for convenience for customer segment II, they are not looking for 'pain relief' and 'customization'. Instead, there is a need for light, convenient 'weight-bearing' walking aids, and 'rehab exercise', which will unavoidably be a bulky, static device. These two requirements conflict with each other and one device cannot satisfy both. Thus, we decided not to choose

this segment. Customer segment III needs much stronger support for walking, and the severity of their ailments is unfortunately beyond our technology's capability.

We thus concluded that providing value to customer segment I, patients with chronic leg pain, through a tele-rehabilitation service is the most attractive business model for several reasons. First, interviewing experts identified the problem that patients do not follow rehab exercise at home. Second, there is a significant market of osteoarthritis patients due to the high obesity rates among the US population or the aging population in Korea [16,17]. Moreover, a tele-rehabilitation system could help patients, insurance companies, and governments save a significant amount on healthcare costs [18].

Through CD, we discovered the needs and opportunities for tele-rehabilitation that we did not imagine before. Consequently, we revised our business model canvas, from a customer segment of "Patients with leg pain or leg injuries" to "Early stage osteoarthritis patients." We changed our value propositions from "reducing pain while walking and standing," 'convenience' (hand-free), and 'customization' to 'pain reduction' and "delaying the progression of osteoarthritis" through a tele-rehabilitation system.

Conducting CD may be straightforward; however, it can be overwhelming when using it for the first time, especially in the healthcare field. This paper introduced a step-by-step method to conduct CD to develop a telehealth system. We demonstrated how to identify the two parts of the business model canvas (customer segments and value propositions). In addition, we identified interviewees, prepared an elevator pitch, obtained and conducted interviews, identified customer segments, and determined the segment to proceed with. Using CD, we took the first, yet essential, step to develop a new business model by identifying a new design concept for a chosen customer segment.

Because no incentives were given to interviewees, this study has its strength in providing unbiased results. However, due to a time limit and difficulty in obtaining interviews, the study was conducted only on a small number of interviewees; therefore, it would be difficult to generalize the result to a larger population. Moreover, we did not consider individuals' characteristics (e.g., geographic or demographic) when analyzing the interview results. Future work will include conducting more interviews in both the United States and Korea while defining customer segments more comprehensively including other potential buyers such as doctors, hospitals, and insurance companies. Once the customer segment is chosen, we will then conduct another CD to identify detailed value propositions.

Although we failed to conduct 100 interviews, CD still helped us pivot to a new target product. Without CD, we could have spent resources developing a hands-free crutch alternative leg brace equipped with advanced technology and realized later that there is not much need for it in the market. CD helped us understand the needs of the users while also taking into consideration the opinions from physicians and other stakeholders. Using CD at the earliest stage of development could be a powerful tool to increase the potential for successful commercialization in the health IT field.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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