



Not just a Barbie in hijab: participant perspectives on culturally tailoring a virtual health assistant for Bangladeshi immigrants in the US promoting colorectal cancer screening

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Background: Colorectal cancer (CRC) screening uptake among South Asian immigrants in the US is the lowest (61.1%) of all immigrant groups (e.g., 65.9% among East Asians and 71.3% among Hispanics). Culture-specific factors influence their reluctance to screen for CRC, despite the availability of easily accessible, non-invasive screening tools, like the fecal immunochemical test (FIT). The current study utilizes a virtual health assistant (VHA) tailored to inform and educate Bangladeshi immigrants about FIT.

Methods: We conducted usability tests to understand Bangladeshi immigrants' informational needs, barriers, facilitators, and visual and linguistic preferences. After 20 minutes of interaction with the VHA, we conducted semi-structured interviews with 30 participants. Participants also filled out a questionnaire of demographic information and VHA gender and ethnic appearance preferences. A qualitative content analysis using the constant comparative method generated themes.

Results: A total of 30 participants (16 women, 14 men) with a mean age of 39.2 years participated. Informational needs included eight themes: (I) risk-reducing behaviors/habits, (II) post-intervention (information desired after interacting with the VHA), (III) CRC-related content (e.g., symptoms, causes, impact on the body, etc.), (IV) financial considerations of FIT, (V) personalized content/options, (VI) pre-test information (how to prepare for the FIT kit use, e.g., "do I need to fast?"), (VII) comparison to other CRC screening options, and (VIII) more specificity of information (i.e., using more measurable language, avoiding vague language like "some", "more", etc.). Major barriers were (I) lack of control, (II) lack of sophistication in VHA animation features, (III) lack of interactivity, and (IV) lack of a trustworthy source. Facilitators were (I) convenience (of using VHA), (II) social cues (of interacting with a VHA), and (III) content (provided by the VHA). In terms of VHA's appearance, which was a combination of its apparent gender and ethnicity, participants demonstrated varied preferences but the majority (n=17) preferred gender concordant VHA. As for linguistic preference, participants generally mentioned either English or an option to choose a language for themselves while claiming that other Bangladeshi immigrants would prefer the Bangla language.

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Conclusions: Participants were open to using a VHA to learn about CRC, either instead of or along with talking to a clinician about it. However, recommendations to improve animated features of the VHA included more detailed and Bangladeshi population-specific information and provided choices to select preferred languages and appearance of the VHA. Future studies should empirically test the required levels of tailoring to effectively increase CRC screening among Bangladeshi immigrants.

Keywords: Virtual health assistants (VHA); colorectal cancer screening (CRC screening); Bangladeshi immigrants; immigrant health; cultural tailoring

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Introduction

Background

The use of emerging and innovative mHealth interventions, defined as medical and public health practice supported by mobile devices (1), such as virtual health assistants (VHAs), to promote cancer prevention and screening is increasing

in the US (2). VHAs are computer-generated software, with varying degrees of autonomy and intelligence, that mimic human behavior, verbal and non-verbal, to communicate with the user (3). VHAs can have an embodied, animated appearance with spoken communication features or they can be chatbots with text-only exchanges; in the current study, the VHA used had an embodied appearance. VHAs have shown promising benefits in health care over the last two decades, having significantly improved cancer literacy, intention to screen, adoption of preventive behaviors such as physical activity, and fruit and vegetable consumption (4-8).

However, development of VHAs without a deep understanding of the needs of the intended audiences, such interventions may lead to further health disparities, digital divide, and unsatisfactory outcomes (9-11). One way to avoid these pitfalls of intervention development is to tailor them by addressing the specific cultural, informational, and access-related needs of the intended audience (12-14). A theoretically grounded beta version of a VHA can be further tailored by having it tested among the members of the intended audience and use their feedback to further tailor it with the specificities provided by them (15,16).

VHAs are easily customizable and thus provide a great opportunity for tailored interventions to promote cancer screening (17,18). VHAs are especially effective in interventions among underserved and minoritized communities for both structural and cultural reasons. Structurally, VHAs can be accessed through computers or smartphones readily available to most people in the US (19), whereas underserved and low-income communities often lack access to nearby hospitals for cancer screening, financial resources for transportation, or ability to take time off work for a screening visit (20). eHealth, bypassing these structural barriers, has already been used to increase screening among minoritized communities and create more equitable access to

Highlight box

Key findings

- Participants found the novelty, convenience, and interactivity of the virtual health assistant (VHA) interesting and were open to using it as an educational tool to learn about colorectal cancer (CRC), its screening methods, and the importance of screening.
- Participants want VHAs that go beyond surface-level cultural tailoring (look and language) and allow for options to cater to individualized guidance based on cancer literacy, and Bangladeshi-culture-specific information about risk-reducing behaviors for CRC prevention.

What is known and what is new?

- Cultural tailoring of an intervention often focuses on gender and ethnicity matching and/or changing the language to the native language of the intended audience. The current study found that participants rather prefer to choose who they want to interact with, and it is not always concordant with their native language, gender or ethnicity.
- Minoritized participants, like Bangladeshi immigrants, prefer deep level tailoring, such as having information that includes their health risk and risk-reducing behaviors in the context of their immigration experience and culture-specific health behaviors.

What is the implication, and what should change now?

- Instead of “adapting” interventions made for white, English-speaking, US-born populations to other minoritized groups, health interventions need to center the intended minoritized population’s specific needs when developing health interventions.

care (20,21). Culturally, VHAs can be customized to the needs of specific groups and individuals (16). Customization includes language, skin tone, and clothing, as well as deep cultural factors such as message framing (e.g., individual *vs.* collectivist, gain *vs.* loss), health literacy, and the need for privacy for conversations about private body parts. Embarrassment about talking to a human clinician about private body parts is often cited as a barrier to screening, especially among minoritized and underserved populations (22).

Colorectal cancer (CRC) is easy and cheap to treat, if detected early (23). Screening for CRC, when under the guideline (i.e., age 45 years or older) or if at a higher risk (i.e., family history of CRC) can reduce the mortality of CRC by 73% (24,25). Non-invasive, accessible screening procedures, such as, fecal immunochemical tests (FITs) are developed to improve screening rates in the US (26). FIT is already being promoted to improve screening rates among other populations who find it difficult to complete invasive screening processes like colonoscopy (17). Out of guideline insured patients can receive mailed FIT kits, collect a stool sample in the comfort of their home, and mail the sample to a lab for results (27).

Rationale and knowledge gap

Despite the ease of use, CRC screening uptake with FIT has been suboptimal, especially among minoritized population groups, such as new immigrants (26). New immigrants have the lowest CRC screening rates in the US, second only to uninsured Americans (28). South Asian immigrants have the lowest screening rate, 61.1% compared to all other ethnic/racial groups (29,30).

South Asians have the lowest CRC screening rates compared to Hispanic, Black, and White Americans (30). A recent systematic review on CRC screening barriers among the US immigrants found five major barriers—access, knowledge, trust, culture, and beliefs (14). While, non-invasive screening like stool testing can address the access barriers, culturally and theoretically grounded communication interventions are needed to address the barriers of knowledge, trust, culture and belief (31).

Additionally, there is a data gap about the subgroups within the South Asian communities whose immigration history, socioeconomic status (SES), cultural and religious backgrounds, and language differ vastly from one another (32,33). While equitable access to care and treatment requires group-specific (e.g., ethnicity, immigration history and status, SES) information to identify barriers to access

faced by minoritized populations, immigrant groups like Bangladeshis are either non-existent in health intervention development or lumped together with “Asian” or “Other” groups (34). Even in studies focused on South Asians, subgroups are rarely equally stratified according to the country of origin or linguistic backgrounds (22,29,35). Emerging research that consider immigration itself as a social determinant of health also shows that immigrants’ socio-political histories can influence their health behavior and health outcomes (36). Lumping all people coming from eight countries and thus at least eight different socio-political history, speaking over 600 languages essentially erase their voices and experiences (37). An intervention designed based on the user experience from a specific South Asian group, i.e., Bangladeshi immigrants, can help lessen that knowledge gap.

Objective

This study aimed to understand the informational and cultural needs of US-based Bangladeshi immigrants regarding a VHA-based intervention promoting CRC screening using stool testing by asking four research questions:

- (I) What are the participants’ informational needs?
- (II) What are the participants’ barriers and facilitators to using the VHA?
- (III) What are the participants’ preferred appearance-related features for the VHA?
- (IV) What are the participants’ linguistic preferences for the VHA?

Methods

This study tested a preliminary version of a VHA developed at the University of Florida among 30 first-generation Bangladeshi immigrants. Participants interacted with the VHA, then provided feedback during in-depth, semi-structured interviews conducted online from November 2020 to March 2021. Each participant also responded to a questionnaire via a Qualtrics link sent to them on Zoom via the chat option for demographic information, and preferences for VHA appearances (*Figure 1*). Interview data were analyzed using qualitative content analysis. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the institutional review board of the University of Florida (IRB201901798) and informed consent was waived according to the institutional review board.



Figure 1 Six versions of the virtual health assistant for the participants to choose from in the questionnaire.

Participants

Participants were recruited using snowball sampling and word of mouth utilizing the community-level access of the first and third authors (A.R. and K.P.S.). Participants were eligible if they were (I) born in Bangladesh, (II) at least 18 years old, (III) currently residing in the US, (IV) proficient in English, (V) had Internet accessibility, and (VI) the ability to participate in an online interview. All interviews were conducted in English.

Data collection

Once the interviewer (A.R.) described the purpose and approach of the study, and the participants verbally consented to participate, they were provided a link to the VHA and were instructed to interact with it. Immediately after their interaction, an interview was conducted via Zoom. Each interview lasted for 30 to 50 minutes excluding the interaction time with the VHA and was recorded and transcribed via a third-party agency for analysis.

The semi-structured interview process included questions about what participants liked about their interaction with the VHA, what they did not like, what could be done to make it more appropriate to Bangladeshi immigrants, and what they wished the intervention contained but did not (Appendix 1). Recruitment was considered complete once data regarding

general perceptions of the VHA reached saturation.

The interaction

Once the participants clicked the link provided to them to interact with the VHA, they were directed to the online platform that hosts the intervention. They received a brief textual message from a “human clinician” about the interaction. Then the VHA appeared to interact with the participant. The interaction started with the VHA describing what CRC is, what are some of the ways to screen for it, and some population statistics about CRC mortality and screening rates. Then, the VHA asked questions about the participants’ diet and behavior (e.g., red meat consumption, tobacco use) to let the participants know whether they are prone to any behavior that increases the risk of CRC. The VHA also assessed the participants’ perceived barriers to screen for CRC which included time, commute, and embarrassment. Finally, the VHA conveyed information about FIT kit as a method to conveniently screen for CRC and demonstrated how to hygienically use the FIT kit using animation.

Analysis

A qualitative content analysis of the transcriptions was conducted, using a traditional approach to inductively code

Table 1 Demographic characteristics of the participants

Characteristic	Category	Value
Sex	Male	13 (46.4)
	Female	15 (53.6)
Income	Under \$75,000	9 (32.1)
	\$75,000 or over	17 (60.7)
	Preferred not to respond	2 (7.1)
Education	High school degree	3 (10.7)
	College degree	9 (32.1)
	Postgraduate degree	16 (57.1)
Religion	Hindu	7 (25.0)
	Muslim	18 (64.3)
	No religion	3 (10.7)
Age (years)	Overall	39.8
	Male	41.9
	Female	37.7

Data are presented as n (%) or mean.

transcripts and identify patterns in the data pertaining to the four research questions (38). We used ATLAS.ti, Version 24 qualitative data management software, for analysis. The analysis included four analytical steps in line with the constant comparative method (39): (I) complete immersion in the data, (II) open-coding the data to identify patterns, (III) collapsing the codes into themes, and (IV) axially coding the themes to identify their properties. The first author (A.R.), collected the data, wrote memos, and read through the transcripts before beginning open-coding. Then A.R. and a qualitative methodology expert (C.L.F.) collapsed the data into themes. Based on the codes affiliated with each theme, A.R. axially coded the themes for their properties and descriptions and, after defining the thematic properties, used the themes to code the transcripts. Through expert review of each step of the analyses, themes, properties, and definitions were finalized. A second coder (K.P.S.) coded 20% (N=6) using the same codebook as the first author, who had highlighted the parts that needed to be coded to ensure consistency in unit of analysis, with a Krippendorff's Alpha of 0.95.

Results

Thirty participants were interviewed (16 female, 14 male).

Ages ranged from 18 to 64 years, with an average of 39.2 years. The participants resided in Florida, New York, California, and Texas. One participant was later excluded for not meeting the inclusion criteria, and one was unable to start the usability test due to time constraints and was also excluded from the analysis. Thus, the final sample size for the usability study was 28. Most of the participants had post graduate degrees (57.1%), were Muslim (64.3%), and annually earned \$75,000 or more (60.7%). *Table 1* includes a full demographic summary.

RQ 1: What are the participants' informational needs?

The first research question explored what content participants expected to see or wanted changed in the intervention. Participants identified eight types of informational needs (*Table 2*), (I) risk-reducing behaviors/habits, (II) post-intervention (post-VHA) procedures, (III) CRC-related content, (IV) financial considerations of FIT, (V) personalized content/options, (VI) pre-test information (prior to FIT kit use or VHA interaction), (VII) comparison to other CRC screening options, and (VIII) more specificity of information.

Overall, the VHA was positively perceived. Participants mostly found the information provided by the VHA easy to understand. Participants especially appreciated the CRC- and FIT-related information they learned from the intervention. The video demonstration of using the FIT kit was cited as the most helpful or most liked part of the intervention, as it clearly showed the process to be easy and hygienic.

RQ 2: What are the participants' barriers and facilitators to using the VHA?

The inquiry about the barriers explored VHA platform-related preferences and information delivery rather than the information provided (*Table 3*). With this definition of barriers, participants identified four barriers to using the VHA: (I) lack of control, (II) VHA animation features, (III) lack of interactivity, and (IV) need for a trustworthy source. Facilitators constituted of positive aspects about the VHA, such as useful information and well-liked features of the interaction (*Table 4*). Here, participants identified facilitators under three themes: (I) convenience (of using VHA), (II) social cues (of interacting with a VHA), and (III) content (provided by the VHA).

Participants preferred the VHA over traditional information reception methods, such as text or YouTube videos. The

Table 2 Participants' informational needs from the VHA (N=28)

Theme	Properties	Description	Exemplar
Risk-reducing behaviors/habits	❖ Diet	After interacting with the VHA, participants express a need for information regarding behaviors they can change or actions they can take to reduce the risk of colon cancer	"Probably what I was asking other than red meat and smoking; is there something else I should avoid. Is there some food that help preventing it, if I eat more of those? How does the genetic stuffs can contribute? if I have a genetical history or this disease, how that could impact me?" —P28, female, 50
	❖ Lifestyle		
	❖ Nutrition		
	❖ Environment		
Post-intervention procedures	❖ Procedure for ordering FIT kit	After interacting with the VHA, participants convey a lack of information or understanding regarding the steps to be taken next	"I have confusion about who is going to send me the supposed home test kit. So to whom I should call to send the FIT kit to collect the specimen. So that was one thing." —P26, female, 47
	❖ Procedure for sending the sample to the lab		
	❖ Contact point for ordering FIT kit		
	❖ CRC symptoms	After interacting with the VHA, participants specifically mention other aspects of CRC they don't know about or wish they had heard about	"Yeah, definitely. I would like to see, like their mentioning it somehow or maybe like show, like what are like the stages each person has and like pictures or like visual things showing what it might look like." —P8, female, 18
CRC-related content	❖ CRC causes		
	❖ CRC effects on body and life		
	❖ Different stages of CRC and how they look on the human body		
	❖ Insurance information	After interacting with the VHA, participants convey or directly state confusion or lack of information about financial aspects of CRC screening	"I don't know, it doesn't say anything about insurance, whether this test is covered by insurance, so that [is] probably something you can incorporate. Yeah, if it's the US guideline to have for all insurance companies to cover this, it's for persons within that age range, then I think it should mention that so that question doesn't arise because otherwise, if you leave some questions unanswered, then people would end up calling the PCP, and then the whole purpose of it will fail, right?" —P10, male, 35
Financial considerations of FIT	❖ Cost of FIT		
	❖ Whether the intervention is free		
	❖ Age	After interacting with the VHA, participants convey a preference for information more tailored toward individual backgrounds and needs	"One of the options was the complication of going to a colonoscopy, which one is for me cost, preparation, something but I noticed it wasn't there for any other barriers, there was no other options. For example, if it was my mom, none of this would apply to her. Her only thing would be she doesn't have anybody to go with her or language issue. So, that wasn't there." —P17, female, 32
	❖ Race and ethnicity		
Personalized content/options	❖ Knowledge		
	❖ Test preparation	After interacting with the VHA, participants express lack of understanding of or information about the screening procedure or preparations for the screening	"How long it could take to test? If I make a mistake, what should I do?" —P14, male, 64
	❖ Test time		
	❖ Test procedure		
Pre-test (pre-FIT) information	❖ Compare with colonoscopy	After interacting with the VHA, participants mention they need to know how FIT compares with other screening methods to comprehend the benefits (or the lack of benefits) of FIT	"What would have made me say, 'Alright, this is unpleasant, but I will still do it, if I were told what the alternative is. Which is a colectomy, which I'm assuming is very painful. I don't know.' If those are my alternatives, if the person said that 'You could do a colectomy, but it's super painful' or 'You could do this, which is unpleasant, but not painful,' I would probably be, 'Alright, fine, I'll do this.'" —P23, male, 38
	❖ Compare pros and cons of the available CRC screening methods		
	❖ Use of more measurable language (e.g., number of days, frequency of use)	After interacting with the VHA, participants mention confusion about certain information provided in terms of it being ambiguous or vague, and ask for more clarity	"In terms of the questions that were asked, there could really be more a bit more specific time range... for example like the red meat one that I mentioned. What would 'occasionally' mean? Because different cultures have different eating habits. For me, I don't really eat that much red meat anymore but there was a time when occasionally would be like once a week. Right now, it's once a year sort of thing." —P11, male, 34
	❖ Reduce use of language that varies individually (e.g., some, most, often)		
Comparison to other CRC screening options	❖ Test procedure		
	❖ Compare with colonoscopy		
	❖ Compare pros and cons of the available CRC screening methods		
	❖ Use of more measurable language (e.g., number of days, frequency of use)		
More specificity of information	❖ Reduce use of language that varies individually (e.g., some, most, often)		
	❖ Test procedure		
	❖ Compare with colonoscopy		
	❖ Compare pros and cons of the available CRC screening methods		

VHA, virtual health assistant; FIT, fecal immunochemical test; CRC, colorectal cancer; PCP, primary care provider.

Table 3 VHA usage barriers

Theme	Properties	Description	Exemplar
Lack of control	<ul style="list-style-type: none"> ❖ Navigation ❖ Limited options 	Perceived control of the progression or the pacing of the interaction (e.g., being able to skip or rewind or fast-forward); being able to choose what information they want to see or don't want to see	"Yeah. For example, if I go to say Mayo Clinic, what it does is it has lots of different subjects, right. It'll say, 'Are you at risk? What are the treatment options?' I can skip, right? I can decide which part I want to read first. I wish the video did that as well. A lot of different options, so I can pick and choose instead of going in order."—P25, male, 46
Lack of interactiveness	<ul style="list-style-type: none"> ❖ Cannot ask follow-up questions ❖ Preference for human contact ❖ Lacks social cues (e.g., emotional response, familiarity with the patient) ❖ Too lengthy ❖ Lacks engaging materials to sustain user attention 	Participants mention a lack of interactivity with the VHA in terms of not being able to ask questions if they have any, or emotionally connect with the VHA as they would with a human clinician, and the interaction being too long to pay attention to	"Well of course you can't really ask any—it's one way, right? The avatar will provide you with instruction of the information and then ask you a question and you will basically click and answer at the bottom. And then just—so that's very specific to the information that the avatar is providing."—P11, male, 34
Lack of a trustworthy source	<ul style="list-style-type: none"> ❖ Who is sending the intervention ❖ Endorsement of trustworthy institutions ❖ Need to be sent by insurance company or provider 	A need to receive the VHA intervention from a trustworthy source or the intervention containing logos or insignia of a renowned medical/research institution	"Is it a product that University of Florida created? Or is it a company? Because if it is a company then immediately after thinking about how sometimes doctors will try to kind of push a medicine or a drug on you because they're getting some sort of incentive from the company."—P25, male, 46
Lack of sophistication in VHA animation features	<ul style="list-style-type: none"> ❖ Need for better animation ❖ Need for more natural human voice 	Participants express a negative perception of the animated agent's appearance (e.g., the animation being subpar or the voice sounding robotic)	"If you do use avatar, then the avatar probably should look more real. I just felt like a Barbie or some kind of that kind of thing is speaking, which doesn't necessarily synchronize with the emotion and hand body movement or facial movement, or even the synchronizing of the lips. Together everything felt less connected to me when I'm seeking something so personal so important."—P16, female, 40

VHA, virtual health assistant.

most cited reasons for preferring the VHA was that it was personalized and interactive: "Like they asked me about 'Have I smoked recently?' or 'Have I taken alcohol?' and I had the options to select for myself, which was really cool" [Participant (P)8, female, 18 years old].

All participants were open to using the VHA, instead of going to the doctor, for information on CRC and CRC screening or as a preliminary method to assess individual risk factors for CRC. In fact, two participants explicitly mentioned they would prefer interacting with the VHA for general health reasons over going to a doctor. Participant 11 (male, 34 years old) mentioned he was used to lying to

his doctor about his smoking habits due to the fear of being judged. However, he felt comfortable telling the truth to the VHA, since it would not judge. Participant 21 (female, 34 years old) mentioned she preferred the VHA because there was no pressure to emotionally connect with it, which was not the case with a human doctor.

Some indicated that the information could be better customized to their needs by providing more clarity and specificity, the option to learn more, more visual information, and more personalization. There was also some feedback about the cultural tailoring of the information. One participant (P10, male, 35 years old) noted that the

Table 4 Facilitators for using the VHA

Theme	Properties	Definition	Exemplar
Convenience	❖ Time	Ease of accessing or using the intervention at one's own time or in one's preferred location	"I prefer after that weekend, if it is very freely available in the weekend, so if I cannot go to—I cannot take off in my office to go to the doctor office, I can make an appointment with the VHA in the weekend. So I don't need to wait a long time to get off from my office."—P29, male, 51
	❖ Location		
Social cues	❖ Realness	Description of the appearance and the qualities of the VHA in terms of human-like attributes, such as the perception of the VHA as a real human, or liking the voice, or description of the interaction being engaging or interpersonal or sociable	"Well of course, you see someone projecting voice to start with, not just asking question as you see as a text or a written form. So, when someone is actually speaking to you, no matter whatever the form it is, it always gives you a little more confidence in what you're interacting with. Rather than just looking at like a chat window or something."—P11, male, 34
	❖ Interactivity		
Content	❖ FIT information	The benefits of FIT-related information they received from the VHA interaction	"Yeah. It was really impressive. I definitely learned more than I should have known. And it sounds like a really, really effective way. Because I remember colonoscopy is actually it's a painful procedure. My husband went through like a few days he was in a lot of pain. So, if it can be done this easily, basically from your home with a very, very—well, not invasive at all procedure I think it's a wonderful program. Yeah."—P30, female 52
	❖ CRC	CRC-related information received from the interaction	"It was definitely informative. At the very beginning, the avatar explained. She set the pace, like what we are trying to do, why we are here, she explained what colon cancer is, what causes it and what things could happen because of that. And also, what are the reasons behind it."—P26, female 47
	❖ Simplicity	The ease of understanding of the information given and the attributions for the ease (e.g., language, lack of jargon, flow of the script)	"I thought that was very simple. A simpler answer that I was looking for, just providing the simple answer to those questions at least put me on the ground where I can understand why should I get tested right away, or I can wait another 10 years."—P23, male 38
	❖ Visual	Benefits of receiving information with visual demonstrations or aids	"I like the video because when she was talking about the poop, that time I feel a little bit embarrassed how to collect poop. Then the video showed me how to do it."—P24, female 45
	❖ General	Generic mention of liking the interaction because it was explanatory or informative	"I would say I learned a lot today in terms of our conversation. And it's not just learning, sometimes you need that push to get motivated to learn more. And I would say that this discussion was helpful in that sense."—P27, female 48

VHA, virtual health assistant; FIT, fecal immunochemical test; CRC, colorectal cancer.

information about CRC risk and tobacco discussed only smoking and not chewing. Since a lot of Bangladeshi chew tobacco, he said this should be included in the message. He also mentioned that not every Bangladeshi would know which meats are red meats. Another participant (P17, female, 32 years old) noted that there were only three options for barriers to colonoscopy: time, preparation, and transportation. She noted that for her mother, the major

barrier would be not having anyone to escort her to the clinic, even if she had transportation.

While there was a positive tone among the participants regarding the animation of the intervention, there was also some feedback to improve it, including improving the synchronization between voice, lips, and body movement; having the VHA look at the participant instead of in a vague direction; and varying the framing of the VHA to retain

Table 5 Appearance-based preference of VHAs among participants from the questionnaire (N=21)

VHA	Number of participants	Gender concordance	Gender discordance
White male	9	7	2
Asian female	5	4	1
Black female	2	1	1
White female	2	2	0
Asian male	2	2	0
Black male	1	1	0
Did not respond	9	–	–

VHA, virtual health assistant.

attention and a perception of interactivity. It is important to note that participants who were highly educated and worked in the tech industry elicited most of the feedback about the animation and modality. Participants without an engineering or tech background tended to view the animation more positively.

RQ 3: What are the participants' preferred appearance-related features for the VHA?

The participants had the option to choose from six options of VHAs in the questionnaire: white, Black, and Bangladeshi-looking male and female VHAs. The white male VHA was the most frequently preferred (n=9), followed by the Bangladeshi-looking female VHA (n=5). Participants tended to prefer a gender-concordant VHA (n=17) rather than a gender-discordant VHA (n=4). Comparatively, more men chose the white male VHA (n=7), while more women chose the Bangladeshi-looking female VHA (n=4). There were no systematic differences in the preferences of participants based on income.

While the questionnaire responses indicated a preference for the white male VHA (Table 5), the interview findings (Table 6) somewhat conflicted. In interviews, most participants indicated either no gender preference or a preference for gender-concordant VHA, while ethnic preferences were mixed equally between no ethnicity preference and a preference for an Asian/Bengali VHA. A few participants appreciated the effort of developing a Bangladeshi-looking VHA but one was skeptic about the feasibility of developing such interventions with such specificity of tailoring and a couple of participants mentioned that they did not find

the Bangladeshi-looking VHAs representative of actual Bangladeshi doctors. One of the participants criticized the Bangladeshi-looking VHAs stating “Clothing change and matching more with culture would actually add a little bit, but as I said, it is almost like seeing the Barbie doll in hijab now” (P16, female, 40 years old).

RQ 4: What are the participants' linguistic preferences for the VHA?

Participants' linguistic preferences were coded into three themes: (I) preference for Bangla, (II) preference for English, and (III) preference for choice to select preferred language (Table 7). Nine participants opined that older Bangladeshi immigrants and the Bangladeshi community at large would prefer a VHA speaking Bangla, the participants' native language. Fewer participants (n=5) expressed a preference for Bangla for themselves. English was explicitly preferred by eight individuals, citing reasons such as their self-efficacy in English, English being expected in health care settings, and the Bangla language lacking certain vocabulary for medical usage.

Two participants explicitly mentioned not wanting the VHA to speak in Bangla, one because Bangla is not always standardized or doesn't always have medical terminology that is known to laypeople (P9, male, 40 years old), and another because the translations in Bangla they had previously experienced in the US health care system were often “weird” (P24, female, 45 years old). Participants who said that English was fine for themselves cited reasons such as English being expected in the health care system, or English not being an issue for younger or educated Bangladeshi immigrants.

Discussion

Key findings

This study identified aspects of the VHA intervention that need to be customized to make it more relatable and better tailored to Bangladeshi immigrant audiences, including information tailoring, linguistic tailoring, and VHA features tailoring. Participants found the VHA overall acceptable as a means to learn more about CRC and its screening methods, found it interactive and convenient to use, and particularly appreciated the animated demonstration of how to use a FIT kit. The tailoring needs of the participants also indicated to a preference for control over the progression

Table 6 Gender and race/ethnicity preferences among the participants (n=28)

Theme	Properties	Description	Exemplar
No preference for gender		Participants explicitly mention they do not have any gender-specific preference for the VHA/doctor	“Not in terms of the avatar, no. Like I don’t have any preference if it was... in terms of if it looks a male or a Bangladeshi-looking male or a Bangladeshi-looking female, I don’t have any preference on that end.”—P11, male, 34
No preference for race or ethnicity		Participants explicitly mention they do not have any race- or ethnicity-specific preference for the VHA/doctor	“I don’t have the problem with the looks. I’m okay, I feel good.”—P21, male, 34
Preference for South Asian/ Bengali ethnicity		Participants explicitly mention a preference for a South Asian/ Bengali VHA/doctor	“Not that I have the option to pick the race. And personally, it doesn’t matter to me. But definitely I know that I would be a lot more comfortable with a Bengali doctor or from the South Asian background, than American. That doesn’t matter to me if you’re White or African American, that doesn’t matter to me or Spanish. That doesn’t matter to me. But if I’m comparing between American versus Bengali, I mean, personally, I would be able to be more open minded with the Bengali doctor.”—P30, female, 52
Preference to choose VHA appearance		Participants mention a preference for the ability to choose the appearance of the VHA based on their race and gender	“Or on screen maybe in the beginning, you give them an option, have a brown doctor, have a black doctor, white doctor, different race, and then you say select your doctor.”—P23, male, 38
Gender-specific preference	<ul style="list-style-type: none"> ❖ Preference for male VHA ❖ Preference for female VHA 	Participants explicitly mention a preference for a specific gender for the VHA/doctor	“Even my husband would prefer a female doctor, for me.”—P16, female, 40

VHA, virtual health assistant.

Table 7 Linguistic preferences among the participants (n=28)

Theme	Properties	Description	Exemplar
Preference for Bangla	<ul style="list-style-type: none"> ❖ Bangla is more appropriate for: <ul style="list-style-type: none"> ◆ Older people ◆ Bangladeshi community at large ❖ Native language for self 	Participants explicitly mention Bangla (or other native languages) as a preferred language for the VHA	“But maybe there are other patients too who have this, you know, obstacles of understanding this language. So, if it is having an option of changing the language, it would be better for many non-English speaking people to communicate with.”—P1, male, 49
Preference for English	<ul style="list-style-type: none"> ❖ English is expected in American health care settings ❖ Medical terminologies unavailable in Bangla 	Participants explicitly mention English as a preferred language for the VHA	“I think language is no problem. You know, the people who lives here, now they understand a little bit of English. Language is no problem, actually.”—P20, male, 40
Preference for choice to pick language		Participants explicitly mention a preference to be able to choose which language to use to interact with the VHA	“Well, definitely should come in different languages, I know English is what I chose, they should have options of different languages and dialects, dialects as well, because I speak a different Bangla with people of different parts of Bangladesh than what I speak at home. So, dialect is the issue especially when it comes to doctors.”—P17, female, 32

VHA, virtual health assistant.

of the interaction. Participants also indicated a preference for options to choose language and appearance of the VHA, rather than being assigned a VHA with an assumption of preferred language or the gender/ethnicity of the VHA. The study identified that tailoring needs of the participant need to go beyond surface-level tailoring, i.e., language or appearance of the VHA and cater to more nuanced needs and preferences of the intended audience, i.e., autonomy to choose, tailoring to the informational needs, tailoring to culture-specific understanding of health practices, diet, and risk factors.

Strengths and limitations

This is the only that tested an innovative, interactive eHealth application among a South Asian immigrant subgroup, i.e., Bangladeshi, and thus addresses the existing data inequity in health research. It is also one of the very few cancer-prevention studies that focused on a South Asian immigrant population—one of the fastest growing immigrant groups in the US (40). Moreover, the study identified deep-cultural aspects of tailoring interventions to ethnic audiences, such as understanding informational needs, exploring barriers and facilitators of usage, and discovering the nuanced preferences for VHA-appearance. Most tailored interventions often focus on surface-level attributes such as changing language or pictures of the people used.

This study had several limitations. Data collection via zoom using snowball sampling led to of the inclusion of participants with high education and income, which may not reflect all Bangladeshi immigrants in the US. Future research should collect input from a more diverse Bangladeshi immigrant population in terms of education and income. The inclusion criteria about required English proficiency may have led to a sample that exhibited lack of preference of VHA in Bangla. Future studies may focus on recruiting participants with no language-related inclusion criteria. Additionally, a lot of older Bangladeshi immigrants are dependent on younger members of the family to navigate the US health care system. This needs to be acknowledged and incorporated into the intervention's message, modality, and implementation.

Explanation of finding

The appreciation of an interactive and convenient information delivery system about CRC screening is understandable

among this group as CRC screening is not prioritized among Bangladeshi immigrant communities in general and a lack of conversation about the importance of screening at the community level results in a lack of awareness (22). Moreover, South Asian immigrants come from a healthcare culture that is paternalistic, i.e., doctors are perceived as the ultimate decision-makers in patient health and patient's role is often passive in their own healthcare journey (41-43). As a result, after migrating to the US, immigrant patients still find it difficult to ask questions or request clarification compared to native-born populations (44). Hence, having a VHA that can provide customized information, that can be paused/controlled at a comfortable pace is understandably preferred by the participants.

The nuanced preference for the appearance-based and linguistic needs of the participants reinforces the need for tailoring to the deeper structures of culture. While in the interviews, there was a general theme of having no ethnic preferences, the questionnaire showed a clear preference for the white male VHA. This might be due to having been conditioned to seeing a white male clinician in the US healthcare system more often than other ethnicities and genders (45). Moreover, a probable reason why fewer participants selected an ethnically concordant VHA was that they might have found the Bangladeshi-looking VHAs as stereotypical, superficial, and did not feel those VHAs represented their idea of how a Bangladeshi clinician would look in a virtual setting. One particular comment by one of the participants about the ethnically-tailored VHA being nothing more than a “Barbie in hijab” indicates the one-dimensional (i.e., women in head covering highlighting one specific type of religious expression) representation of Bengali, who are diverse in religious expression, attire and culture, might be perceived as a lack of cultural-sensitivity.

The linguistic tailoring needs were not as straightforward as had been expected, as the majority of the participants did not prefer to use the Bangla language. In fact, there was a third-person effect when it came to preference for Bangla—that is, participants felt that they were fine with English, but that other Bangladeshi immigrants would prefer Bangla (38). Moreover, Bangladesh is a former British colony, and Bangladeshis generally value English fluency as a symbol of high status, while a lack of English proficiency is viewed as a lack of education (46,47). However, participants' most common initial linguistic preference was having the option to choose. After probing, participants specified a language preference. This preference to choose indicates that it might be better to provide the option to choose a language

rather than assume English proficiency or the lack of it and thus risk stereotyping.

Comparison with similar research

Previous literature identified that South Asian immigrants might not prefer FIT for CRC screening for hygiene reasons related to religion (22). In our study, all but one participant considered FIT as hygienic and mentioned a preference for using it. While it is highly likely that the video demonstration clarified the hygiene of the FIT process, a few other reasons cited by participants were discovered. One participant mentioned that as a parent, she has handled her children's diapers and does not have any hygiene-related issue regarding stool collection (P28, female, 50 years old). While previous literature mentions that fear of touching stool is related to Muslim individuals' worry about becoming unholy (35), a devout, hijab-wearing Muslim participant mentioned that her religious faith and her health care were two different aspects of her life. As long as she did not have to do something explicitly prohibited in the holy scripture, she did not mind doing it for health reasons (P16, female, 40 years old).

Moreover, while previous research in tailoring interventions for minoritized group have emphasized on gender and racial concordance, our finding indicated a more nuanced need for such tailoring guidelines (48,49). While there were specific preferences for ethnicity and gender, we also found that nine participants (30%) mentioned preferring the autonomy to choose rather than having their language or the appearance of their clinician (virtual or real) being chosen by others in the interviews. This finding supports Otte *et al.*'s findings from their scoping review of the role of patient-provider concordance on patient experience and found the results from 23 studies inconclusive (50).

Similarly, with language concordance, our findings show a more nuanced preference for language among individuals who speak other languages than English. Language concordance between patient and provider is expected and necessary in many cases (51). However, the synthesis of literature on language concordance show inconclusive results as the effect of concordance on patient outcomes vary between negative, positive, and neutral (52,53).

Implications and actions needed

The study explored the tailoring needs among Bangladeshi immigrant audiences. The next step would be to tailor

VHAs with the different tailoring suggestions from the participants and co-develop the VHA with continued discussions with the community members, so that their nuanced preferences for gender and ethnicity are reflected in the VHA's appearance. Future studies should be conducted to identify the effect of differently tailored VHA-based interventions on this population's screening behaviors. Additionally, as the study showed that linguistically there are concerns about Bengali language lacking certain standard medical terminology, future research need to incorporate Bengali linguists to identify how to address this concern by developing new terminologies in Bangla language, or, incorporating the English terminologies into the Bangla vocabulary, and promoting these medical terminologies among Bangla-speaking public. Moreover, cross-sectional and longitudinal studies need to be conducted to evaluate the efficacy of this intervention in improving adherence to CRC screening guidelines, and FIT uptake among the intended audiences. Finally, how the intervention can be incorporated into the medical workflow in primary care clinics need to be explored for effective implementation and dissemination of the intervention.

Conclusions

The current study helped identify accommodative needs for tailoring a VHA-based intervention to promote CRC screening using FIT among first-generation South Asian immigrants. Future research is needed to identify the tailored intervention's effectiveness compared to non-tailored interventions. Theoretically, the study reinforces the importance of incorporating the deep structures of culture and interventions when developing health interventions, rather than focusing solely on surface-level culture. The results show that the majority of the accommodative needs pertain to needs for knowledge regarding CRC and screening, trust, personal independence over the intervention's pacing and progression, and the ability to make one's own choices. In terms of surface-level cultural preferences, there was an inclination for use of a native language but a clear lack of any specific preference for gender or racial concordance. Survey-based, large-scale studies will be needed to identify specific immigrant groups' preferences for gender, language, and race of a VHA.

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Footnote

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