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## SHORT REPORT

# Development of text messages for primary prevention of cardiovascular disease in persons with HIV



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**OBJECTIVE** Persons with HIV (PWH) have increased risk for atherosclerotic cardiovascular disease (CVD). Despite this increased risk, perceived cardiovascular risk among PWH is low, and interventions that are known to be beneficial in the general population, such as statins, have low uptake in this population. We sought to develop a bank of text messages about (1) the association between HIV and CVD and (2) advice on reducing cardiovascular risk.

**METHODS** We developed an initial bank of 162 messages. We solicited feedback from 29 PWH recruited from outpatient clinics providing HIV care at a large urban tertiary medical center and a public hospital in San Francisco, California. Participants reviewed 7–10 messages each and rated message usefulness, readability, and potential impact on behavior on a scale from 1 (least) to 5 (most). We also collected open-ended feedback on the messages and data on preferences about message timing.

**RESULTS** The average score for the messages was 4.4/5 for usefulness, 4.4/5 for readability, and 4.0/5 for potential impact on behavior. The text messages were iteratively revised based on

participant feedback, and lowest-rated messages were removed from the message bank. The final message bank included 116 messages on diet (30.2%), physical activity (24.8%), tobacco (11.2%), the association between HIV and cardiovascular disease (9.5%), general heart health (6.9%), cholesterol (5.2%), blood pressure (4.3%), blood sugar (2.6%), sleep (2.6%), and weight (2.6%).

**CONCLUSION** We describe an approach for developing educational text messages on primary prevention of cardiovascular disease among PWH.

**KEYWORDS** Atherosclerotic cardiovascular disease (ASCVD); Primary prevention; Digital health; Mobile health; Text messages; Human immunodeficiency virus (HIV)

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## Introduction

Persons with HIV (PWH) have increased risk for atherosclerotic cardiovascular disease (CVD) despite viral suppression with antiretroviral therapy.<sup>1,2</sup> PWH are twice as likely to develop CVD, and in the past 20 years, the global burden of CVD in PWH has tripled.<sup>3</sup> The underlying mechanism of heightened risk among PWH is likely multifactorial, including traditional risk factors, side effects from antiretroviral therapy, and chronic inflammation and immune activation.<sup>3,4</sup> Despite this increased risk, perceived cardiovascular risk among PWH is low.<sup>5</sup> Interventions that are known to be beneficial in the general population, such as statins, have low uptake in this population.<sup>6–8</sup> Although PWH are often engaged in regular follow-up with HIV providers, they have suboptimal control of traditional risk factors.<sup>9,10</sup>

Thus, there is a need for interventions to address the increased atherosclerotic CVD risk among PWH. Digital health applications have been used in HIV care to improve linkage to care and adherence to HIV therapies.<sup>11,12</sup> Numerous studies have also evaluated the use of text messaging or other mobile health interventions for primary prevention of CVD.<sup>13–17</sup> However, to our knowledge, digital health applications have not been used to inform PWH about the elevated cardiovascular risk among PWH or to engage them in reducing cardiovascular risk.

In this study, we sought to develop a bank of text messages about (1) the association between HIV and CVD and (2) advice on reducing cardiovascular risk. We then sought to refine the messages based on feedback from PWH.

## Methods

The content of the messages on risk reduction was based on the American Heart Association's Life's Essential 8

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materials, text messages that were developed and piloted for a study at the University of Washington to reduce cardiovascular risk in cardiac rehabilitation participants,<sup>18,19</sup> and published studies of text message interventions to reduce cardiovascular risk.<sup>13,16,20,21</sup> The content of the messages on HIV and CVD was based on [NIH.gov](https://www.nih.gov) information for patients, UpToDate, and expert opinion.<sup>22–24</sup>

We followed a process similar to that described by Redfern and colleagues<sup>21</sup> to develop a bank of text messages to decrease cardiovascular risk in patients with established CVD. The messages were categorized by behavior change technique as described in a taxonomy by Abraham and Michie.<sup>25</sup> The first author (MM) drafted the messages in consultation with co-authors who are experts in the cardiovascular effects of HIV (PH), CVD prevention and cardiac rehabilitation (AB), and digital engagement and research (JO, AB, DL). The messages were designed as 1-way communication to participants.

We recruited PWH from 3 outpatient clinics providing HIV care at a large urban tertiary medical center and a public hospital in San Francisco, California, during September–October 2022. Inclusion criteria were being HIV positive, age 40 years and older, and English-speaking. Study staff identified consecutive participants from the waiting rooms of the clinics. Participants were recruited and interviewed until theoretical saturation was reached.

Study staff met with patients before or after their clinic visit. Participants were asked to review up to 10 messages, which were written on paper. They then answered multiple choice questions with Likert-like responses about the message usefulness, readability, and potential impact on behavior, rating each messages on a scale from 1 (least) to 5 (most). We also asked an open-ended question about how each message could be improved. Messages with average scores of  $\geq 3$  across the 3 metrics were retained. We also asked participants multiple choice questions about their

**Table 1** Example of the highest-scoring messages by behavior change technique

Behavior change technique <sup>†</sup>	Highest-scoring message (final modified version)	Average message score (across the 3 domains)
Providing information about behavior health link	You can take steps to reduce your risk of heart disease: Take HIV medicines to keep HIV under control. Eat a healthy diet. Be physically active.	5
Provide information on consequences	Maintaining a healthy weight is good for your heart—it lowers your risk for heart disease, high blood pressure, diabetes, and other health problems.	5
Prompt intention formation	Are you thinking about quitting smoking? Try making a list of 3 reasons you want to quit tobacco and put the list somewhere you see it daily.	5
Prompt barrier identification	Have fun! Physical activity doesn't have to be a chore. Think of activities you enjoy and make a plan to do them.	4.8
Provide general encouragement	Keeping your viral load undetectable with HIV medications may decrease your risk of heart disease. If you take your medications regularly, keep up the good work!	4.8
Set graded tasks	There are many ways to get active. You may find walking the easiest way to start.	5
Provide instruction	Eating whole-grain foods can help lower your cholesterol. Oatmeal, whole-grain cereals, brown rice, whole-wheat bread, and rye bread are all whole-grain foods.	5
Prompt self-monitoring of behavior	Keep a log of your exercise. This will help you in setting and achieving your physical activity goals.	5
Prompt specific goal setting	Trying to lose weight? Set a SMART weight loss goal: Specific, Measurable, Attainable, Relevant, & Timely. For example, 5 pounds over 2 months.	5
Relapse prevention	Quitting tobacco takes a lot of willpower. Reward yourself when you reach goals. Forgive yourself if you take a step backward and try to get back on course.	4.3
Time management	Find ways to move more throughout your daily routine, whether it's at work, on your commute, or at home. Every active minute counts toward your goal!	5

<sup>†</sup>Behavior change techniques described in a taxonomy by Abraham and Michie<sup>25</sup>.

**Table 2** Survey scores by message content area for the final message bank

Content area	N (%)	Usefulness score <sup>†</sup>	Readability score <sup>†</sup>	Potential impact score <sup>†</sup>
Blood pressure	5 (4.3%)	4.8	4.6	3.6
Physical activity	29 (24.8%)	4.3	4.3	4.0
Smoking cessation	13 (11.2%)	4.2	4.3	3.8
Blood sugar and diabetes	3 (2.6%)	4.3	4.5	4.0
Cholesterol	6 (5.2%)	4.3	4.4	3.7
Diet and nutrition	35 (30.2%)	4.3	4.3	4.0
Weight	3 (2.6%)	4.8	4.8	4.8
Sleep	3 (2.6%)	4.7	4.2	4.0
General heart health	8 (6.9%)	4.3	4.4	4.0
HIV and cardiovascular disease	11 (9.5%)	4.3	4.3	4.0

<sup>†</sup>Values are averages out of a maximum score of 5.

preference for what time of day and day of the week to receive text messages. Ethics approval was obtained from the University of California, San Francisco Institutional Review Board (IRB #22-37156), and all participants gave informed consent to participate. The research reported in this paper adhered to Helsinki Declaration guidelines on human subjects research.

## Results

The initial bank included 162 messages on the topics of (1) blood pressure, (2) physical activity, (3) smoking cessation, (4) blood sugar and diabetes, (5) cholesterol, (6) diet and nutrition, (7) weight, (8) sleep, (9) general heart health, and (10) HIV and CVD. Behavior change techniques used in the messages included providing information about behavior health link and consequences, prompting intention formation, prompting barrier identification, providing general encouragement, setting graded tasks, prompting self-monitoring of behavior, and prompting specific goal setting (Table 1).

We recruited 29 participants to provide feedback on the text messages. The majority of participants were male (66%) and 55–64 years old (59%). A diversity of races and ethnicities were included, including 45% non-Hispanic White, 31% non-Hispanic Black, 14% Hispanic, and 10% Asian participants. Education levels were varied: 14% of participants had not graduated from high school, 4% completed high school, 10% completed junior college, 28% completed some college, 24% graduated from college, and 17% had a master's degree. One-third of participants were current smokers.

Each participant reviewed the content of 7–10 messages, and there were 284 responses across the messages. The average score for the messages was 4.4/5 for usefulness, 4.4/5 for readability, and 4.0/5 for potential impact on behavior (Table 2). Messages were revised as needed and additional messages were added based on participant feedback. Participants recommended several key improvements to the messages, particularly defining or replacing unclear terminology. Other advice included simplifying longer messages, ensuring advice is specific and actionable, keeping the messages positive, meeting people where they are, and

making messages about medications applicable to PWH who use long-acting injectable antiretrovirals (Table 3).

After revision of the messages based on participant feedback, the final message bank included 116 messages ( $\leq 160$  characters). The topics covered included 5 (4.3%) messages about blood pressure, 29 (24.8%) physical activity, 13 (11.2%) smoking cessation, 3 (2.6%) blood sugar and diabetes, 6 (5.2%) cholesterol, 35 (30.2%) diet and nutrition, 3 (2.6%) weight, 3 (2.6%) sleep, 8 (6.9%) general heart health, and 11 (9.5%) about the association between HIV and CVD.

Half of the participants did not have a preference about which days to receive the text messages. Of those who reported a preference, most (82%) preferred to receive messages on weekdays only. Seventeen of 29 (59%) participants reported a preference for the time of day of the messages; of these, 8 participants (47%) preferred to receive messages in the morning, 4 (24%) in the early afternoon, 3 (18%) in the late afternoon, 1 (6%) in the evening, and 1 (6%) in the morning or evening.

## Discussion

In this study, we describe the iterative process used to develop and refine a bank of text messages for primary prevention of CVD among PWH. We developed text messages based on national guidelines, expert opinion, previously published text messaging interventions, and behavioral theory. The messages were then further refined based on feedback from PWH. We report the details of this process, along with participant perceptions about the messages. We found that overall the text messages were well received by participants in the pilot study, with average scores  $\geq 4.0$  for usefulness, readability, and potential impact on behavior.

Open-ended feedback from participants improved the text messages. Compared to the messages on risk reduction, the messages on the association between HIV and CVD underwent more revisions. This is not surprising, given there are fewer readily available patient education materials on the topic; instead, we had to rely more heavily on expert opinion in the initial drafting of these messages. Participant input was critical for ensuring these messages were understandable and relevant to a diverse audience.

**Table 3** Open-ended participant feedback on the messages

Participant feedback	Example quote	Original message	Revised message or removed
Remove unclear terminology	<p>“Suppressing might be a big word for some people, viral load undetectable may be more familiar.”</p> <p>“Clarify physical activity means exercise.”</p> <p>“Patients won’t know what trans fat and hydrogenated oil, if they can’t pronounce a word.”</p> <p>“I had to read it twice to understand it. I think the vapor and liquids, the liquids throws me off.”</p> <p>“Will confuse people because they don’t understand calories. What do you mean by calories? How much physical activity? Then people reject it because it’s confusing, people fear what they don’t understand.”</p> <p>“Device, you mean like a phone or something? Move it, move what?” “What is sleep hygiene, I’ve never heard sleep hygiene.”</p> <p>“The word abnormal could pose a challenge. Maybe changing the language for that. High is better than abnormal.”</p> <p>“The words are very medically based. Nonadherence to HIV treatment and treatment failure. If there’s ways to say it more easily understandable.”</p>	<p>Suppressing your viral load with HIV medications may decrease your risk of heart disease...</p> <p>To manage your blood pressure, try moving more. Physical activity helps control blood pressure, weight and stress levels.</p> <p>Make smart food choices to build an overall healthy eating style. AVOID: trans fat and partially hydrogenated oils (found in some commercial baked goods and fried foods)</p> <p>The first step to quitting smoking, vaping and using tobacco is to understand the risks and health effects for you and your family. Cigarettes, e-cigarettes and tobacco products contain many toxic chemicals, as do their smoke, vapor and liquids.</p> <p>Watch Calories: Eat only as many calories as you use up through physical activity. Understand serving sizes and keep portions reasonable.</p> <p>Clean up your sleep hygiene. Move it: charge your device as far away from your bed as possible. Added bonus? The distance may help you feel less overwhelmed in general.</p> <p>Abnormal cholesterol levels are common in patients living with HIV and are associated with heart disease. Have you had your cholesterol tested?</p> <p>HIV-specific risk factors may increase risk of heart disease. These factors include non-adherence to HIV treatment, treatment failure, low CD4 cell count (less than 350 cells/microL), or a history of delayed start of treatment or prolonged period of HIV viral load that was not suppressed.</p>	<p>Keeping your viral load undetectable with medications may decrease your risk of heart disease...</p> <p>To manage your blood pressure, try moving more. Exercise helps control blood pressure, weight, and stress levels.</p> <p>Removed</p> <p>Removed</p> <p>Removed</p> <p>Removed</p> <p>High cholesterol levels are common in patients living with HIV and are associated with heart disease. Have you had your cholesterol tested recently?</p> <p>Removed</p>

**Table 3** (Continued)

Participant feedback	Example quote	Original message	Revised message or removed
Keep the messages positive	"I don't know if I would start with poorly controlled. Starts on a negative note. Might put somebody on the defensive."	Poorly controlled HIV and not taking HIV medications may increase the risk of heart disease. If you're having trouble managing your HIV, talk to your doctor about how they can help support you.	Keeping HIV infection under control may decrease your risk of heart disease. Talk to your doctor about how they can help support you.
	"You might make someone feel guilty. Would be helpful to say 'if you haven't, try going on a walk'"	Did you exercise today? Click here if you did!	Did you exercise today? If you haven't exercised yet, try going on a walk.
	"I don't like the question. You're guiltning them."	People who exercise regularly have a lower chance of heart disease. Have you exercised yet today?	Removed
Simplify longer messages	"I think bullet points needed. It reads like a run on sentence."	To increase your exercise, start small! Any exercise is better than no exercise. If you normally take the elevator, try using the stairs today.	To increase your exercise, start small! If you normally take the elevator, try using the stairs today.
Make the advice specific	"You need specific examples, tailored to their culture/ religion. In our area, getting fresh fruits/ vegetables can be hard or expensive. I have to shop in other areas where fruit/ vegetables cheaper. Some people may be getting food deliveries."	Try cooking at home instead of eating out. Take control over the nutritional content of your food by learning healthy preparation methods.	Removed
	"Seems vague to me. I don't know what regular exercise even means."	Regular exercise can improve your blood pressure and cholesterol.	Removed
	"It's a good message, but it could be said in a more conversational tone. More relatable. Any exercise is better than no exercise. Examples of what's better: walking up to change the TV rather than sitting with the remote, try taking the stairs down and then later trying going up, down is better than the elevator. Remind them of these pivot points. Choices that are likely to come up in their typical day."	Start small with exercise— begin with low-intensity exercise and slowly increase the intensity over time.	To increase your exercise, start small! If you normally take the elevator, try using the stairs today.
Meet people where they are	"Could be offputting to someone who doesn't want to quit. You're not meeting them where they're at."	Make a list of 3 reasons you want to quit tobacco and put the list somewhere you see it daily.	Are you thinking about quitting smoking? Try making a list of 3 reasons you want to quit tobacco and put the list somewhere you see it daily.
Make the messages applicable to patients who use long-acting injectable antiretrovirals	"This wouldn't apply to me because I get injections, I would be frustrated to get this."	Keeping HIV infection under control by taking your HIV medications everyday may decrease your risk of heart disease...	Keeping your viral load undetectable with medications may decrease your risk of heart disease...

Many studies of mobile phone text messaging interventions do not document the process of message development.<sup>21,26–28</sup> More studies describing message development and reporting process measures are needed in the sphere of digital health interventions. Although some studies of text messaging interventions for CVD prevention have demonstrated effectiveness,<sup>20,29</sup> other studies have found no effect on the primary outcome.<sup>13,16</sup> Understanding differences in the message development and content across studies is critical for elucidating factors that contribute to the effectiveness of these digital interventions.<sup>30</sup>

This study is unique in describing the development of messaging about cardiovascular risk designed for PWH, who are at increased risk of CVD. Prior studies of mobile phone interventions to address multiple risk factors in a primary prevention population have mostly targeted a general population audience.<sup>31</sup> Several studies have tailored digital interventions for particular races or ethnicities at elevated cardiovascular risk, including participants of South Asian ancestry and African Americans.<sup>16,32</sup> To our knowledge, the present study is the first to describe the development of a digital health intervention to reduce cardiovascular risk among PWH.

This study has several limitations. We recruited patients from outpatient HIV clinics at 2 urban hospitals in San Francisco, and our findings may not be generalizable to other regions. PWH are a diverse population, and ensuring that the messages were relevant to participants of diverse cultural and educational backgrounds was challenging. We included both a large urban tertiary medical center and a public safety-net hospital, and we recruited patients from a diversity of races, ethnicities, and education levels. Although the sample size was small, we recruited participants until we had reached theoretical saturation. Finally, future studies should examine the effectiveness of text messages among PWH, looking at outcomes such as blood pressure, blood glucose, weight loss, and medication adherence, as well as intermediate outcomes such as self-efficacy, physical activity, and diet.

In conclusion, we describe an iterative process used to develop and refine a bank of text messages for primary prevention of CVD among PWH, adding to the growing literature on the development of digital health interventions for CVD. Our experience may inform the design and conduct of future studies developing text messages for primary prevention among specific groups at elevated cardiovascular risk.

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## Authorship

All authors attest they meet the current ICMJE criteria for authorship.

## Patient Consent

All patients provided informed consent.

## Ethics Statement

The authors designed the study, and gathered and analyzed the data according to the Helsinki Declaration guidelines on human research. The research protocol used in this study was reviewed and approved by the institutional review board.

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