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# Conversational Agents for Health and Wellbeing: Review and Future Agendas

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## **Abstract**

This paper is a literature review of 57 papers that have examined the role and impact of conversational agents (CAs) in the health domain. We note that three key

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themes repeatedly arose during the review: therapeutic alliance, trust, and human intervention. We also point out several areas that have been largely overlooked, such as specific patient characteristics that influence the effects of CA usage, the results of differing CA designs, and specific human-CA relationships. Based on the current gaps in scholarship, we recommend several future intersections at which CAs and healthcare can meet.

## **Author Keywords**

Artificial intelligence; conversational agent; healthcare; virtual agent; wellbeing.

## **CSS Concepts**

• **Human-centered computing~Human computer interaction (HCI)**

## **Introduction**

Advances in artificial intelligence (AI) technology have brought heightened attention to conversational agents (CAs, popularly referred to as chatbots) in industry and academia. The terms chatbots and CA are often used interchangeably, as both refer to systems that mimic human language and behavior to implement certain tasks for the user via a chat interface, either text-based or voice-based [1]. Technological giants (e.g., Google, Amazon, and Apple) have commercialized such CAs in forms of both hardware (Amazon Echo or Google

Home) and software (such as Apple Siri) [17,3,4]. CAs are now widely used across many fields, such as museum tours [22], tourism activities [30], various learning environments [3], and mental health interventions [13].

The healthcare field has enthusiastically embraced the use of CAs as a patient care aid to support physical/mental health, by serving as an e-health tool that is convenient, easy to use, and allows patients to overcome health literacy barriers [19, 35]. For instance, Bickmore et al. [6] explain how CAs can be utilized to establish a therapeutic alliance, which improves the quality of the relationship between the health care provider and the patient [5]. A therapeutic alliance has been established as a key factor in successful interventions in the mental health domain [28, 32]. CAs are useful in establishing this alliance as patients have been shown to be more willing to self-disclose personal information to virtual therapists compared to actual human therapists [25] because they felt that their responses were not being judged.

However, although the adoption of CAs into the health and wellbeing field seems positive, it represents a relatively new advancement in treatment options, with many factors yet to be explored. The relatively large amount of publications appearing in the engineering or the medical domain [37] presents an opportunity for HCI professionals to bridge multiple stakeholders by designing user-centered tools for patients. Therefore, we decided to complete a review of past literature featuring CAs and healthcare to discover which areas should be focused on by HCI professionals.

We conducted a literature review of 57 papers selected from the ACM Digital Library, AMIA, JMIR, and Google Scholar. We deduced several salient themes from this literature review and were also able to isolate and recommend several future research topics. From our research, three important themes emerged that pertained to CAs: therapeutic alliance, trust, and human intervention. Secondly, we discovered that specific patient characteristics, the effects of different CA designs, and human-CA relationships have been largely overlooked. Finally, we provide recommendations for future research to design and incorporate CAs that can meet various healthcare demands, such as patient characterization, establishing children as a target group, and evaluating different CA designs.

### **Literature Selection and Analysis**

Papers were selected from the ACM Digital Library, AMIA, JMIR, and Google Scholar based on queries such as "artificial intelligence," "conversational agents," and "healthcare." We excluded papers that were heavily focused on algorithm development due to our primary interest being in HCI and CSCW. In this paper, we do not intend to provide a complete scope of all existing literature, but rather to focus on providing critical insights that will contribute to an informed discussion during the workshop. The papers were analyzed with a focus on CA features. We divided the features of each CA into four categories: modality, level of analysis, therapy content, and user benefits. Each category contains corresponding sub-categories, such as text/voice, mobile/tablet for modality, or therapeutic alliance/trust/customization for user benefits. Finally, we measured the sub-categories that appeared frequently.

### **Past Literature on CA and Healthcare**

We have identified three key themes that feature predominantly in prior literature: therapeutic alliance, trust, and human intervention. First, an examination of the therapeutic alliance between CAs and patients was included in 14/57 (25%) papers. Since CAs can listen to patients and give them feedback, they are able to form a therapeutic alliance with patients. Studies show that therapeutic alliance is important because it is positively correlated with satisfaction towards the system, patients' desire to continue using the service, and expectation to follow the CA's advice [7]. This was enhanced by the CAs offering effective support or displays of empathy, either directly [7] or indirectly [7,18,40,26]. CAs can develop rapport with the patient, generating the perception of therapeutic alliance [11]. To this end, several works have embedded empathetic responses into their CAs, both verbally and nonverbally [2,7,8,16]. A recent publication demonstrated how not only *being cared by a CA*, but *caring for a CA* results in more positive outcomes in terms of self-compassion [24].

The next important factor for clinical CAs is trust. This feature was addressed in 7/57 (12%) papers. The level of trust the user felt towards the CA is an important foundation in shaping willingness to interact with them [38, 39]. Xu established that trust in a system with a robotic agent is not different from trust with a human agent [41]. Kang and Wei demonstrated that when a patient's support needs – whether informational or emotional – align with the CA's responses, trust towards them increases [20]. Zhang et al. showed that a patient's trust increases when the provider's interest aligns with that of the patient [42]. Fadhil et al. demonstrated that there is an interaction effect

between communication style (including emoji or text only) and topic of dialogue (physical well-being or mental well-being), which impacts trust in the CA [15]. As such, through different conversational or visual designs, researchers have tried to increase the level of trust users feel towards the CAs.

Finally, the last factor of CA is human intervention. This feature appeared in 6 out of the 57 papers. Studies often included intervention by human therapists because CA technology does not aim to replace human healthcare professionals [27] and is not yet capable of being highly responsive and empathetic [23]. Human therapist exists to address situations beyond the capabilities of CAs [34]. Specific circumstances where a human therapist is called for include asthma [34], suicidal behavior [29], hospital discharge with patients with depressive symptoms [7] or diabetes [8]. It would be useful to develop a tool that calculates when a human therapist should intervene. Methods such as cloud computing [12], data log [9], and feature integration [14], could be used to conduct future research that contextualizes patient settings and determine if and when human intervention is necessary.

### **Gaps in Prior Work and Future Work**

Across the three salient themes on which CA research has been primarily focused, we have found three possible avenues for future research that have not been sufficiently addressed. First, the characteristics of target patients have been neglected. Many studies have focused on the clinical outcomes of patients without addressing individual differences among patient groups. Moreover, the designs of CAs have not been varied sufficiently to test the validity of CA intervention. Most

studies have utilized a single CA design decision, without evaluating which design is more suitable for a certain target group or certain health problem. Lastly, the relationship between the CA and human should be investigated further. Given the advent of AI-based CAs, we believe there has been insufficient research on identifying and evaluating factors that contribute to alliance and trust between AI-based CAs and humans in the health domain, and how human therapists and CAs can collaborate for clinical goals.

Based on the identified unexplored areas, we provide recommendations for future research. First, we recommend identifying patient characteristics and applying them to the CA intervention. This is important because characterizing the user allows the system to customize the intervention to best meet patient needs. Customization of AI technology and CAs is an important aspect for user satisfaction and adherence [10, 18, 34], and research that distinguishes user characteristics and applies them to CA development is necessary (e.g., how do patients with different loci of control benefit from different sets of motivational messages).

Second, we recommend studying children as a target group. Children's fascination for technology [33], inclination to disclose personal information to virtual agents [31], and robots such as Paro [36] indicate that there is great potential for CAs to be specifically targeted towards children. With the advent of more natural synthetic voice technology, we expect that children will be able to easily access CAs without assistance. However, ethical issues must be considered to ensure children's safety and privacy.

Finally, we recommend trialing different CA designs to deliver interventions and build alliances or trust. For example, what modalities are especially important for the treatment of patients with autism? Various platforms such as mobile or at home CAs (e.g., Amazon Echo), can also be tested. What are the different effects that arise from this distinction? How can different CA designs induce therapeutic alliances or trust?

### **Expectations for the Workshop**

We would appreciate the opportunity to participate in this workshop for CSCW 2019 because of the relevance to our research and the fruitful discussions it will hold. The first author's previous work on CAs and healthcare was based on a workshop and interviews with teenagers which sought to understand how teenagers would like CAs to be designed for stress management [21]. The study showed that teenagers want to talk to CAs because they believe CAs can keep their secrets, provide them with useful information, and are available 24/7. However, it failed to see CA as a collaborative tool, focusing on user-centered design, not a social point of view. The workshop's theme surrounding the social aspects of AI such as its role, trust and collaboration with humans will help us broaden our perspective and conduct future research in a different point of view. We also hope to hear the opinions about our research questions and directions we will bring to the workshop. It will be a valuable experience to listen to the insights of other medical and connect with them.

We can contribute to the workshop by bringing a new perspective from UX viewpoint and providing background for the discussion gained through our literature review. We hope to share the lessons learned from our experience for a productive workshop.

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