

Can a Virtual Coach Activate Patients? A Proof of Concept Study

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ABSTRACT

Objectives: Virtual assistants formed through the union of artificial intelligence (AI) and natural language understanding (NLU) technologies (eg, Siri) are routine in our daily lives. The purpose of this study was to test patients' acceptance of a virtual health coach (VHC) who emulates medical staff to activate the patient to engage in a conversation with their physician about healthy lifestyles.

Study Design: Descriptive survey study.

Methods: Eighty-nine primary care patients agreed to test "new technology" while waiting in the exam room for their physician. Patients used a handheld tablet computer to interact with an animated VHC who asked questions about common health concerns, including weight, smoking, drinking, stress, or medication adherence. During the brief intervention, the VHC advised the patient to have a conversation with the physician about the identified lifestyle concern.

Results: Patients were comfortable with the technology and said it positively impacted their feelings about the organization. They talked to the VHC, rated the technology as easy to use, and felt that they would use it again and that other patients would enjoy it. Many patients tried to talk to the VHC about the specific reason for their visit.

Conclusions: VHCs using AI and NLU technologies are acceptable and useable, and they positively impact patients during exam room "downtime." The technology easily integrates into the clinic workflow and does not extend the length of the visit. Although patients were willing to talk with the VHC, in many cases, they confused the VHC's line of questioning about general lifestyle concerns with the purpose of their visit.

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Patient "activation" is a recognized concept that describes a person's knowledge, confidence, and skills to manage his or her own health and healthcare; thus, patients who are activated in their health and healthcare generally have better outcomes and lower costs.¹ Yet, 75% of patients are not adequately informed or confident, nor do they have the necessary skills to manage their health. In particular, healthy lifestyle behaviors are problematic for most patients. Those with lower activation rarely participate in behaviors that require active self-management, such as exercise, eating a healthy diet, and managing stress.²

Interventions to increase patients' activation in their health have focused on the development of skills and advice tailored to the patient's level of activation. For example, training patients to ask their doctors questions and giving them support to do so has been shown to increase both activation levels and participation in healthcare.^{3,4} Observations of patient-physician encounters suggest only 10% of the primary care visit is devoted to lifestyle topics and, further, that these 2 minutes mostly entail the physician bringing up a lifestyle concern. Such limited and ineffective interactions have prompted calls for additional communication training for primary care providers to help them engage patients in lifestyle issues in a time-efficient and effective manner.⁵

A virtual health coach (VHC) offers a solution to the problem of patient activation and patient-physician discussions of lifestyle issues. Current technology enables the design of an animated VHC who can understand everyday language and respond to patients in

a conversational manner. Patients are accepting of virtual agents and, interestingly, some disclose more to a computer interviewer than to its human counterpart.⁶⁻⁸ Standardized behavioral change and motivational interventions can be built into VHC interactions.^{9,10} The ability to standardize conversations allows challenging and time-consuming interactions to be brief, consistent in quality, and scalable. VHCs could ultimately cost less than real providers in specific contexts.¹¹ Thus, they are an attractive alternative to training physicians to be proficient in effective lifestyle discussions by using motivational interviewing strategies, which has proven to be challenging at best.^{12,13}

The purpose of the current study was to test the feasibility of a technology innovation in the primary care setting, building on an earlier unpublished study of a prototype. We wanted to determine patients' acceptance of a VHC—with artificial intelligence (AI), natural language understanding (NLU), and animated capabilities—by engaging in a verbal interaction with the coach while waiting in the exam room for the doctor. The VHC is intended to emotionally connect with, encourage, and support patients in preparation for a conversation with their doctor about a lifestyle issue that the patient identifies as concerning.

METHODS

Setting and Procedures

Physicians and their medical assistants (MAs) from women's health and adult medicine clinics participated in the study. MAs gave patients a handheld tablet and provided the instruction, "We are testing new technology and need your help." There was a prominently displayed "start" button. The Northern California Kaiser Permanente Institutional Review Board allowed a waiver to a signed consent document.

The VHC oriented the patient to the purpose of the tablet app and provided instructions for the microphone. As the VHC "spoke," the tablet's screen simultaneously displayed the VHC and the text of the VHC's words on the screen to allow patients to read the conversation. The patient was asked to select a general health concern (eg, weight, smoking, drinking, stress, taking medications, or none of the above) and respond to a series of questions, interspersed with empathic and supportive statements, all with the purpose of encouraging the patient to bring up the concerning health topic as soon as the doctor entered the room. The VHC used motivational questions to prime the patient for the conversation.¹⁴ At the end, there was a "learn more" button for reading materials relevant to the lifestyle topic the patient selected. Upon entry, the physician asked, "What did you discuss with the health coach?"

Patients completed surveys disseminated by the authors and brief interviews at the end of their visit. Physicians were surveyed via e-mail.

Technology

The VHC (an AI-based cognitive software solution) was created by a contracted vendor, and it spoke English and Spanish. It was built on the Alme platform, which combines a healthcare domain model and NLU with an avatar to drive interactive conversations. Samsung tablets were connected to a secure, corporate wireless network.

Outcomes, Measurements, and Analysis

Data were captured via the tablet app, including verbal interactions, the lifestyle concern selected, and the mode of communication (talking, typing, and tapping an icon). Surveys used a 1-to-7 Likert scale to measure aspects of the experience, and patients also provided verbal feedback. Means and standard deviations were calculated for survey responses, and the user experience data were also described.

RESULTS

Eighty-nine patient-VHC conversations were captured. One patient refused to participate, and 63 patients (12 male, 48 female) were available for surveys and interviews. Thirty-four patients were from women's health clinics and 29 were from adult medicine clinics. The average age of males was 56 years (range = 33-82 years), and the average age of females was 41 years (range = 18-84 years). Eight physicians participated.

Patients talked out loud to the VHC in 82% of the interactions and typed responses 6.6% of the time. When an icon was available, patients "tapped" on it 74% of the time versus voicing their lifestyle concern audibly. Most patients rated the technology as easy to use, felt other patients would enjoy using it, and were willing to use it again, while the modal response was "neutral" about their own enjoyment. Many reported the positive impact of the technology on their feelings toward the healthcare organization. Patients' survey data are presented in [Table 1](#).

Patients said they felt encouraged by the VHC to talk with their doctor, and 51% of them reported they engaged in a conversation with their physician about the health topic they selected on the tablet. Twenty-six percent reported they had not talked with the physician about this topic previously. "None of the above" was the most frequently (66.3%) selected lifestyle concern. Of that 66.3%, 24 patients specifically stated, "I'm healthy," 26 vocalized a specific reason for their visit, and 9 of the verbal responses of patients were unintelligible. Weight was the most frequent concern (18%), followed by stress (7%), medication adherence (6%), drinking (2%), and smoking (1%).

The verbal comments regarding feedback on the VHC included it was "fun," "interesting," "very cool," "impressive," as well as "It was great to have something to do while waiting" and "I love this about this organization." A number of other comments were similar to "It would be great if it related to the reason I'm here." Comments spe-

Table 1. Patient Ratings on a Scale From 1 (low) to 7 (high)^a

	1 (LOW)	2	3	4 (NEUTRAL)	5	6	7 (HIGH)	Mean	SD
How easy was it for you to use this new technology?	1	0	4	6	4	11	37	6.06	1.42
How much did you enjoy using it?	6	6	1	30	8	3	8	4.11	1.67
How comfortable are you with using “touch screens,” such as tablets, iPads, and iPhones?	1	2	1	5	3	4	47	6.29	1.45
How comfortable are you with using the voice recognition feature on your phone or iPad?	4	3	3	5	8	12	28	5.51	1.86
How much did you feel that the health coach wanted to help you talk to your doctor?	3	2	3	22	8	10	13	4.84	1.63
How encouraged did you feel to talk with your doctor about the health topic you selected?	3	0	2	21	6	6	22	5.22	1.69
Do you think other patients would enjoy using this new technology?	0	1	3	21	14	8	15	5.13	1.33
How does the use of this new technology impact your feelings about this institution?	0	1	2	21	6	12	20	5.39	1.41
Would you be willing to use this type of technology again?	3	2	2	12	8	15	20	5.34	1.69

SD indicates standard deviation.

^aAlthough 63 patients were surveyed, all did not answer every question.

cific to the VHC included, “weird movements,” “robotic voice,” and 1 patient stated, “I didn’t like it.”

Sixty-seven percent of the patient–VHC conversations were completed, meaning patients reached the final screen. There were Internet stability issues in some cases, and technology malfunctions in others; for some, the physician entered the room before the patient–VHC exchange was completed.

There was a significant negative correlation between age and comfort with using “touch screens” ($r = -0.51$; $P < .00003$; $R^2 = 0.26$). No relationship was detected between the variables of age and comfort using voice recognition technology. Physicians reported minimal impact of the technology on the duration of the visit, and they were, on average, neutral about the usefulness of the VHC. **Table 2** displays the physician ratings.

DISCUSSION

The purpose of this feasibility study was 2-fold: first, to determine patients’ acceptance of a VHC while waiting for their physician, and second, to ascertain whether patients would engage in a conversation with their physician about a lifestyle concern identified through the

virtual interaction. We believe this is the first report of using AI/NLU technologies with patients in the primary care setting and consider the findings worthy of further investigation.

Patient Experience

Patient responses to the technology exceeded expectations. Regardless of age, patients were willing to use a VHC while in the exam room and to speak aloud to it. As in earlier reports, patients were positive about the technology.^{7,15} Patients also felt encouraged by the VHC to engage in a conversation with their physician. Interestingly, although patients think others will enjoy the VHC, their own enjoyment ratings were “neutral.”

Patient responses regarding the intent of the VHC were perplexing. A sizable number selected “none of the above” regarding lifestyle concerns, which contradicts current healthy lifestyle investigations.¹⁶ Many patients neglected the instructions about “overall health” and “not your specific reason” for today’s visit and told the VHC about a specific problem. Nevertheless, half of the patients reported they had a conversation with their physician about the topic they discussed with the VHC, and about half of this group said they had not dis-

Table 2. Physician Ratings on a Scale From 1 (low) to 7 (high)^a

	1 (LOW)	2	3	4 (NEUTRAL)	5	6	7 (HIGH)	Mean	SD
To what extent did the app ease the burden on you to bring up lifestyle issues during the visit?	2	1	0	4	1	0	0	3.13	1.55
To what extent did the app impact the duration of your visits?	2	1	0	5	0	0	0	3.00	1.41
To what extent did the app help you connect a patient to our resources?	1	0	1	2	2	1	1	4.38	1.85
To what extent would you recommend this Avatar app to a colleague?	1	0	0	3	2	0	2	4.63	1.92
To what extent did you feel you were better able to help your patients by having them first talk with the Avatar Health Coach?	1	0	1	3	2	1	0	4.00	1.51

SD indicates standard deviation.

^aBased on responses from 8 physicians.

cussed this topic with their physician previously.

Physician Experiences

Physicians were “neutral” about the VHC. However, although several expressed verbal concern about increasing the encounter time, this outcome was not reported. Physicians were more positive in the earlier prototype test. One said, “It makes me have a conversation relevant to the patient. I want to discuss smoking, but this lets me know the patient is worried about stress. It saves time.” In the current study, little time was spent orienting the physicians about the purpose of the VHC, and this may, in part, be responsible for their lower satisfaction ratings. In addition, the desired outcome of the VHC interaction was for the patient and physician to have a discussion about a lifestyle concern, but this did not happen consistently.

Technology

The technology can improve. The voice recognition technology did not always capture the verbalizations of the patient, and the secure wireless connection was unstable. Some patients described the voice of the VHC as “robotic” and the movements as “unnatural” and “jerky.”

Based on greater success of an earlier prototype, we speculate that the appearance, movement, and/or voice of the VHC could be distracting to patients. In our unpublished study of 11 patients that displayed a posturized image of a coach on the tablet, patients followed instructions, identified a lifestyle concern, and discussed it with the physician in every case. In the current study, the VHC was an ani-

mated, semi-realistic virtual agent (similar to those in a video game) with empathic gestures and expressions. Elements, or the combination of these features, potentially diverted patients’ attention from the instructions, and, although the multi-featured VHC might be acceptable in a video game, the healthcare setting is inherently different and patients have ingrained expectations

Future Investigations

The application of behavioral and psychological strategies through technology (ie, behavioral intervention technologies) has tremendous promise for healthcare.¹⁷ We see the VHC as the inaugural attempt to integrate motivational and patient activation strategies with AI/NLU technologies. Future VHC iterations could include voice enhancement, modified movements, and altered appearance.¹⁸ Strengthening the instructions about the purpose of the interaction will be important, as well, to ensure the desired conversation takes place. Additional advancements could leverage data from electronic health records to personalize the exchange, and the VHC’s questions could address specific visits, such as birth control considerations for women’s health and alcohol screening in adult medicine.

CONCLUSIONS

The introduction of a VHC in the healthcare setting could be considered “disruptive technology,” which is defined as “a technology that shakes up an industry, or a groundbreaking product that creates a completely new industry.”¹⁹ According to Clayton Christensen, it often lacks refinement, does not perform well because it is new, and

appeals to a limited audience. We think this describes our VHC concept: it needs refinement, better performance, and broader appeal, and it has untapped potential to improve quality, efficiency, health outcomes, cost, and patient satisfaction.

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