

# Engaging African American Parents to Develop a Mobile Health Technology for Breastfeeding: KULEA-NET

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Loral Patchen, CNM, PhD, IBCLC<sup>1</sup>, Lindsey Ellis, NP, MPH, IBCLC<sup>1</sup> ,  
Cherise B. Harrington, PhD, MPH<sup>2</sup>, Tony Ma, MS<sup>3</sup> , Rohini Mohanraj, MHA<sup>3</sup>,  
Virginia Andrews, MPH<sup>4</sup>, and William Douglas Evans, PhD<sup>4</sup>

## Abstract

**Background:** African Americans breastfeed less than other groups, which has implications for health throughout the life course. Little is known about mobile health technologies to support breastfeeding.

**Research aims:** This study proceeded in two phases. The aim of Phase 1 was to identify ideal technological components and content of a mobile health intervention. The aim of Phase 2 was to determine the usability of a prototype, KULEA-NET, based on the Phase 1 findings.

**Methods:** For this mixed-methods study, we used community-based participatory research methods and user-centered technology design methods. We used open coding in NVivo 11 to organize data from focus groups and in-depth interviews, then we analyzed the data. We then developed a prototype and tested the prototype's usability with the System Usability Scale. Fifty pregnant and postpartum African Americans from the District of Columbia participated.

**Results:** Participants preferred an app with text messaging technology and identified areas for intervention: self-efficacy, parent-child attachment beliefs, social support, public breastfeeding and social desirability, and returning to work. Desired features included local resources, support person access, baby care logs, identification of public breastfeeding venues, and peer discussions. The System Usability Scale score was 73.8, which indicates above average usability.

**Conclusions:** A mobile health technology like KULEA-NET can be used to meet the breastfeeding needs of African Americans, build social desirability, and complement traditional health care. The appeal of an African American-specific intervention is unclear. Responding to mixed feeding practices is challenging. KULEA-NET is a mobile breastfeeding intervention guided by the preferences of African American parents and offers promising usability metrics.

## Keywords

breastfeeding, access to care, breastfeeding support, cultural norms, focus group, qualitative methods

## Background

Breastfeeding has numerous health benefits across the lifespan, and the Section on Breastfeeding (2012) recommends exclusive breastfeeding for the first 6 months. Yet, just one quarter of all U.S. infants are exclusively breastfed to 6 months, and there are disparities: fewer African American infants (20.7%) are exclusively breastfed to 6 months compared to white infants (29.1%; Centers for Disease Control and Prevention [CDC], 2019). Similarly, there are race/ethnicity disparities in many health outcomes, including conditions with which breastfeeding has been associated with reduced risk, such as heart disease (CDC, 2013). Increasing breastfeeding among African Americans has the potential to

reduce other health disparities across the lifespan and is a public health and social justice priority.

<sup>1</sup>MedStar Washington Hospital Center, Washington, District of Columbia, USA

<sup>2</sup>North Carolina Central University, Durham, NC, USA

<sup>3</sup>Benten Technologies, Manassas, VA, USA

<sup>4</sup>George Washington University, Washington, District of Columbia, USA

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### Corresponding Author:

Loral Patchen, MedStar Washington Hospital Center, 110 Irving St NW, Suite EB7113, Washington, DC 20010, USA.

Email: Loral.Patchen@Medstar.net

Authors of current literature about interventions to support breastfeeding among African Americans advocate for disseminating knowledge and building self-efficacy; enhancing personal, professional, and community support; and promoting breastfeeding culture. Findings from research on technology-based interventions to influence breastfeeding are promising. Lau et al. (2016) conducted a meta-analysis and concluded that electronic technologies (such as websites) significantly improved breastfeeding exclusivity at 6 months. However, there is insufficient research into *mobile* health (mHealth) technologies (Chen et al., 2018). At least 92% of Americans aged 18–49 own a smartphone and about one quarter rely on it for internet, especially non-white individuals (Pew Research Center, 2019). Mobile technology is a complement to traditional healthcare and allows for greater engagement—particularly among low-income parents who experience greater access barriers—and dissemination of information at the exact time of need (Guerra-Reyes et al., 2016). The LATCH trial enrolled predominately low-income, Hispanic mothers in Connecticut and found that 80% of participants read text messages, and messages effectively linked participants to counselors (Harari et al., 2018; Martinez-Brockman et al., 2018a). The intervention did not affect breastfeeding behavior at 2 weeks or 3 months, however (Martinez-Brockman et al., 2018b). MumBubConnect delivered weekly interactive text messages to predominately high-income, Anglo-Celtic Australians (Gallegos et al., 2014). Distress was responded to with a phone call. The intervention did significantly increase exclusive breastfeeding (Gallegos et al., 2014). Technology-based interventions do not generally serve support networks. Our literature review revealed one research-based mobile application (app) in development targeting fathers in Australia: The Milk Man (White et al., 2016). Results of an impact study are pending.

FeedFinder is an app with global positioning systems (GPS) technology that lists nearby venues that support breastfeeding. Users in the United Kingdom identified and rated these venues (Simpson et al., 2016). Telelactation connects a user to a lactation professional through a video call and is available from any location, at any time, and at reduced cost compared to traditional in-person lactation support (Uscher-Pines et al., 2017). The impact of these emerging technologies is unknown. There is no scientifically-based mobile health (mHealth) technology available that integrates these features and specifically supports African American individuals in achieving breastfeeding goals. This study proceeded in two phases. The aim of Phase 1 was to identify ideal components and content of a mHealth intervention, and the aim of Phase 2 was to determine the usability of a prototype based on the Phase 1 findings.

### Theoretical Framework

Social cognitive theory and health branding provide a theoretical framework for the study. A health branding approach

### Key Messages

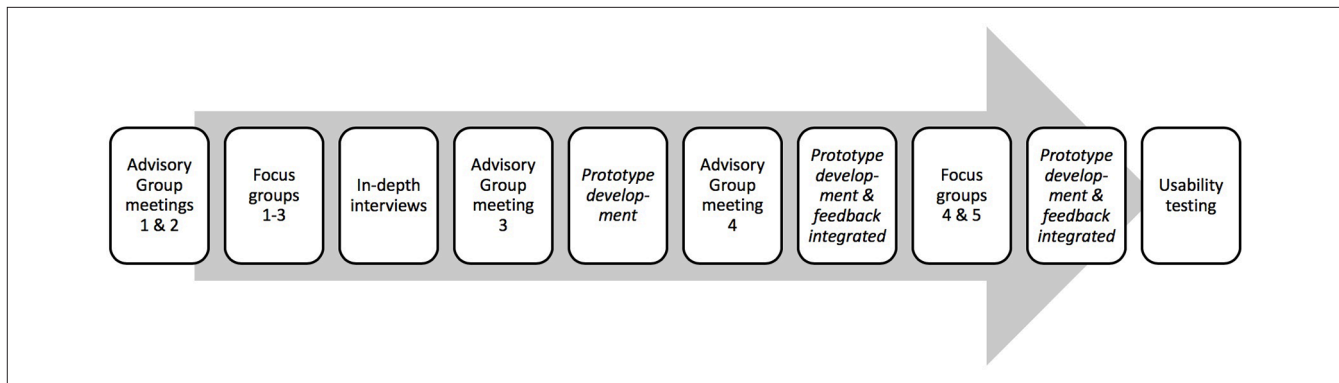
- African Americans breastfeed significantly less than white Americans. Little is known about the role of mobile health technologies to support breastfeeding initiation and continuation among African Americans.
- We conducted Phase 1 focus groups and interviews with pregnant self-identified African Americans in Washington, DC, to identify key areas that a mobile health technology intervention should address. They identified low self-efficacy, parent-child attachment beliefs, social support, public breastfeeding and social desirability, and returning to work as important. They preferred an application (app) and text messaging technology. Desired features included local resources, support person access, baby care logs, identification of public breastfeeding venues, and peer discussions.
- In Phase 2 we created KULEA-NET, a prototype app and text messaging intervention to support breastfeeding among African Americans based on the preferences of our participants. Usability test results were promising.
- Feelings were mixed about the appeal of a mobile health technology intervention specifically for the African American community. Some conveyed skepticism since individuals of all races/ethnicities may experience breastfeeding challenges.

appeals to an individual's self-interest and emphasizes the cost/benefit of a health-promoting behavior in the hope that the individual will take up that behavior (Evans & Hastings, 2008). Social cognitive theory posits that individual behavior is influenced by the social environment (Bandura, 2004). An individual must know what to do and how to do it, and modeling by others makes success more likely (Bandura, 2004). How persons in an individual's environment respond to a health behavior matters, and expectations of a negative response can preclude a person from engaging in that behavior (Bandura, 2004). Self-efficacy—how confident persons are in their ability to successfully perform a behavior—also influences health behavior (Bandura, 2004).

### Methods

#### Design

We conducted a mixed-methods study using community-based participatory research methods and user-centered technology design methods, both of which engage intended users at every step. These methods facilitated our goal to develop and conduct a formative evaluation of a culturally informed and impactful intervention.



**Figure 1.** Graphic Representation of Study Design.

For Phase 1, we relied on focus groups and in-depth interviews with members of the African American community, as well as an advisory group of professionals who serve African American parents to co-create the content and technological components of the intervention. Findings from these discussions guided development and modifications of the KULEA-NET prototype. For Phase 2, our usability testing provided feedback about the content and technological components of KULEA-NET. See Figure 1 for a graphic representation of our study design.

### Study Design 4.29.20

**IRB Approval and Informed Consent.** This study was approved by the Institutional Review Boards of the George Washington University and the MedStar Health Research Institute. Written informed consent was obtained from all participants. Potential focus group and in-depth interview participants were approached during an office visit or contacted by phone about the study. If interested, they selected a date and time to participate. The research team obtained consent on paper immediately prior to the group or interview. For usability testing, potential participants were approached during an office visit (prior to giving birth) or on the postpartum wards (after giving birth). If interested, consent was obtained on a digital consent form.

At least one International Board Certified Lactation Consultant (IBCLC<sup>®</sup>) and obstetrical health care provider were present at each focus group to answer questions and provide desired education. Each participant received a \$50 gift card at the end of the focus group or interview. Usability testing participants received a \$25 gift card at enrollment and a \$50 gift card at the end of the study. Advisory group members were provided a stipend of \$1250.

### Setting

This study took place in the District of Columbia. Focus group and in-depth interviews occurred from January to July 2018 and participants were recruited from outpatient offices

affiliated with MedStar Washington Hospital Center (MWHC). Usability testing took place during December 2018 and participants were recruited from MWHC's outpatient offices and postpartum units.

### Sample

**Phase 1/Aim 1: Co-Creating the Prototype. Advisory Group.** We formed an advisory group to guide the study. Six experts in lactation, pediatrics, nursing, midwifery, early parenting behavior, and infant development from the local community participated. Five participants identified as African American, four were healthcare providers, and three were IBCLCs<sup>®</sup>. All had at least 5 years' experience in service delivery to the African American community, and all were willing to attend at least four meetings and to provide feedback about the intervention.

**Focus Groups and In-Depth Interview Participants.** For focus groups and in-depth interviews, self-identified African American individuals aged 18–40 with no contraindications to breastfeeding were eligible for participation. For the first three focus groups, we included primiparas at least 28 weeks' gestation. For the last two focus groups, we included both primiparas and multiparas at least 24 weeks gestation. Three groups were limited to primiparas to capture their narrative without the potential confounding effect of experienced parents. In-depth interviews with new participants allowed for deeper probing and mitigation of "group-think" and response bias. Focus group participants were invited to suggest support people for in-depth interviews to include their perspective. Support people did not participate in focus groups. We recruited by purposive sampling.

Ultimately, 25 pregnant people participated in five focus groups, ranging from three to seven participants. Four pregnant individuals, none of whom had participated in a focus group, and two support people (one male partner and one mother) participated in in-depth interviews. Pregnant participants were an average of 26 years old and 31 weeks' gestation. Most (83.3%) were first-time parents.

**Phase 2/Aim 2: Usability Testing.** Eligibility criteria for usability testing were as follows: self-identification as African American, aged 18–40, possession of a smartphone, no contraindications to breastfeeding, between 38 weeks' gestation (antepartum) and 8 weeks postpartum, and either "breast-feeding only" or "mixed feeding" statuses. Participants were recruited via purposive sampling.

Fourteen participants completed usability testing. Seventeen enrolled and three were lost to follow-up. None of them had previously participated in a focus group or interview. Two (11.8%) enrolled prior to giving birth, and 15 (88.2%) enrolled within 3 days after giving birth. Ten (58.8%) were first-time parents. Average age was 26.4 years.

## Measurement

**Phase 1/Aim 1: Co-Creating the Prototype. Advisory Group.** During the first meeting, we oriented members to the project goals. The second meeting was used to determine content and guiding questions for focus groups and in-depth interviews. We convened the third meeting after focus groups and in-depth interviews to review findings and gather input on how to translate findings to prototype development. At the fourth and final meeting, members reviewed the prototype content in detail.

**Focus Groups and In-Depth Interviews.** After the first two advisory group meetings, we conducted three focus groups and all in-depth interviews. After an introduction to the study, review of ground rules, and an ice breaker, the first three focus groups and all in-depth interviewees were asked about technology and internet use, social media use, and preferred sources of information. Breastfeeding and health literacy were then explored through discussion of beliefs and attitudes about breastfeeding and baby care topics that impact breastfeeding, including introduction of solid foods, holding and spoiling babies, maternity leave and returning to work, human milk substitutes, infant sleep, and breastfeeding in public. Barriers to and facilitators of breastfeeding were explored, like time availability, stress, social support, social acceptability, and access to information. Last, participants were asked about their preferences for receiving informational and motivational content related to breastfeeding. The last two focus groups took place after development of the KULEA-NET prototype. These new participants provided feedback on the prototype and text messages by reviewing screenshots, visual mock-ups, sample content, and sample text messages via PowerPoint presentation. Focus group and in-depth interview topics are presented in greater detail in Table 1. Questions were adapted for support people who participated in in-depth interviews, but the topics were the same. Focus groups and in-depth interviews proceeded until saturation was reached on nearly all topics. The focus group facilitator was an ethnically concordant doctoral level behavioral scientist with expertise in both qualitative and quantitative methods and

studies addressing health disparities across the life course. This same individual facilitated all focus groups and in-depth interviews.

## Phase 2/Aim 2: Usability Testing

Usability, in this context, is a measure of the user experience with an app. We assessed satisfaction, effectiveness, and quality of experience. In this formative phase, we focused on developing KULEA-NET for postpartum use and conducted usability testing among postpartum participants.

Prototype usability was measured with the System Usability Scale (SUS), the most common questionnaire used for this purpose. SUS is a highly reliable (Cronbach's alpha of 0.91) 10-item Likert scale that measures function, efficiency, effectiveness, and satisfaction with electronic tools (Bangor et al., 2008). Scores range from 0–100, with 0 indicating not at all usable and 100 indicating perfect usability. The average SUS score is 68; higher scores indicate greater-than-average usability. Sample size requirements are modest: 15 users identify approximately 97% of all usability issues (Bangor et al., 2008). See Table 2 for SUS measures.

## Data Collection

**Phase 1/Aim 1: Co-Creating the Prototype. Advisory Group.** Meetings took place on-line and were recorded. Advisory group members also provided written feedback.

**Focus Groups and In-depth Interviews.** All focus groups took place in-person. All except one in-depth interview took place by phone. All discussions were audio recorded. Participants' confidentiality was maintained by asking them not to use their own or others' names. Informed consent documents were locked in a cabinet separate from recordings. Recordings and transcriptions were kept in password protected files only accessible to team members. Identifiers were stripped from transcripts.

**Prototype Development.** This activity began after the first three focus groups and all in-depth interviews. Our team outlined desired functions, drafted content, created visual mock-ups, crafted text messages, and developed a timeline to deliver messages. Advisory group members reviewed the resulting prototype, and we made modifications based on their feedback. We then conducted the last two focus groups to elicit feedback on the prototype and then again made modifications based on their feedback before usability testing.

**Phase 2/Aim 2: Usability Testing.** Following the completion of the Phase 1 activities, we conducted a usability test of the prototype. The KULEA-NET app was downloaded onto participants' smartphones and they used the app for 3 weeks. Participants then answered usability questions via an online link sent to them electronically.



**Table 1.** Focus Group and In-Depth Interview Topics.

Focus group	Topic	Specific questions
Focus groups 1–3, in-depth interviews	Media & information sources	<ul style="list-style-type: none"> <li>• Technology, internet, &amp; social media use</li> <li>• Preferred sources of information</li> <li>• Pregnancy/breastfeeding websites</li> <li>• Text message services</li> </ul>
	BF & health literacy	<ul style="list-style-type: none"> <li>• Beliefs about BF</li> <li>• Beliefs about baby care topics that influence BF               <ul style="list-style-type: none"> <li>◦ Introduction of solid foods</li> <li>◦ Safety of human milk substitutes</li> <li>◦ Holding and spoiling babies</li> <li>◦ Emotional development</li> <li>◦ Infant sleep</li> <li>◦ Burden to mother</li> <li>◦ Perceived difficulty &amp; likelihood of failure</li> </ul> </li> <li>• Maternity leave &amp; returning to work</li> <li>• Human milk substitutes</li> <li>• Public BF</li> </ul>
	Barriers to & facilitators of exclusive BF	<ul style="list-style-type: none"> <li>• Time availability</li> <li>• Importance/value</li> <li>• Stress</li> <li>• Social support</li> <li>• Social acceptability</li> <li>• Access to information</li> </ul>
	Preferences for receiving BF content	<ul style="list-style-type: none"> <li>• Social media</li> <li>• Messaging</li> <li>• Videos</li> <li>• Other ideas from participants?</li> </ul>
Focus groups 4 & 5	KULEA-NET prototype feedback	<ul style="list-style-type: none"> <li>• App               <ul style="list-style-type: none"> <li>◦ Visual mock-ups</li> <li>◦ Educational material and eLearning videos</li> <li>◦ Reminders</li> <li>◦ Social and professional support features</li> </ul> </li> <li>• Text message relevance and comprehension</li> </ul>
	General feedback	<ul style="list-style-type: none"> <li>• Other desired content</li> <li>• Support network members</li> <li>• Delivery timing</li> <li>• Would you join and/or share?</li> <li>• Acceptable cost</li> </ul>

Note. BF = breastfeeding.

## Data Analysis

**Phase 1/Aim 1: Co-Creating the Prototype.** All discussions were recorded, transcribed, and stripped of identifiers. Transcripts were analyzed using conventional content analysis, which is used to describe a phenomenon for which little research or theory exists through “inductive category development” (Hsieh & Shannon, 2005). Transcripts were reviewed using open coding in NVivo 11. Codes were refined, reduced, and categorized by conceptual similarity to create the final codebook, which was applied to all transcripts.

**Phase 2/Aim 2: Usability Testing.** The SUS data were analyzed using standard methodology that creates an index

using  $(x-1)$  for odd and  $(5-x)$  for even questions, summing the score, then multiplying by 2.5. The “x” represents a participant’s response to each item. This methodology is described in detail elsewhere (U.S. Department of Health and Human Services [HHS], 2019).

## Results

### Phase 1/Aim 1: Co-Creating the Prototype

**Advisory Group.** Advisory group members rejected references to popular media figures with African American identity, such as Beyoncé, and to popular films, such as *Black*

**Table 2.** System Usability Scale Questions.

1. I think that I would like to use this system frequently.
2. I found the system unnecessarily complex.
3. I thought the system was easy to use.
4. I think that I would need the support of a technical person to be able to use this system.
5. I found the various functions in this system were well integrated.
6. I thought there was too much inconsistency in this system.
7. I would imagine that most people would learn to use this system very quickly.
8. I found the system very cumbersome to use.
9. I felt very confident using the system.
10. I needed to learn a lot of things before I could get going with this system.

Note. This is a Likert scale with five possible responses to each item ranging from strongly disagree [1] to strongly agree [5] (U.S. Department of Health and Human Services, 2019).

*Panther.* They alerted us that some messages could be perceived as sexualizing breastfeeding. They also assisted with language and terminology (e.g., “snap-back” to convey weight loss). Finally, members recommended inclusion of general pregnancy content, which would have broad appeal and enhance engagement.

*Focus Groups and In-Depth Interviews.* Participants identified key content areas that a mHealth intervention should address: low self-efficacy, parent–child attachment beliefs, social support, public breastfeeding and social desirability, and returning to work. They reported an unmet need for credible breastfeeding information and preferred an app and text messaging intervention. There were diverse views on whether an intervention should be tailored to African Americans.

*Low Self-Efficacy.* Participants expressed what can be best described as low self-efficacy. They perceived breastfeeding to be more difficult than human milk substitutes, and expected significant challenges with latch, milk supply, and pain. Many seemed to accept that they would not meet their breastfeeding goals, sharing anecdotes of others’ difficulties. A few felt that breastfeeding could be the easier option and shared anecdotes of others’ success, but this did not generate expectations for personal success. They desired guidance on selecting and feeding human milk substitutes.

*Parent–Child Attachment.* Many participants believed that breastfeeding could contribute to undesirable parent–infant attachment and promote unhealthy infant dependence. Breastfeeding past a certain age or being too available to an infant was perceived to inhibit social development and self-sufficiency that could last into adulthood. Participants felt nursing-at-the-breast and prolonged breastfeeding duration, therefore, was undesirable. Giving a bottle, even if filled with human milk, seemed to mitigate this concern.

*Social Support.* Many participants cited partners that were supportive of—and sometimes insistent on—breastfeeding. Modeling and support by non-partners, and participants’ mothers in particular, were also important. Others were discouraged by the lack of role models in their social circle. In choosing to breastfeed, they were breaking with tradition, making it necessary to seek out new sources of information and support. Supporters who participated in in-depth interviews expressed enthusiasm at being included in the intervention.

*Public Breastfeeding and Social Desirability.* Some participants expressed that they would be uncomfortable breastfeeding in front of others. For a few, this applied within their homes and around loved ones. Others expressed concern about the discomfort of *others* and the belief that they would receive unwanted, negative attention. Some felt that no public breastfeeding was acceptable and intended to breastfeed only at home and to give a bottle outside the home. Most felt a cover was necessary to breastfeed in public. Without a cover, the parent was being immodest and public ire might be justified. One participant framed uncovered public breastfeeding as an unwelcome act of social defiance. No one expressed intention to consistently breastfeed uncovered in public. One participant spoke about breastfeeding in public as a right. See Table 3 for illustrative responses. Breastfeeding did not seem to be the norm in their communities as evidenced by the rarity of seeing an infant nursing at the breast. One participant questioned “why we as a race decided not to breastfeed. Supposedly we had the best milk ... Even back in slavery we were breastfeeding, you know, the slave master’s children.” While participants’ perceptions of the impact of wet nursing among enslaved African Americans on current social desirability was not explored further in these focus groups or interviews, an integrative literature review by DeVane-Johnson et al. (2017) describes a number of negative historical reproductive health experiences including forced wet nursing and lack of choice among black women in America that contribute to current breastfeeding beliefs and behaviors.

*Returning to Work.* Participants feared the return to work as a breastfeeding parent. They were unsure how to find adequate time and facilities to express milk and how to store it. One participant spoke about being the first employee to request work accommodations. Superiors were uninformed and poorly prepared to support her. One participant identified the struggle of balancing work outside the home with breastfeeding and parenting.

*Information Preferences.* Participants desired breastfeeding information yet perceived it to be difficult to access. Healthcare providers were a trusted source, but participants expressed disappointment with the information received during prenatal care. Some were aware of lactation specialists but were unsure how to access them outside of the hospital. None had taken a breastfeeding class, and most did not plan to because of cost or uncertainty about availability.

**Table 3.** Breastfeeding in Public/in Front of Others Illustrative Participants' Responses.

Theme	Illustrative participant quotes
Will bottle feed in public	"I'm not comfortable going to the mall or to a restaurant and breastfeeding at the Table I'd rather just make a bottle at home and make sure I bring it with me."
Unacceptable to others and will elicit negative, unwanted attention	"It's not accepted. I just read an article called... this lady who got kicked out of [a restaurant] for breastfeeding."
Will cover to avoid negative, unwanted attention	"To answer your question umm no qualms with doing it. I plan on if and when I need to....I'm going to use cover ups just cuz I don't feel like dealing with the negativity that's out there."
Parent's responsibility to be modest, cover and put others at ease	"I have nothing against you breastfeeding your baby, but it's like...at least cover yourself... like common courtesy. Like we don't take you feeding your baby away from you, but still be mindful of other people's [comfort]."
Act of defiance	"I think people take it too far now...I've seen people that, because it's so controversial, everybody [is] pro-breastfeeding, which is great, they just like doing it to be spiteful. In my opinion, like 'I'm just going to do it right here,' no cover."
Will cover, but others' comfort not my concern	"I don't have a problem with it. I think there's enough devices now where you can cover yourself to do it. I think more and more people are becoming accepting...at the end of the day this is me and my child. I'm trying to feed my child. If it's disturbing you that much...get up and walk away. It's not like I'm gonna follow you around feeding my child so you have to be exposed to it."
Will breastfeed covered or uncovered	"I'm not gonna care. If my son's hungry, guess what—turn your cheek...I'll try to find a bathroom or, you know, something, but I'm not gonna be too concerned about that."

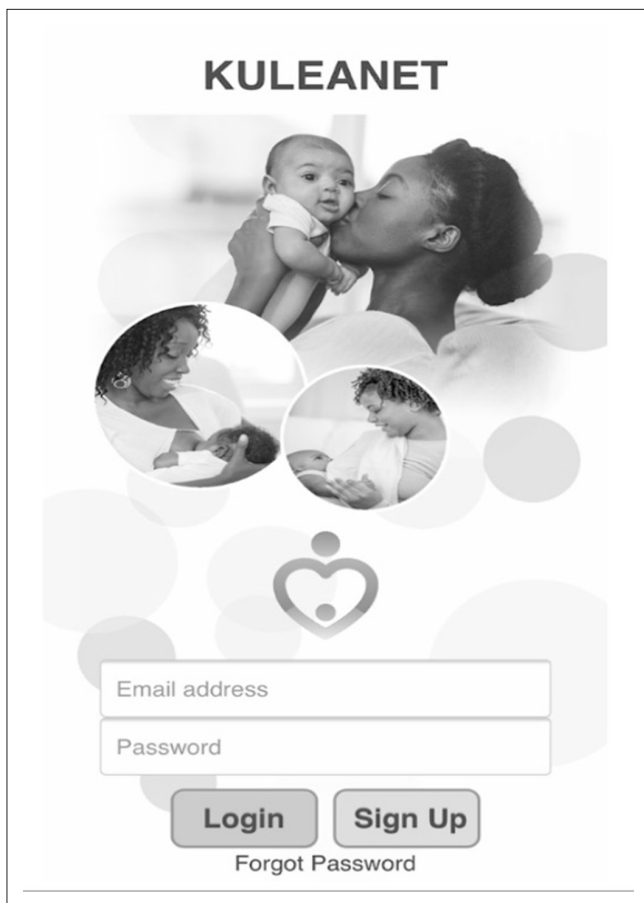
Participants liked information from a variety of sources: articles or forums, peers, and professionals. They appreciated information perceived to be factual and free of persuasion or judgment. Controversy surrounding infant feeding caused some to distrust information, so they wanted acknowledgment of limitations and gaps in science.

*Mobile Health Preferences.* Participants searched for online information most often on mobile phones. Apps, websites, and forums were desirable platforms. They shared mixed opinions about social media, with concerns about credibility and privacy. Most wanted text messages because they bring information to them and demand their attention. A frequency of one to three texts per week was optimal. Messages should guide them to more information or be interactive. In anticipation that they would have limited and unpredictable free time and attention, they wanted flexibility and control over when they access information.

*African American Specificity.* There was diversity in opinion about tailoring the intervention for African American parents. Participants wanted to see images of African Americans and welcomed information that might be more relevant to African Americans (e.g., safety of hair care products like relaxers). However, they noted that breastfeeding challenges were not specific to any one race/ethnicity, so targeting the African American community was inappropriate. Advisory group members rejected references to popular African American media figures. This suggests that efforts to be inclusive of African American parents was welcomed, but a focus on icons in African American culture requires a nuanced approach. Overall, participants assigned greater importance to geographic specificity than aligning the intervention to African American race/ethnicity. Table 4 shares illustrative responses.

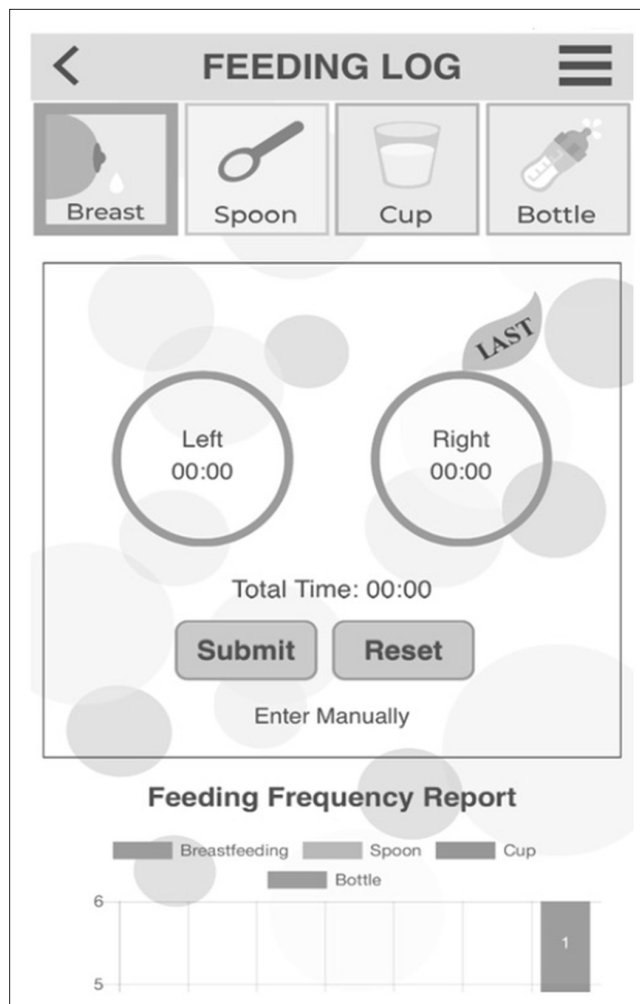
**Table 4.** Illustrative Responses on Whether KULEA-NET Intervention Should be Specific for African Americans.

Theme	Illustrative participant quotes
In favor	"Having a dedicated place for things that could pertain to me would be helpful...so I'm not sitting here thinking...this study that they used was mainly Asian women so that's what they're reporting right now and it's not...for me. I think it would be helpful to know that it's specifically for black women."
Neutral	"If it says most black women have issues producing blah blah blah, try this, then I would try it because it is saying something specific for me."
Opposed	"No, it wouldn't make a difference, but I feel like it should be targeted to everybody. Like, not only black woman are struggling with breastfeeding."



**Figure 2.** Screenshot of log-in.

*KULEA-NET Prototype.* The resulting KULEA-NET prototype was an app and text messaging intervention that supports African Americans to initiate and exclusively breastfeed for 6 months. Upon registering for the app, the user enters pregnancy information that allows for customized content. See Figure 2 for a screenshot of the log-in screen. The app includes four main sections: static content library, video content library, nearby resources, and log for feedings and diapering. The static content library contains printed information on a wide range of topics, including breastfeeding benefits, common challenges and solutions, public breastfeeding, and returning to work. Videos provide content that is best learned with visual aids, such as latching and positioning. Motivational videos that feature African American parents telling their breastfeeding stories were also included. The nearby resources section includes two parts: a geographically-specific registry of breastfeeding organizations and professionals and a crowd-sourced GPS map that will determine a user's geographic position and locate private lactation rooms and breastfeeding-friendly public spaces in the vicinity. Users rate the space on cleanliness, privacy, and comfort. Users and support persons can



**Figure 3.** Screenshot of Feeding Log.

log details of feedings and diaper changes. See Figure 3 for a screenshot of the feeding log.

KULEA-NET users identify a support person upon registration. The support person has full access to the library content and can log feeds and diaper changes. Pop-ups invite the support person to send encouraging messages to the breastfeeding parent.

Text messages deliver timely information to a user's smart phone home screen and allow the user to tap to access expanded content in the libraries. Messages cover numerous topics, and key knowledge (e.g., the adequacy of colostrum and how to build and maintain milk supply) is emphasized with multiple messages. Messages are delivered at least three times per week on a timeline determined by the due date or delivery date. Our intention is for some messages to be interactive; by responding, a user could receive additional support. Examples of text messages are presented in Table 5.

*Post-Prototype Focus Groups.* Overall, participants responded positively to KULEA-NET's design and features. They were



**Table 5.** Examples of KULEA-NET Text Messages.

Content area	Text message
Benefits	Breastmilk is nature's super food. Did you know that your breastmilk is specially made for your baby and changes as your baby grows? Click here to learn more about why breastmilk rocks.
Pain & latch challenges	Breastfeeding can be a pain in the nipple! Sore nipples in the first week or so is normal. A good latch is important. Click here to learn what else to do to make breastfeeding as comfortable as possible.
Supply challenges	Got milk? Of course you do! The secret to making enough breastmilk is breastfeeding early and often. Avoid these common mistakes to keep your supply up.
Attachment & dependence	Worried about being booby-trapped? Many moms worry that breastfeeding will spoil or make it hard to leave baby with others. But that's NOT true!
Mixed feeding	Breast is best, but some moms will also give formula. We don't recommend that. If you are considering giving your baby both, check out this link.
Sociohistorical context	Did you know that African American women on the east coast are less likely to breastfeed than Caucasian women on the west coast? Let's change that fact!
Public breastfeeding	Are you worried about breastfeeding in public? Here are some tips for keeping your baby fed and yourself comfortable when out and about.
Return to work	Breastfeeding and work CAN work. How will I pump and store milk? Will my baby take a bottle? What about my milk supply? These are common working mom concerns, but we've got your back!
Interactive	Hey mom! Just checking in. If it seems like your baby doesn't want your breastmilk, text MILK to 555-555-5555.

Note. This is a sample of text messages. These messages were chosen because they address key content areas determined by focus groups and in-depth interviews, or because they demonstrate a feature of the KULEA-NET intervention. For important content areas, such as milk supply, our intent is for a user to receive multiple, different text messages. Text messages will be delivered on a time-line tailored to the pregnancy's gestational age and the infant's age.

most enthusiastic about tips on returning to work and logging feeds and diaper changes. They wanted content on infant growth and development to be added. They preferred videos that were no more than 5 min and that responded to their immediate learning needs. Participants liked inclusion of a support person and the crowd-sourced GPS map that identifies public places to breastfeed. Participants confirmed the relevancy of text message content and agreed that they would “tap” to access more information within the app. Some terms were not well understood, like “exclusive breastfeeding” and “nipple confusion.” However, uncertainty with a term's meaning would prompt them to read more. Participants suggested additional features: listings for breastfeeding classes and mental health and family support services; logs to record infant anthropometrics, sleep, and parental mood; and reminders for healthcare appointments.

Modifications were made based on focus group feedback after each session, then we proceeded to usability testing. Usability testing did not include text messaging or the support person; the nearby resources feature was active.

### Phase 2/Aim 2: Usability Testing

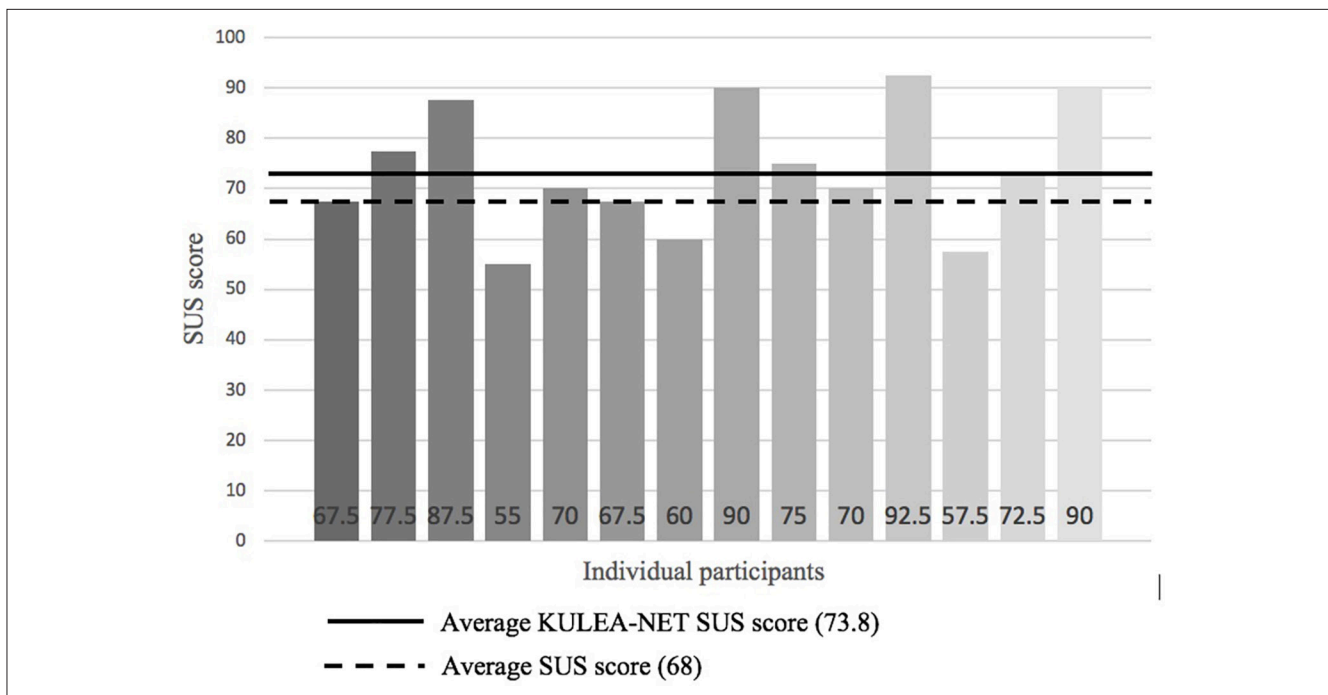
The mean KULEA-NET SUS score was 73.8 compared to the average SUS score across 500 studies of 68 (Sauro, 2011). Individual KULEA-NET scores ranged from 67.5 to 90. Individual and average usability scores are presented in

Figure 4. Participants would recommend KULEA-NET to a friend and believed that it was a valuable tool.

## Discussion

### Phase 1/Aim 1: Co-Creating the Prototype

**Key Factors that Influence Breastfeeding.** Public disapproval and social undesirability are well-documented barriers to exclusive breastfeeding in the African American community (DeVane-Johnson et al., 2017; Hinson et al., 2018; Kim et al., 2017; Ware et al., 2014). Our findings revealed the magnitude and intensity of this barrier and elucidated nuances. Our participants felt that uncovered breastfeeding was unacceptable and immodest. Some were so uncomfortable with breastfeeding outside the home that they intended to use bottles of their own milk or human milk substitutes, which jeopardizes or precludes exclusive breastfeeding. Asiodu et al. (2017) and Gross et al. (2015) suggested circulation of positive images of African Americans breastfeeding to challenge these perceptions and build social desirability. Accordingly, KULEA-NET integrated the *It's Only Natural* breastfeeding campaign from the U.S. Department of Health and Human Services (2018) into the resource library. We hope that this may begin to shift perceptions and build comfort among parents themselves. However, community campaigns and systems-level interventions are needed to neutralize the negative attention



**Figure 4.** Individual and Average KULEA-NET System Usability Scale (SUS) Scores Compared to the Average SUS Score. Note. The average SUS score is based on the average score across 500 studies as reported in Sauro (2011), Feb. 2). Measuring usability with the System Usability Scale (SUS). Retrieved March 5, 2020 from <http://measuringu.com/sus/>

that breastfeeding parents experience, or expect to experience, from others. DeVane-Johnson et al. (2018) recommend that culturally sensitive interventions promote privacy for breastfeeding. KULEA-NET responded to this need by integrating the GPS feature that assists in finding public venues with private breastfeeding space.

The robust support of partners was important to our participants. Thomson et al. (2016) found that a mother is significantly more likely to breastfeed if the infant's father is supportive. Personal social supports, and the partner and grandmother in particular, should be a focus of intervention (Asiodu et al., 2017; Kim et al., 2017). Furman et al. (2016) successfully recruited urban, primarily African American fathers to participate in breastfeeding education. Subsequent iterations of KULEA-NET will fully develop recommended features to engage support persons.

Beliefs surrounding parent-child attachment also discouraged exclusive breastfeeding among our participants. This may be an example of the emphasis that individuals in the African American community place on child strength and independence as a consequence of slavery and oppression, and the need for resiliency and survival in a racist society as discussed by DeVane-Johnson et al. (2018). In-depth research is needed to assess the role that this history has on African American breastfeeding patterns. The same authors suggested that interventions expose African American women to these sociohistorical influences, and one of our participants did request such information. KULEA-NET does not include

this content but references demographic variations in breastfeeding rates.

Asiodu et al. (2017) advocated for information on mixed feeding as part of a culturally-informed intervention. Our participants requested information on human milk substitutes, which is a complex finding in the context of the goal to promote exclusive breastfeeding. KULEA-NET includes content on benefits of exclusive breastfeeding, common challenges to exclusive breastfeeding, and weaning from breastfeeding, but does not offer specific information on human milk substitutes or mixed feeding best practices. Future work is needed to determine how to thoughtfully accommodate these competing priorities.

Social cognitive theory and health branding concepts guided KULEA-NET development. The content libraries are included to teach users what to do and how to do it. Images of African Americans breastfeeding throughout the platform model the behavior for users to replicate. The app builds self-efficacy by boosting users' confidence in their ability to breastfeed. Text messaging, imagery, and videos portray breastfeeding as beneficial and attractive. Our goal was to brand breastfeeding the most socially desirable option.

**African American-Specific Intervention.** The desire for an intervention specific to an African American audience was mixed (e.g., the use the culturally-tailored imagery). Breastfeeding challenges are not unique to African Americans. However, rates of breastfeeding across racial/ethnic groups vary

significantly, suggesting that differences among individual and system-level supports exist. One interpretation of this complex finding is that default white culture has excluded the experiences and perspectives of people of color. Another possible interpretation is that public health practitioners have commonly “targeted” lifestyle choices or behaviors perceived to be problematic. In doing so, they have irresponsibly and incorrectly associated these behaviors only with communities of color, or, alternatively, they have failed to consider the context in which true disparities exist and persist. Although health disparities related to breastfeeding do exist, this may or may not warrant an ethnic/race-specific approach. However, our participants perceived that wanting to provide for one’s child is universal and should not require ethnicity/race-specific content. A possible reconciliation of these data is the notion that there may be concerns that are of greater magnitude to African Americans, and that these concerns must be incorporated. Images and language should be inclusive rather than specific. More fully integrating African American individuals into an intervention that is relevant and applicable to all may be the desired approach. An intervention specifically for African Americans might be perceived as further marginalizing. This finding was unexpected, and we were unable to reach saturation. Our team is planning additional in-depth interviews to better understand opinions on this topic.

### *Phase 2/Aim 2: Usability Testing and Next Steps*

**Future Prototype Development.** Full-scale development of KULEA-NET will include additional features desired by participants, including a catalog of local breastfeeding classes, links to external resources, and a discussion forum. Other investigators of breastfeeding technologies also have identified these features as desirable (Abbass-Dick et al., 2017; Biediger-Friedman et al., 2016; Guerra-Reyes et al., 2016). Advisory group members and participants requested content and features relevant to pregnancy and infant care, but outside the scope of breastfeeding. We were unable to integrate all requests but understand that a comprehensive app is of interest and may maximize engagement. Gallegos et al. (2014) and Martinez-Brockman et al. (2018a) emphasized the importance of relevant and timely text messages. Our findings support the relevance of text messages and the next phase of KULEA-NET will assess timeliness of delivery. Features that were not fully functional or of limited content during the formative phase will be developed and tested. Although we enrolled only postpartum individuals in our usability study, our next iteration will engage individuals early in pregnancy.

**Application to Lactation Practice.** KULEA-NET complements traditional lactation supports. Consistent with our participants’ dissatisfaction with breastfeeding information provided at prenatal appointments, researchers have suggested

that African American individuals are less likely to receive support in the healthcare system (Gross et al., 2017; Johnson et al., 2016; Lind et al., 2014; McKinney et al., 2016). Mobile technologies like KULEA-NET may have particular influence among African Americans who are more likely to be marginalized in the health care system. None of our participants had taken a traditional class, underscoring the potential value of KULEA-NET. It may be most effective when integrated into traditional healthcare. Users engaged more in the Growing Health App if recruited by care providers (Laws et al., 2018).

**Future Research.** Our next step is to evaluate KULEA-NET’s effectiveness in supporting African Americans individuals to initiate and continue breastfeeding exclusively for the first 6 months. This will establish the value of an app and text messaging intervention to achieve breastfeeding goals. We also plan to evaluate the impact of introducing KULEA-NET at different time points, such as prenatally, at the time of birth, and postpartum. Additional research is needed to determine the most effective ways to enhance social desirability of breastfeeding. The role of sociohistorical stigma (slavery, forced wet nursing, and lack of choice) documented by DeVane-Johnson et al. (2018) in influencing our participants’ beliefs about parent-child attachment, breastfeeding outside of the home, and social desirability is uncertain. Best practices to promote exclusive breastfeeding in the context of wide-spread mixed feeding practices are also needed.

### *Limitations*

Focus group and in-depth interview discussions were guided by our questions. Other themes may have emerged with different prompts. Group think and response bias may have influenced findings. Divergent views may have been missed, although this risk was mitigated with in-depth interviews. Our sampling method makes self-selection bias possible. The mean age of participants was 26, and they may have responded more favorably to a technological intervention than older parents.

### *Conclusions*

The ideal mHealth breastfeeding intervention is an app with text messaging that is inclusive of, but perhaps not exclusive to, African American parents. Our participants expressed a desire to breastfeed, but anticipated challenges. Self-efficacy, parent-child attachment beliefs, public breastfeeding and social desirability, and returning to work were important barriers that KULEA-NET needed to address. The KULEA-NET prototype earned high usability scores and offers promise in its ability to engage African American individuals and support breastfeeding. Our next step is to develop content and features more robustly and conduct a randomized-controlled study to assess KULEA-NET’s influence on

breastfeeding initiation and duration among African Americans in an effort to narrow the race/ethnicity gap in breastfeeding and related health outcomes.

### Declaration of Conflicting Interests

Loral Patchen discloses participation in the Diclegis Speakers Bureau for Duchesnay Pharmaceuticals. The other authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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### ORCID iDs

Lindsey Ellis, NP, MPH, IBCLC  <https://orcid.org/0000-0003-3524-9271>

Tony Ma, MS  <https://orcid.org/0000-0003-3092-0572>

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