



Exploring the Challenges and Opportunities in Developing Systems to Improve Alcohol Use Disorder through Chatbot Technology

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ABSTRACT

Alcohol use disorder is a debilitating psychiatric condition, which can have devastating effects on the individual, their friends, and family. Most of the communication between patients and their treatment team involves brief verbal exchanges within a clinical setting, which is not necessarily conducive to the needs of the patient in their daily life. In this research, we sought to identify methods by which chatbot technology could be used to enhance treatment for alcohol use disorder (AUD). We also sought to establish an alternative communication medium by which to engage in digestible daily interactions with AUD patients (to monitor the psychological state of the user) as well as their companions (to make them aware of important events and coach them in their interactions with the user).

CCS CONCEPTS

- Human-centered computing → Empirical studies in collaborative and social computing.

KEYWORDS

Alcohol Use Disorder, Chatbot Technology

ACM Reference Format:

Xiang-Zhi Qiu, Chien Wen (Tina) Yuan, Nanyi Bi, Ming-Chyi Huang, and Chuang-Wen You. 2023. Exploring the Challenges and Opportunities in Developing Systems to Improve Alcohol Use Disorder through Chatbot Technology. In *Extended Abstracts of the 2023 CHI Conference on Human Factors in Computing Systems (CHI EA '23), April 23–28, 2023, Hamburg, Germany*. ACM, New York, NY, USA, 5 pages. <https://doi.org/10.1145/3544549.3585635>

1 INTRODUCTION

Alcohol use disorder is a debilitating psychiatric disorder characterized by the persistent, uncontrolled consumption of alcohol, which

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CHI EA '23, April 23–28, 2023, Hamburg, Germany

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ACM ISBN 978-1-4503-9422-2/23/04.

<https://doi.org/10.1145/3544549.3585635>

can have devastating effects on the individual, their friends, and family [20]. Many patients suffering from alcohol use disorder undergo treatment to reduce the severity of withdrawal symptoms, which often involves inpatient treatments. After the withdrawal symptoms subside, the individual enters an outpatient maintenance program to assist them in maintaining sobriety. During outpatient visits, the treatment team offers medication and behavioral counselling [27]; however, most of the communication between patients and their treatment team involves brief verbal exchanges within a clinical setting. Note that a lack of daily communication can seriously limit the benefits of counselling. The natural language processing (NLP) of chatbot technology has advanced sufficiently to understand human language and respond in a manner that is similar to the way that humans respond [8]. The ability to deliver messages via mobile devices opens the door to using chatbot technology to overcome communication barriers. In this research, we sought to identify methods by which chatbot technology could be used to facilitate treatment for alcohol use disorder (AUD).

Existing chatbot technologies have been used to provide support for individuals dealing with mental health issues [7, 11, 18, 25], such as depression [12], stress [15, 26], dementia [32]. Chatbot systems have also been designed to act as support agents for individuals seeking assistance in dealing with substance use disorders [23], including tobacco [1], opioids [21], and general substance use disorder [29]. Researchers have also developed chatbots to assist individuals with alcohol use disorder who are required to attend follow-up maintenance programs to maintain sobriety [10, 29]. Note however that those systems do not consider the characteristics of AUD patients, such as impaired cognitive or memory abilities [16, 24], which could hinder exchanges between the chatbot and the patient [4]. Furthermore, researchers have yet to develop a chatbot counselling system that includes all of the stakeholders, including the friends, colleagues, and family members. In this study, we adopted a user-centric approach to analyzing the needs of the stakeholders in developing our preliminary chatbot counselling system.

This research project was based on a small-scale needs assessment study involving interviews with four psychiatrists from an anonymized hospital. The objective in conducting these interviews was to elucidate the difficulties in communicating with AUD patients and their important others and to explore the possibility of

using chatbot technology to alleviate those difficulties. Our analysis of interview transcripts led to the identification of three salient themes: (1) Psychiatrists require alternative avenues of communication by which to monitor patients and provide guidance; (2) It should be possible to compose daily digestible interactions with AUD patients or their important others; and (3) Important others must be reminded not to engage in activities that could have a negative effect on patient recovery. In accordance with the insights gained in the interviews, we developed a preliminary chatbot system aimed at enabling meaningful interactions with AUD patients based on natural language. Our aim was to monitor patient progress, dispel the myths of AUD treatment, and stimulate discussion during sessions with the psychiatrist.

2 NEEDS ASSESSMENT STUDY

Needs analysis was based on one-on-one in-depth interviews with psychiatrists. From an anonymized hospital, we recruited four psychiatrists (1 male and 3 females; D1 ~ D4) aged 31 to 35 years old (AVG= 32.5 years old; SD = 1.91), who had at least six months of experience in treating patients with alcohol use disorders (AUD).

We first conducted semi-structured interviews with the psychiatrists to elucidate the difficulties they face in treating alcohol use disorder. We also collected their opinions as to the use of existing chatbot technologies for treatment [30]. The general interview questions focused on the following aspects: (1) Their thoughts related to AUD, (2) their clinical experience in communicating with AUD patients and/or patient companions to determine their recovery status and provide guidance, and (3) the best ways to communicate with patients to improve motivation, gain clinical insights, and enhance an understanding of AUD, (4) suggestions for identifying targets and designing tasks for patients to perform in their daily lives, and (5) their experience in using existing chatbot solutions to facilitate AUD treatment. Each interview was audio-recorded with IRB permission and lasted between 90 and 120 minutes.

We transcribed the audio recordings of the semi-structured interviews and conducted bottom-up thematic analysis to identify salient themes [5], after which axial coding was used to connect them. Multiple rounds of open coding revealed the difficulties of communicating with patients and companions under current practices used for AUD treatment. They revealed that as the most common companions of AUD patients, family members must bear the brunt of the trials and tribulations of the recovery process. We identified themes related to the myths and misunderstandings of AUD and the potentially negative influence that companions can have on recovery. Our analysis revealed a number of issues that can hinder communication in AUD treatment and various ways that chatbot technology could be used to improve AUD treatment in the future. The key issues are detailed in the following subsections.

2.1 Requiring Alternative Communication Medium to Improve Patients' Understanding towards AUD

According to DSM-5 [3], AUD is considered a legitimate diagnosable mental health disorder; however, all of the participating psychiatrists described how their patients and companions did not fully understand the meaning of AUD or how to deal with it. It appears

that many patients and their companions do not view AUD as a mental disorder. As a result, many companions blame patients or themselves for relapses. For example, D4 made the following comment: *Many patients and their companions lack an understanding of AUD. They tend to attribute AUD to insufficient willpower or behavioral shortcomings. Few of them treat it as a psychiatric illness. These misconceptions lead to a belief that they can control alcohol use behavior as long as they use their personal willpower. Many patients view attempts to help them as a personal insult, based on a belief that they are too weak to control themselves. Sometimes, the psychiatrist needs to remove the labels patients have placed on themselves.* Many psychiatrists prescribe AUD medications (e.g., naltrexone [2]) to block the euphoric effects of alcohol intoxication. Nonetheless, it appears that many patients are reluctant to take these medications due to financial concerns or the stigma attached to psychiatric drugs. As a result, psychiatrists must explain what the drugs are used for and how to take them as well as the potential side effects. D3 made the following comment: *In the first clinical visit involving patients and their family members, I explain that we have psychiatric medications for AUD (e.g., disulfiram, naltrexone, and acamprosate) and how to use them. Before prescribing any medication, I have to refer to a blood test report to assess whether it would be appropriate for them, and then discuss the pros and cons. Much of the discussion involves persuading the patient of the need for medical intervention.*

In subsequent visits, it is important that the psychiatrist provide the patient with basic knowledge related to AUD and the use of AUD medication. Unfortunately, many psychiatrists lack the time to interact with patients about trivial health education matters or misconceptions of AUD. Note also that the best time to educate the patient (when they are prepared to digest this information) does not necessarily correspond to the scheduled clinical visits. D1 made the following comment: *I have so many things to explain during each visit that my patients often have to wait in a long queue. But there still isn't enough time to get through all of it (laughs). [...] I also have to assess the patient's condition. Psychiatrists must be cautious to avoid being harmed by patients, especially when asking them about personal matters. For example, if he/she is in a bad mood, I must avoid some subjects to avoid triggering a violent reaction. It is important to ask the patient if he/she wants to talk, because if they don't want to talk, then whole interaction will be a waste of time.*

Considering the limited time they have with the psychiatrist, patients tend to forget a lot of what they were told, especially after returning to their busy daily lives. The psychiatrists expressed a need for an alternative avenue of communication by which to interact with their patients outside office hours. Hopefully, this would make it easier to convey everything that the patient needs to know, and to reinforce the important points when the patient is in a suitable frame of mind. D3 made the following comment: *Right now, I feel a huge gap between clinical visits and the patient's daily life. If we had some kind of tool or AI bot to deliver personal reminders, it could really strengthen the connection between the patient and psychiatrist. Ideally, the patient could send messages to the treatment team and receive personalized responses. For example, if the patient were unable to understand or remember an important point, then he/she should be able to replay what was said (like a tape recorder).*

2.2 Concerns and Opportunities for Composing Daily Digestible Interaction with AUD Patients or Their Companions

Extensive research [16, 24] has indicated that the brain function of individuals suffering from AUD for an extended period can be profoundly affected by this abuse. Some of the psychiatrists interviewed in this study mentioned that this kind of impaired brain function manifests as an inability to deal with long or complex sentences. D1 made the following comment: *Patients with AUD tend to be impatient and lack concentration, which makes it difficult for them to read or understand long sentences. And their memory capacity is not very good. [Is it because of the alcohol damage?] Ya... The frontal lobes have been harmed by alcohol. It impairs their cognitive ability. When processing a long sentence, you need to remember the first part while reading the last part. It's hard for them.* Thus, it was suggested that the messages could be more persuasive if they were short and easy to comprehend.

Many individuals with AUD have spent a long time trying to recover, which means that keeping them motivated in their abstinence is a key goal for psychiatrists. In the interviews, it was suggested this was best achieved by providing evidence of improvement. Nonetheless, it can be very difficult to prepare objective data as evidence of improvement. D2 made the following comment: *My clinical experience has taught me that when patients are unable to provide data to characterize their alcohol-related behavior, there is not much that I can say to them. [...] It is important to have a record of their improvement. Situations in which the patient does not have a feeling that they are improving often lead to relapse. I want to be able to show the patient some numbers indicating improvement. This can also be helpful in promoting a sense of self-efficacy.* Note that when using existing technologies, solutions of encouragement tend to be generic. Canned messages without contextual information lack a relevance to the individual, and personal idiosyncrasies make it all but impossible adjust the message according to the context of the patient's life. For examples, we discovered in the interviews that there might be a specific time or a set of specific cues that require words of encouragement to resist the craving for alcohol. D1 made the following comment: *Encouraging patients to remain sober is not easy, due largely to the fact that the personal life of the patient is often in shambles. It would be terrific if we could provide encouragement when the patient is craving alcohol or dealing with issues that tend to trigger alcohol use.* It should be possible to use mobile and/or wearable technology to collect contextual information via sensors or a self-reporting mechanism. The contextual information could then be used to formulate reminders that bear relevance to the patient's current situation. Thus, the patient could receive messages that point to their achievements and preserve credibility by avoiding empty slogans. D1 made the following comment: *One of my patients once told me, "Someone praised me for doing basically nothing", which made him feel unworthy... and left him unaffected. It would be much better if that person had provided concrete facts of previous accomplishments, such as the time they spend using the tool to report data or ... asking the tool how to take medications. Concrete facts are an indication of real actions. [Do you mean concrete facts, not overstating what they did?] Yeah, the wrong kind of encouragement can be detrimental. [...] It's useless to provide false encouragement.*

Patients and/or their companions often share sensitive thoughts or vent negative emotions when interacting with psychiatrists. If there were some way for patients to speak out (vent their emotions) in their daily life, then it might prevent the accumulation of negative emotions. In the interviews, the psychiatrists expressed concern that patients would be unwilling to discuss sensitive topics or express their emotions when dealing with a disembodied technological entity. D4 made the following comment: *Patients care about the professional service we can offer. [Do you mean that the patients would not see the chatbot as a psychiatrist?] Yes, it might be difficult to interact with a non-professional or non-human.* There is no way for a treatment team to accompany patients in their daily lives; however, it might be possible to use a chatbot as a delegate. Some of the psychiatrists commented that if the system designer could establish a link between the chatbot and treatment team, then it is very likely that the patient would be willing to express their emotions. D1 made the following comment: *As a psychiatrist, I cannot remain by the side of my patients all the time. I need a way to extend my presence... a proxy [...] The patients and companions must be informed that the treatment team participated in the design process. They also need to know that the data collected by the tool is essential to AUD treatment. They need to feel that this system was designed for their benefit, and that it was approved by our professional treatment team. Then, I think that patients would try it out.*

2.3 Reminding Companions to Avoid Exerting Negative Influences on Patients' Recovery

Researchers [36] have demonstrated that there is a strong linkage between feelings of loneliness and AUD. Family members can play an important role in staving off feelings of loneliness; however, it is crucial that family members provide support, and that they resist the temptation to nag, blame, or emotionally manipulate the patient. Nonetheless, recovery from alcohol dependence is a long road, fraught with difficulty and multiple lapses. When the frequency of lapses increases, the tolerance of some family members dwindles, while other family members blame themselves for the failure to control alcohol use. The co-dependence [28] among family members can erode the boundaries required for meaningful communication. D3 made the following comment: *Co-dependence is a commonly encountered among family members of AUD patients. The family members begin to feel that they are responsible for the patient's actions.*

More than one of the psychiatrists mentioned that many family members adopt an aggressive stance in solving the AUD problem. In many cases, the family members are more enthusiastic than the patient to learn about the problem and take action, which in turn puts considerable pressure on the patient. It appears feasible that a chatbot could be used to keep family members in line by reminding them that overcoming AUD is more difficult than they can imagine. Through daily digestible conversations, a chatbot could be used to let family members know how hard the patient has been working to improve themselves. D4 made the following comment: *Data collected from a mobile app could be used as evidence showing how hard the patient was working to remain sober. The level of trust between family members and patients is often weak... so it is important to provide concrete data. It isn't at all easy to foster a sense of empathy among family members. Many family members insist*

that it is up to the patient to control their drinking. Family members need to be made aware of how difficult the patient has worked to reach their current sobriety. The family members need to cherish those achievements.

It is also important to consider that many family members have bought into the myths related to psychiatric medications. One such myth involves the use of psychiatric medications after consuming alcohol. D3 made the following comment: *I have encountered numerous family members telling the patient not to take ANY medication after drinking alcohol or risk dying. It seems that about seven or eight out of ten family members believe this. [How can you correct such situations?] I discuss with the patient and/or family members the medicines that cannot be mixed with alcohol and those that can or should be taken after consuming alcohol. [Do you think it would be helpful to deliver these reminders outside the office?] I think it would have a positive effect. We cover a lot of topics in the office, and it is difficult to keep them all straight. And sometimes, they spend the whole session venting, so they cannot remember the really important things, such as taking medicine on time. Covering these fundamental issues would take a long time. . . 20 to 30 minutes per patient.* It has long been supposed that correcting myths and misunderstandings requires face-to-face communication with patients or family members in the office; however, more than one psychiatrist commented that this can lead to uncomfortable confrontations in which it would be difficult to resolve any issue. D4 made the following comment: *Whenever I encountered patients who misunderstand AUD or psychiatric medication, I try to correct it. [...] I need to understand the reasons for their reliance on incorrect methods, and then just remind them or try to stop them.*

Note however that psychiatrists must deal with other pressing matters as well, such as assessing the patients' conditions or explaining how to take medications. One of the psychiatrists suggested delegating the task of assessing the patients' progress to a chatbot. D1 made the following comment: *I think patients are less likely to be angry with robots, because robots are not judgmental, which is seldom the case when interacting with humans. I know that when I talk to a patient, the patient is often concerned about what I think of him. A robot would avoid this trouble.*

3 PRELIMINARY SYSTEM DESIGN

Our preliminary design for our chatbot system comprised three main modules: (1) A module for gathering contextual and inference, (2) A module for the delivery of knowledge and reminders, and (3) A conversation agent to interact with users using natural language responses and based on collected contextual and a priori knowledge related to the user.

The first module will be used to gather contextual information related to the emotional state of the user, i.e., the context [14], to determine the best times to deliver messages or initiate conversations. Sensory data indicative of the user's physiological state will be automatically forwarded to the mobile device of the patient or companion. This information could include sleep conditions [6], workout or exercise regimens [31], heart rate [17] or even information shared by other applications, such as the alcohol screening results [33, 34]. The mechanism should also allow the user to self-report their mood, cravings, energy level, and other notable conditions using natural language. Based on low-level signals (contextual information), it should be possible to infer high-level events

(e.g., triggers for alcohol use) of which the patient or companions should be notified to avoid high-risk situations [19].

The second module is meant to deliver information or reminders of importance to the patients and/or companions (e.g., the nature of AUD), reminders (e.g., the time to take medication), or alert the users of any unusual physiological signals (e.g., cues for alcohol use). Note that the delivery of this information should fit within the situation derived from contextual information. In collaboration with treatment specialists (psychiatrists or psychologists), we will first prepare a database of AUD-related knowledge [35], with a focus on issues that are widely misunderstood. Note that we will seek to make the explanations easy to understand while avoiding repetition. This will be achieved by decomposing the concepts into short paragraphs or sentences describing simple concepts or reminders (e.g., remember that the psychiatric medication can be taken even after drinking alcohol). We will then use a crowd-sourced platform to gather volunteers to rephrase the snippets to form candidate pools attributable to a particular concept or reminder [22]. The pool of candidate phrases will then be tapped at random to supply conversations via the always-available conversational agent on the user's mobile device.

The third module is a conversation agent designed to interact with patients via natural language processing. An effort will be made to minimize the length and complexity of the sentences to accommodate the impaired language processing capacity typical of many AUD patients. The daemon will also provide easily understandable responses based on their questions and contextual background. Our plan is to use templates to construct responses, based on previous findings that templates (in the form of rubrics and/or checklists) could aid the completion of complex writing tasks [9, 13]. Our intention is to use the "Acknowledgment - Answer (if question)/New Information (if non-question) - Encouragement" structure for the template. Basically, the acknowledgment is a simple summary or paraphrase of what the user asked (to show that the agent understands the query). When the input is identified as a question, the agent will seek to answer it. When it is not a question, the chatbot will provide new information that is relevant to the topic introduced in the query. The agent will then conclude the interaction with encouragement drawing on the intent of the users' input or the contextual information gathered previously (e.g., acknowledging that the user has been maintaining a workout streak for a couple of days).

4 CONCLUSION

We are planning to recruit patients with AUD and family members to work with psychiatrists in refining the design of the system. A prototype of the system will then be used in a field study involving AUD patients and their companions to assess the potential and feasibility of the proposed system. We believe that the themes distilled from the pilot assessment and the preliminary system design will stimulate discussion in the LBW session.

ACKNOWLEDGMENTS

This research was supported by the National Science and Technology Council of Taiwan (NSTC 109-2221-E-003-010-MY3, 110-2634-F-002 -051, and 111-2221-E-007-117).

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