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Developing an mHealth Intervention to Increase HPV Vaccine Confidence Among Black Families

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ABSTRACT

Despite over 15 years of human papillomavirus (HPV) vaccination implementation, uptake remains below national targets. Black/African American adolescents are less likely to complete the HPV vaccine series, due to a myriad of multilevel factors including vaccine hesitancy. The objective of this study was to develop a tailored mHealth intervention to promote vaccine confidence among Black families with adolescents. We generated a message bank from the literature, then prioritized and edited content according to needs identified in previous research with Black parents, community stakeholder input, and expert consensus. We conducted three rounds of prototype feedback sessions with 16 parents of adolescents aged 9–13 years from the Greater Newark Area. We recruited at family-friendly events, through community researchers, and with snow-ball sampling. We employed user-centered design techniques, elicited open-ended feedback, and collected relevance ratings for rapid qualitative analysis. Transcripts were thematically analyzed. Results indicated intervention content and features should be tailored by information source and channel. Fact-based messages with neutral framing balancing cancer prevention benefits and safety were highly rated. Including links to trustworthy sources was perceived as increasing credibility and helpful for family-centered decision-making. Parents also wanted age-appropriate information with graphics to explain the purpose and importance of HPV vaccination to their adolescents. Developing the intervention with families highlighted the need for multi-modalities, including informational short-message-service (SMS) and detailed emails with tailored information. Multi-modal interventions providing accurate information tailored to parents' questions and concerns, have potential to educate and empower parents to protect their children from HPV cancers.

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Introduction

Human papillomavirus (HPV)-associated cancer disparities persist among Black/African American women and men.[1–4] Vaccination can potentially prevent over 90% of cancers caused by HPV, including head and neck, cervical, penile, anal, vaginal, and vulvar cancers.[5–7] Despite recommendations for adolescents as young as 9 years old to receive 2 doses of the HPV vaccine,[8–10] national targets lag for receipt of at least one HPV vaccine dose.[11,12] National surveys indicate 61% of adolescents aged 13–17 completed the HPV vaccine series in 2023, which is substantially lower than other adolescent vaccinations (88–89%).[8–10] Disparate vaccination rates have been observed across different sociodemographic factors including insurance, income, race/ethnicity, as well as health care facility type and educational attainment of parents.[11,12] For example, Black adolescents have significantly lower completion rates compared to White adolescents,[13] and socioeconomically disadvantaged parents may have lower intentions to vaccinate.[14]

Vaccine hesitancy, or an uncertain attitude and reluctance toward vaccination,[15,16] is a well-documented barrier to HPV vaccination.[17] Although there are some differences by race/ethnicity,[18] determinants of HPV-vaccine hesitancy stem from concerns about the vaccine's safety,

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side effects, necessity, and efficacy.[19] Specifically Black parents are more likely to refuse HPV vaccination when they share decision-making with other family members and have social networks expressing sexuality and religious concerns or misinformation.[20–22] Medical mistrust and previous negative health care experiences also affect hesitancy and refusals among Black families.[22–24]

Interventions across multiple levels (eg, parent, provider, and health system) are needed to improve vaccinations.[25] Although clear recommendations from a provider improve intentions and initiation,[26,27] weaker recommendations have historically been documented among Black and Hispanic families[28,29] as well as those with lower income or who receive care at public health care facilities.[30] Provider interventions that include communication training to address common concerns as well as reminders from the practice or health system have shown some improvement in HPV vaccine uptake.[31,32] When provider messages focus on easing concerns, parents' confidence in vaccines increases[33] as do intentions to vaccinate; however, parents' key concerns may persist.[31,32] For Black parents who may have broader medical mistrust and other norms affecting vaccination, concerns are particularly persistent. Additional parent-focused interventions like culturally targeted mobile health (mHealth) strategies have potential to improve HPV vaccine knowledge, intention, and initiation,[34] however, tailored mHealth interventions to address parent's hesitancy concerns have yet to be evaluated.

Therefore, we employed user-centered design techniques to develop a tailored mHealth intervention to be used in conjunction with tools already in place in pediatric offices to increase HPV vaccine confidence among Black families. This manuscript describes the iterative, community-engaged process of exploring parents' interest in intervention features, feedback on message content and scope, and preferences for overall design. A future clinical trial will test the feasibility of the intervention among Black families.

Methods

Preliminary studies

Prior to the current study, we conducted formative research among a multiracial and multiethnic group of parents living in the same communities as the current study to identify determinants of HPV vaccine hesitancy and to understand key barriers and facilitators to vaccination. We previously found that Black parents had unique social and behavioral determinants and specific preferences regarding trusted information messengers and sources. For example, Black parents exhibited stronger information-seeking behaviors after discussing vaccination with their adolescent's pediatrician—online, with spouses/partners, or through social connections—and expressed mistrust in health care authorities, which influenced their main concerns.[35] Based on this work, we systematically mapped these determinants with evidence-based behavior change methods to design a feasible and relevant intervention that fit the local context of adolescent vaccination in low-resourced communities.[36] The Increasing Vaccination Model[37] informed the development of the intervention prototype. Using this model, we focused on how parents' vaccine knowledge, risk perceptions, confidence, information sharing, mistrust, and social norms shape vaccine hesitancy. Additional structural and logistical barriers also influence vaccination behavior; therefore, we planned to explore self-efficacy to overcome these barriers.

Initial message bank

We searched PubMed for studies assessing and addressing HPV vaccine hesitancy among parents to generate an initial bank of items and messages. Items were independently abstracted and organized by behavioral science staff based on the determinant, or domain, related to HPV vaccination. We abstracted potential intervention messages and mapped them onto the determinant based on the change method, appropriateness, and effect for changing parental knowledge, attitudes, intentions, or behavior. Redundant items and messages were eliminated, and the remaining items were edited for readability (Table 1). The multidisciplinary research team with expertise in behavioral interventions, adolescent health, and health communication reviewed and selected the most relevant questions based on community-identified information needs with input from a community advisory board, local clinicians, and community researchers. The following domains were included in the latest iteration: safety/side effects, necessity, starting age, prevention benefits, provider communication, barriers, and self-efficacy.

Intervention prototype

We developed an automated, interactive short-message service (SMS) messaging prototype that functioned as a back-and-forth, question-answer-message format. Each item from the bank was displayed and participants were prompted to respond using a Likert scale ranging from 1 (strongly disagree) to 5 (strongly

Table 1. Development of intervention domains, questions, and corresponding messages.

Domain	# messages	Topics covered
Age (to initiate)	5	Uncomfortable discussing sex; benefit of younger initiation
Child barriers	2	Child's fear of vaccination; assent/involved in decision
Efficacy	2	Vaccine protects against HPV-related disease
Health prevention	7	HPV-related cancer protection; other HPV-related conditions; HPV is very common
Necessity	10	Importance for boys and girls; not yet sexually activity
Provider communication	5	Feeling comfortable and prepared to ask questions; quality of conversation
Provider recommendation	2	Receipt of provider recommendation; strength of recommendation; satisfaction with information
Reminder/Recall	6	Notification for upcoming dose, past-due
Safety/side effects	12	Short- and long-term side effects; "new" vaccination concerns; ingredients
Self-efficacy/Logistical barriers	6	Lack of insurance, childcare, or transportation; scheduling/availability
Social network	3	Vaccination (mis)information and/or HPV-related experiences shared with/by family and friends
Trusted information source	9	School requirement, credible websites, conversations with personal pediatrician
Recommendation awareness	4	Vaccination recommendations, schedules, and dosing
Total	73	

agree). Based on the real-time response, a follow-up intervention message would be sent (Figure 1(a)) tailored to the response. For example, participants exhibiting low knowledge about benefits would receive messages with information about HPV-related cancer prevention. For users with strong intentions to vaccinate or those not endorsing concerns, affirmative messages were displayed (Figure 1(b)) to encourage vaccination scheduling, reinforce vaccine confidence, and improve message sequencing and flow.

Participants and recruitment

The study took place in two diverse, urban counties (ie, Essex and Hudson) in northern New Jersey. Parents of Black adolescents aged 9–13 years living in the study communities were eligible to participate if they could read/speak English. We recruited through a variety of approaches from October 2023–October 2024: (1) in-person and online through community partners' family-oriented events, health fairs, and social media; (2) passively at family-friendly locations (eg, public libraries, parks, playgrounds); (3) through community researchers; and (4) snowball sampling. The community researchers, who were previously trained in participatory methods, human subjects protections, and qualitative data collection,[38,39] promoted the study on social media, through social networks, and shared flyers at beauty salons, grocery stores, coffee shops, and places of worship throughout the study communities. Interested parents completed a screener online; eligible parents electronically consented, provided demographic information *via* a brief survey, and were contacted to schedule an interview. Of 56 parents interested and eligible to participate, 49 provided contact information; however, 30 were lost to follow-up after multiple contact attempts. We scheduled 19 interviews, and 16 were successfully conducted. Three did not show or reschedule.

Data collection

We conducted semi-structured online Zoom interviews to reduce participant burden and eliminate the need for travel or childcare. The interview guide was designed to engage end-users to generate actionable feedback about the design and need for an mHealth intervention for HPV vaccine hesitancy (Supplementary File 1). We probed on previous experiences with patient portals, SMS communication with pediatric facilities, and preferred communication channels. Specific features of the intervention were explored: different tailoring aspects (eg, referencing particular sources, personalized follow-up information), timing and frequency of message delivery, and flow. This also included feedback on the functionality, helpfulness of features, and potential barriers.

We presented an early prototype and asked about perceived usefulness. We demonstrated features of the SMS intervention, asking parents to review and rate the relevance of messages on a scale of 1 (not at all relevant) to 5 (very relevant). We probed on the credibility and understandability of the messages and asked parents for suggestions and edits for how the content could be improved to meet their needs. We also elicited preferences for message framing, terminology, length of message, and level of detail through A/B testing.

The guide was pilot tested with community researchers and outreach staff to refine questions, formatting, and length. Then, a female research assistant (RW) with training in public health and psychology conducted semi-structured interview sessions with parents. All sessions were recorded and transcribed professionally. Post-interview summaries were written in a structured template to preserve impressions, provide additional context, and were later consolidated into a matrix for comparative analysis. Participants received gifts cards after interviews were completed.

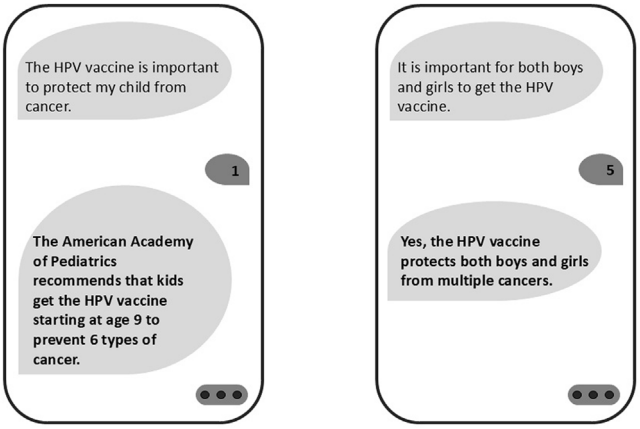

Figure 1. Left side (a) depicts SMS intervention prototype dialogue. Right side (b) depicts example of SMS affirmative dialogue. Users will be promoted to respond using a Likert scale ranging from 1 (strongly agree) to 5 (strongly disagree). Based on their response, a follow-up intervention message will be sent.

This study was approved by the authors' Institutional Review Board.

Data analyses

Transcripts were deidentified. Throughout data collection, we rapidly analyzed individual transcripts and summaries[40,41] using a matrix,[42] which allowed findings to be acted upon iteratively. Rapid qualitative analysis focused on ratings, positive and negative feedback, and refining multiple prototype iterations for additional testing. Two team members (REK, RW) read and reviewed transcripts and summaries to generate the matrix and preliminary coding framework. Upon reaching thematic saturation, when no new themes occurred in interviews,[43] we stopped recruiting and conducted a more in-depth analysis. The coding framework was organized by the interview guide topics, mainly intervention-specific codes (eg, features, design, functionality, content, potential barriers) and theoretical constructs (eg, norms, information sources). Participant-generated ideas about features and design were coded separately from prototype content. Transcripts were independently coded and 25% were reviewed by a second team member. Coding discrepancies were openly discussed to reach a consensus, and the revised approach was applied to all transcripts. Additional members of the study team met to discuss code reports and interpretations iteratively to corroborate and synthesize key themes.[44]

Results

Sample characteristics

We conducted sessions with 16 parents lasting 62 min on average (Table 2). Our sample was all women with a mean age of 36 years. Parents were NH-Black (81%) or Hispanic-Black (19%) and most were US-born (62%). Non-US-born parents were from Nigeria, Jamaica, and Guyana. Most had a household income of <$55,000 annually (74%), were formally employed (62%), and had completed college (50%).

Over half (56%) of the adolescents discussed were 11–13 years. All but one adolescent, who was

Table 2. Description of parents and age-eligible adolescents.

	N (%)
Parent characteristics	
Woman	16 (100)
Mean age (SD)	36 (4.5)
Race/ethnicity	
NH-Black	13 (81.25)
Hispanic-Black	3 (18.75)
Non-US-born	6 (37.5)
Household income	
<$30,000	6 (37.5)
$30,001–55,000	6 (37.5)
$55,001–80,000	1 (6.25)
Refused to answer	3 (18.75)
Educational attainment	
High school or less	4 (25.0)
Attended some college	4 (25.0)
Graduated college/higher education	8 (50.0)
Employment status	
Formally full/part time	10 (62.5)
Unemployed/Disabled/Student/ Homemaker	6 (37.5)
Adolescent characteristics	
Gender	
Boy	10 (62.5)
Girl	6 (37.5)
Age	
9–10	7 (43.75)
11	3 (18.75)
12–13	6 (37.5)
Insurance	
Medicaid/CHIP	15 (93.75)
Uninsured	1 (6.25)
HPV vaccine receipt	
0 doses	10 (62.5)
1 dose	1 (6.25)
Don't know/not sure	5 (31.25)

uninsured, were covered by Medicaid/CHIP. One adolescent had received the first HPV dose, and the remaining had either not initiated (62%) or parents were unsure of their child's HPV vaccination status (32%). None described delaying or refusing HPV vaccination; however, a few used alternate schedules to space out other childhood vaccines. Although some were aware and interested in HPV vaccination, they described challenges accessing the HPV vaccine at local pharmacies. Emotional barriers to vaccinating nonverbal, autistic children and those afraid of needles also occurred.

Thematic analysis

Below we describe parents' previous experiences with mHealth (eg, patient portals, insurance apps) and phone-based (eg, SMS, email, phone call) communication with health care providers. Then we summarize key findings regarding intervention functionality, namely that parents found vaccination appointment reminders useful and wanted information before their appointments to prepare questions and discuss vaccination with their partners and children. Prototype feedback revealed the need for tailoring on channel (ie, SMS vs. email), additional online resources (links vs. no link), trusted information source (ie, federal, professional, or local institution), and provision of adolescent-friendly education. For message framing, parents emphasized the importance of neutral, fact-based content to promote informed decision-making.

Previous mHealth communication experiences

Most parents (75%) had received SMS reminders for their child's health care appointments, and the remaining managed scheduling through a mobile-based patient portal or phone calls with the office. Patient portals such as *MyChart* were also used routinely to obtain visit summaries, test results, and complete post-appointment satisfaction surveys. One parent recalled using CDC's Milestone Tracker application to stay updated on early childhood immunizations and noted this would be useful for HPV vaccination. Notifications *via* SMS and patient portals about appointments were deemed acceptable and considered "a welcoming gentle reminder because sometimes life can happen and you can forget things."

Half of parents also received SMS from pharmacies, personal health care providers, and/or insurance companies about flu and COVID vaccination reminders. These messages were perceived as "helpful, because it's giving you further information about that disease and how to combat it." Generally, SMS were viewed as needed reminders for busy mothers because they were convenient when "you could just save it and add it to your [digital] calendar".

Intervention design

Channel

When asked about their preferred channel for an intervention, SMS (56%) was strongly favored, followed by email (31%). SMS was described as "faster" and "more convenient" than email, whereas email was viewed as better for record keeping, handling detailed information, and providing more privacy than SMS. Similar to those who preferred email, one parent preferred printed materials or mailed letters from pediatricians for reviewing and saving information. Although one parent wanted to receive vaccine-related communication only in person from her child's pediatrician, others echoed the sentiment that vaccine counseling would be helpful.

Notably, those who preferred email still wanted to receive vaccination appointment and scheduling reminders through SMS:

> They [pediatrician's office] don't text me. They're actually working on that, but […] the office I go to is very, I guess, very packed, overwhelmed, or something. Because I was saying that I forgot an appointment because they made it so far out. It just literally slipped my mind. And I said, I didn't get a reminder, and they were like, oh…
>
> —parent of a 9-year-old girl

Timing and frequency

Suggestions for timing of message delivery were usually based on the school calendar. For example, preferred timing was at the beginning and end of the school year and during holidays when schools are likely to be closed. One parent also suggested delivering messages on or approaching an age-eligible child's birthday, starting at 9 years old.

Another common request was to receive intervention messages *before* the pediatric appointment. This was mainly framed as giving parents time to formulate questions, discuss with their spouses, and/or prepare their children to expect a vaccine. Half of participants included their spouse or the adolescent's other parent in decisions, which was why they wanted "a heads up on what month they're getting what [vaccine] and if there's side effects" so they could discuss the information and make a decision before the next

appointment. Although parents did not let their adolescents refuse vaccination, providing their child with information on the purpose of vaccinations and answering their questions was valued:

> I let them know that it's time for them to get their vaccinations. If they have questions on what it's for, I usually do some research and have them read what I found. And if they have questions, I'll answer them. Or if I can't answer them, I'll wait for us to go to the pediatrician for the appointment, and I'll bring it up to the pediatrician.
>
> —parent of 13-year-old and 10-year-old girls

Regarding the duration of the prototype and frequency of messages, parents had mixed opinions ranging from weekly or monthly, to quarterly. However, all parents agreed it was important not to send too many messages too often because they could quickly become a nuisance, overwhelming, and ultimately be ignored.

Additional features and design recommendations

Most parents were not interested in receiving infographics (multimedia messaging service) through SMS, but a few thought graphics might be helpful in email or on linked webpages. A few also thought "kid-friendly" websites with graphics would help explain the purpose and importance of the HPV vaccine to adolescents. One parent proposed sending a link to a webpage with a table of contents or "frequently asked questions" for users to self-select which topics to learn more about.

Intervention content

Relevance of messages and domains

Messages encouraging open communication with pediatricians and cancer prevention benefits of vaccination had the highest relevance ratings; however, most messages were rated as highly relevant, with each domain mean ≥ 4.4 (Table 3). Messages discussing the necessity of HPV vaccination for children who were not yet sexually active received mixed feedback. Those who scored necessity messages as less relevant subsequently voiced questions about whether their own child needed the vaccine. Still, most parents found this information important to include.

Tailored links

Because they found the brief SMS prototype desirable, the majority of parents wanted more detailed information available elsewhere and suggested messages include "a data reference", "journal article", or citation to corroborate statements. Citations were particularly important for messages covering HPV vaccination necessity, safety/side effects, and starting age. Many parents wanted to "do some research on my own" before reaching a decision. Those who preferred email over SMS shared this sentiment for detailed vaccination information and appropriate citations.

Parents also liked messages that closed with an option to receive additional information or connected them to a webpage because "you're putting the power in the parent's hand." Some suggested including statistics and/or a link with each message would improve message credibility:

> It's best to include a neutral third-party link, so that the recipient can go and look it up for themselves. [That way] it doesn't seem like the person who is giving me the information is biased. I can see that there's an unbiased link, and it's just easier for me to do it for myself. Because I have done it in the past with my kids' pediatrician about asthma. And she gave me information [from] a third-party source, and I was able to look it up and come to the same conclusions.
>
> —parent of a 9-year-old boy

The American Academy of Pediatrics (AAP) was deemed a trustworthy and reliable source for vaccination information and received positive feedback when referenced in prototype messages. Trust in other health care authorities was mixed. For example, some felt the CDC was credible and a "go-to" destination for vaccine information, preferring a federal source. However, others trusted CDC less as a result of the COVID-19 pandemic and instead favored links to the state health department, universities, and local hospitals because they were viewed as tangible, community-friendly sources. One non-US-born mother pointed out the World Health Organization (WHO) would be most suitable for her as she believed it covered the well-being of all people globally.

Seven participants reported they would fact check any information they receive "because, honestly, we can look it up ourselves because that's all we do anyways, is look up everything" by doing an online search. A few considered WebMD and Mayo Clinic to be "a credible site, a medical site", though many parents reviewed a few links, admittedly appearing at the top of their search engine results, to compare and confirm information:

> For everything I go to Google. Because when I came into America, I hear[d] some people saying their children don't take the vaccine because the vaccine comes with a lot of stuff, like children being sick, having autism, all those stuff. You understand? […] at first, I was scared, so I had to do some research.
>
> —parent of a 9-year-old boy

Table 3. Domains, items, average relevance ratings, and parents' message feedback.

Domain	Sample message	Mean relevance	Exemplary quote of message feedback
Starting age	It is important to give the HPV vaccine before exposure to the virus to prevent HPV-related health issues such as cancer.	4.53	So telling them this is letting them know that [vaccination] is to prevent them from getting health issues such as cancer. And parents, they're going to read that and be like, 'yes, this is important.' You don't want your child to be at risk of these, so reading that would encourage me as a parent to make sure that gets done before they reach 12. —**parent of a 10-year-old boy**
Barriers	If your child dislikes getting vaccines, it may help to make a plan before the appointment to help your child feel more comfortable.	4.40	The second one sets the tone, because it's saying, "make an appointment and let your child know what's going on"… So you're not just throwing them to the wolves, like "here, you got to get this shot," and they're like, "no, no, no, no, no." —**parent of an 11-year-old boy**
Health prevention	The HPV vaccine can prevent head and neck, cervical, penile, anal, vaginal, and vulvar cancers.	4.57	I think that's the best reply so that you will know the risk of not taking the HPV vaccine. —**parent of a 9-year-old girl**
Necessity	We understand your child may not yet be sexually active. Vaccinating your child before they start having sex is the best way to ensure they are protected.	4.54	I don't think anything should change because what I was thinking about is some kids are sexually active at a very young age. […] before 12 years old, so, I guess, that would be a reason why you should get [HPV vaccine] around that time because you never know what the kids are doing around this age. Some of them might get into sexual activities. —**parent of a 12-year-old boy**
Provider communication	It's okay to speak up and ask questions so you understand what the pediatrician is recommending. If you share honestly, then your pediatrician can do his/her best to answer your questions.	4.75	I actually have a hard time feeling comfortable talking about vaccinations with my kid's doctor as well. So that response actually gave me the reassurance that I needed —**parent of a 13-year-old girl**
Safety/side effects	The HPV vaccine is safe, just like the other vaccinations recommended for children at this age. It has been administered in the USA since 2006.	4.53	Some people just want to know how long it has been in existence in the USA and even some other parts of the world, just before they are, you know, comfortable with it. […] I was among the people that didn't want to take [COVID vaccine] because it was new. […] I wanted to see that there's no much more side effects outside from fever. —**parent of a 13-year-old boy**
Self-efficacy	Your child will be fully protected against HPV after receiving both doses. Be sure to make an appointment so your child gets the second dose 6 months after starting the vaccine series.	4.44	This give us—gives a specific time. This is very important so, you know, for those parents, they will keep track and know when they have to go [to vaccination appointments]. —**parent of a 9 year-old boy**

Neutral message framing

Most parents valued having access to informative, fact-based vaccination information. Specifically, messages on the relationship between HPV and multiple cancers were motivating some parents to learn more about "what you're trying to save your child from":

> […] you want to be specific with the messages. You want to be impartial but specific. For me, that's how I want to be talked to with the medical community. Just give me the facts, the information without any opinions. And then I can go and follow up on my own. And if I see something that, hey, it corroborates what you guys are saying, then I'll go and probably I would vaccinate.
>
> —parent of a 9-year-old girl

Further, about half of parents expressed reservations about vaccination safety and questioned the necessity of HPV vaccination; these parents strongly preferred messages avoid any persuasive language. Instead, they wanted straightforward, neutral messages. Language promoting vaccination was perceived as biased. Straightforward, descriptive information was preferred:

> It's like you're just trying to butter me up just to get this [vaccine]. Be honest and just say, "Hey, we understand that you have some concerns about the side effects." And then just address some of those side effects or give links to those side effects. "Hey, a side effect can happen." Validate that. Address those side effects because, like I said before, I didn't get the flu shot because of the side effects.
>
> —parent of a 9-year-old girl

Discussion

We elicited feedback on the design and content of a prototype mHealth intervention to address HPV vaccine hesitancy among Black parents of adolescents aged 9 to 13 years. Despite many parents stating they were supportive of vaccines, they commonly expressed hesitant beliefs and behaviors; parents articulated multiple concerns, wanted time to process vaccination

information, and valued having control over when to vaccinate their adolescent. Our results indicate that parents were interested in the prototype SMS intervention and found the content highly relevant. Receiving notifications and information prior to vaccination appointments was important. Parents emphasized the helpfulness of brief, fact-based SMS paired with links to their preferred sources. Information sharing norms highlighted a need for both parent and child educational tools.

Majority of parents in our sample preferred an SMS intervention, mainly because it served as a helpful reminder and could easily be linked with an appointment management system. However, a subgroup desired more detailed information *via* email. Other studies with diverse racial/ethnic samples have also found high acceptability of SMS interventions and interest in multi-modality messaging approaches.[45,46] Studies testing electronic reminders (ie, SMS, email, or patient portals) have demonstrated promising results regarding initiation[47] and series completion compared to usual care,[48] although few reminders have been culturally adapted or individually tailored.[49] Based on parents in our sample simultaneously wanting brief SMS and more detailed information like follow-up emails, we will move forward with SMS and email options.

Our results also indicate a need for multiple tailoring or personalization features of messages. Parents had different levels of trust in various information sources[50] (ie, CDC, AAP, and local hospitals/universities), which may be due to residual decreases in trust in government from the COVID-19 pandemic. Although others have recommended tailoring based on knowledge gaps, hesitancy concerns, and structural barriers unique to Black families,[51–54] we found it is important to tailor or have a menu of options based on information sharing and desired level of details. Many but not all parents in our study wanted additional information and/or links to trusted sources ahead of vaccination appointments that could be shared with spouses/co-parents or infographics to help prepare adolescents for the vaccination appointment. Although other studies with largely Spanish-speaking samples have shown how personalized SMS reminders can improve timely HPV vaccination, educational messages may not have additional benefits if parents are not interested in more information.[55,56]

Although parents in our sample were interested in receiving more information on HPV vaccination, we also found a strong preference for non-persuasive content. Others have similarly found easing concerns was more effective compared to encouraging vaccination.[33] These findings may be similar among hesitant parents across various race/ethnicity groups. For example, hesitant non-Hispanic-White parents also reported needing more information about similar concerns that parents in our study expressed (ie, HPV prevalence/necessity, vaccination benefits, and side effects/safety data).[57] Additional content that was deemed highly relevant among our participants included starting age and feeling comfortable communicating with providers; parents were encouraged by the message affirming honest conversations with the pediatrician. As others have suggested, motivational interviewing techniques likely remain critical to easing hesitant parents' concerns.[58] However, limited provider time highlights opportunities to adapt these techniques to mHealth or digital interventions,[59] which remain scarce for Black families.[60]

Like all qualitative inquiries, our study has some limitations. These findings are specific to Black families in New Jersey, which may have context-specific determinants of HPV vaccine hesitancy.[61] Additionally, our sample included highly educated, English-speaking mothers, and others have observed differences in HPV vaccination intentions by parents' educational attainment[14] and willingness to vaccinate based on health literacy.[62] Although our sample included Black Hispanic and non-US-born parents, future work is needed to ensure tailored interventions address unique needs of minority groups.

Conclusions

Parents' feedback about a mHealth intervention prototype to promote vaccine confidence among Black families indicated tailoring needs on a variety of intervention features and content. Specific functionality and timing aspects of the intervention design were driven by information sharing before vaccination appointments to make family-centered informed decisions. A future feasibility trial will test whether tailored, fact-based messages *via* SMS and email with links based on trusted sources increase HPV vaccine confidence among Black families. By engaging end-users to develop confidence messaging and leveraging information sources parents trust, we aim to confirm HPV vaccination is safe and prevents diseases. By providing accurate information tailored to parents' questions and concerns, we have potential not only to educate but also to empower parents to take proactive steps to protect their children and prevent HPV cancers.

Statement of Public Health Significance

This analysis provides valuable insights about parents' unique needs and preferences for a relevant and credible intervention to improve confidence in HPV vaccination among Black families.

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Data availability statement

The data that support the findings of this study are available from the corresponding author, [REK], upon reasonable request.

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