Ten Steps to Design a Counseling App to Reduce the Psychosocial Impact of Human Papillomavirus Testing on the Basis of a User-Centered Design Approach in a Low- and Middle-Income Setting

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PURPOSE This study describes the 10 steps followed to produce the information architecture of a user-centered design (UCD) counseling mobile application, the first phase to develop an app. The app aims to reduce the psychosocial impact of the human papillomavirus test result and improve women's knowledge of human papilloma virus and cervical cancer.

METHODS We used a UCD approach to produce the information architecture of the app (ie, how to organize contents into features). We analyzed field notes, meeting agendas, and documentation produced during each stage of the design process. We described the goals, methods, and outcomes of each step. We also discussed the critical challenges and the strategies to address them.

RESULTS The steps are (1) knowledge, attitudes, and beliefs mapping: reanalysis of team's research findings from prior studies; (2) environmental scanning of apps available on the market; (3) stakeholders' point of view: The International Advisory Committee; (4) potential user's profile: building archetypes through the Persona method; (5) women's interviews: user's preferences and experiences; (6) effective features: scoping review to select app's features that address psychosocial impact; (7) the user journey: ideal interaction with the gynecological service and the counseling app; (8) women's focus groups: using Personas and Scenarios to discuss app's mock-up; (9) women's design sessions: prototype test and card-sorting techniques; and (10) team's design session: translating results into visual objects and features.

CONCLUSION We provide here detailed descriptions of the UCD process of an app for human papillomavirus–tested women for those venturing into the area of mHealth strategies work. Our experience can be used as a guide for future mHealth app development for a low- and middle-income setting.

INTRODUCTION

Cervical cancer (CC) mortality is a major public health issue. In Argentina, every year, 4,500 new cases are diagnosed, and 2,300 women die from this disease annually.[1] High CC mortality is related to problems in the cancer control continuum, including lack of follow-up, diagnosis, and treatment.[2,3] It is expected that human papillomavirus (HPV) vaccine programs and HPV testing will lead to the elimination of CC over the next decades.[4]

As HPV testing detects a sexually transmitted infection with oncogenic types of HPV, HPV positivity can have connotations of promiscuity and stigmatization and can result in shame, worries about future sexual relationships, and questions about the women's or her partner's

sexual behavior. HPV positivity can also produce anxiety, fear of cancer or death, and disease denial.[5-7] The HPV psychosocial impact might not only diminish women's quality of life but also reduce their ability to complete diagnosis and treatment.[8]

Providing information that meets women's needs and counseling are key in alleviating HPV-related distress and its possible impact on adherence to follow-up.[9,10] The WHO recommends counseling as a strategy for interpersonal communication between health providers and women, allowing them to become more informed and knowledgeable about HPV and CC prevention, to discuss sensitive topics (eg, sexuality), and encourage them to adopt preventive practices.[11]

CONTEXT

Key Objective

What steps were followed to produce the information architecture of a user-centered designed app aimed to human papillomavirus (HPV)–tested women?

Knowledge Generated

We followed 10 steps to produce the information architecture of a counseling app for HPV-tested women designed with a user-centered approach. For women, the app should mainly provide information on HPV, cervical cancer, and steps to follow after different HPV test results. Information provision turned out to be the organizing axis of the design, and it became a prominent element in the different screens. The app should be mainly offered by health providers, include appointment reminders for follow-up and treatment, and present stories and testimonies of HPV-positive women.

Relevance

The study results are key for the implementation of a mHealth-based intervention aimed at providing counseling and increasing women adherence to follow-up/treatment in low/middle-income settings, with high potential contribution to the achievement of WHO targets to eliminate cervical cancer.

Although face-to-face counseling would help women overcome the psychosocial impact, its implementation presents many difficulties such as lack of trained providers,[12] lack of sufficient time and privacy during consultations, lack of awareness about the importance of counseling, and embarrassment when raising issues concerning sexual behaviors.[13] As a result, HPV-tested women often receive insufficient and/or confusing information about the use and benefits of HPV testing and how to follow-up.[14]

We need innovative and scalable solutions to enhance provision of information, counseling, and support to HPV-tested women that will allow a more efficient use of human resources and time and improve women's autonomy in accessing patient-centered information. mHealth interventions can enhance the relationship between patients and health providers[15-17]; in particular, the use of mobile applications (apps) to communicate with patients and provide support has been shown to improve health outcomes for different health conditions.[18-20] Apps can be used even after the consultation ended and require less staff.[17,18] In cancer care, apps offer the possibility of providing accessible information and education at minimal costs throughout the cancer care continuum.[20]

Nonetheless, the literature has shown that most downloaded apps were used only once because users did not immediately engage with them, undermining the intervention's potential effectiveness.[21,22] Additionally, people's intention to use apps for self-care purposes is influenced by perceived usefulness and ease of use, performance expectancy, social influence, self-efficacy, and potential lack of privacy. Evidence shows that involving end-users in the app design may enhance its perceived utility and usage.[23,24] In addition, the app proposed features should be integrated within a theory-driven health intervention oriented to behavior change.[25]

We propose an app for HPV-tested women designed with a user-centered approach, whose included features will be integrated within a theory-driven health intervention. The app will provide information and support to HPV-tested women from HPV testing and results delivery to treatment if needed. The app would constitute a low-cost, easy-to-use tool that would change how HPV-tested women access evidence-based information and counseling.

The first phase of an app design is producing the information architecture (IA) which can be summarized as the organization of contents and objects (eg, screens and features), the clear descriptions of their functions and interactions, and the provision of ways for the user to get to them (eg, understandable labels and navigation flows).[26] The IA is a critical dimension of an app design as it will clearly state its format, presentation, and functions which are key elements for intuitive access to app content and task completion.[27]

This study describes the 10 steps followed to produce the IA of a user-centered design (UCD) counseling app for HPV-tested women. The description dwells on the contribution of each step to the design, the techniques used, and the findings obtained. The study results are key for the implementation of a mHealth-based intervention aimed at reducing the psychosocial impact of HPV testing and increasing women adherence to follow-up/treatment, with high potential contribution to the achievement of WHO targets to eliminate CC.[4]

METHODS

Framework

We relied on the design thinking framework, which is a user-centered framework which provides a guide to translate the intervention aims into technological components and specifications for digital behavioral change interventions.[28] In addition, the process of designing the IA incorporated a series of different methods and participatory techniques which were iteratively applied[23] through two major phases: identifying problems (through researching and defining) and solving problems (by creating and

testing). Figure 1 shows how the 10 steps described in this study are integrated into the two phases of the IA design.

Formative research was a main activity of the IA design process (extensively described elsewhere).[29] We conducted online individual interviews (step 4), focus groups (FGs) (step 8), and design sessions (DSs) (step 9) with HPV-positive women age 30 years or older aimed at understanding their perceptions about the app and to investigating their preferences regarding the app design, content, and framing. All other steps shown in Figure 1 were used as additional inputs to the app's iterative design.

Formative Research Setting

The study took place in Ituzaingó, a district located in the Metropolitan Area of Buenos Aires. In 2015, HPV testing was established as primary screening for women age 30 years or older attending the public health system, mainly the population not covered by the social security sector (such as workers in the informal economy and their families). The public health sector comprises a network of primary health care (PHC) units linked with the secondary level of care that provide care free of cost, including screening, diagnosis, and treatment if needed.

According to Argentinean recommendations,[30] HPV-positive women are triaged with cytology. Women with abnormal Paps are referred to colposcopy and biopsy if needed. Women with histologically confirmed CIN2 or worse are referred for treatment. HPV-negative women are recommended rescreening in 5 years. HPV-positive women with normal cytology are recommended rescreening in 18 months.

Participants of Formative Research

Eligible women were literate, age 30 years or older, residing in Ituzaingó, and mobile phone users. We used a purposive sampling procedure among women HPV tested in the past 12 months at Ituzaingó public health institutions. We conducted fieldwork during the COVID-19 pandemic (November-December 2020 and August 2021). Despite this unprecedented context, we recruited 29 women for individual interviews, of whom 19 (66%) participated in the four FGs and 11 took part in the two DSs.

The formative research study's protocol was approved by the Diagnóstico por Imagen Morón private clinic's ethics committee. Women provided verbal informed consent, which was audio recorded for documentation. Anonymity of participants was guaranteed.

Data Collection and Analysis Used Through the 10 Steps of the App Design Process

We analyzed results from formative research, field notes, documentation produced during each step (such as memos and visual products), and publications of partial results.

For each step, we described its goals, techniques, and outcomes. Thematic analysis[31] was used to analyze data
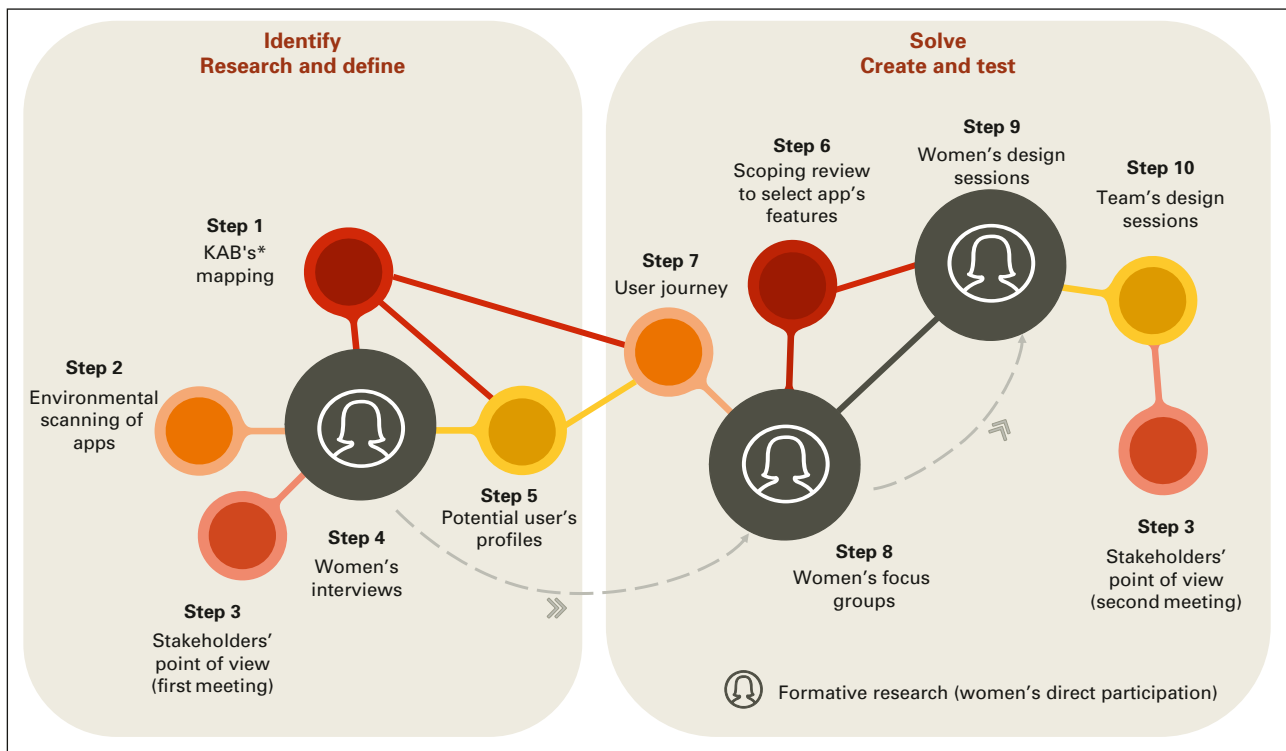
FIG 1. Design-thinking phases and the 10 steps to produce the app's information architecture. *KABs mapping toward HPV testing and follow-up procedures. HPV, human papillomavirus; KABs, knowledge, attitudes, and beliefs.

described in steps 1, 5, and 8 (Fig 1), relying on the Health Belief Model and the Integrative Behavioral Model frameworks, which has been extensively described elsewhere.[29] The analysis allowed us to organize data into themes, detect emerging topics, and get richer data.

RESULTS

Step 1—KABs Mapping

Sep 1 was aimed at systematizing patterns in women's knowledge/attitudes/beliefs (KABs mapping) toward HPV testing and follow-up. For that, we reanalyzed qualitative data obtained in previous studies by our research team, which allowed us to make reinterpretations considering new research questions.[32]

We examined three different corpora of data: first, from interviews carried out in 2012 among women age 18-55 years in the province of Buenos Aires who had abnormal Pap smear results (n = 30)[33,34]; second, from interviews (n = 38) conducted among HPV-tested women in 2013 in the province of Jujuy[7,14]; and finally, data from six FGs carried out in Jujuy with women age 30 years or older (n = 48) who had performed HPV self-collection in 2016-2017.[35]

On the basis of Health Belief Model and Integrative Behavioral Model, we classified data into the following themes: knowledge, attitudes, beliefs, perceived barriers, perceived self-efficacy, and cues to adhere to follow-up. Then, we distinguished emergent subthemes and selected the quotes that better described each theme (Table 1). The KABs mapping was a main input for step 5 (end-users' profiles), step 7 (user journey), and steps 4 and 8 (interview and FG guides, respectively).

Step 2—Environmental Scanning of Apps

We conducted an environmental scan to explore and characterize the current landscape of apps related to HPV and CC. Between June 1, 2020, and June 14, 2020, we searched both the Apple and Google app stores using the key terms HPV and CC both in English and Spanish. Search update was done in December 2021. Apps oriented at health professionals and those focused on general aspects of gynecology and/or sexuality were excluded.

We summarized the following variables: app name; developer, owner, and supporting institution; target audience; main features; availability (free or paid); year of release; main topic repository category; languages; and operating systems (iOS, android, or both).

We found 19 apps published between 2014 and 2021. All of them were in English while some were in other language (Turkish, Spanish, Italian, or Portuguese), with English as second option. Nearly half of the apps fell into the health/fitness category, followed by medical. Most apps were free and aimed at everyone. Only apps related to HPV vaccination were targeted to a specific audience (mostly parents and very few to teens). The most frequent topics were information about both HPV vaccination and CC

prevention. The app main features were to provide information through texts or infographics, remind appointments, and visualize user progress (eg, remaining vaccination doses). All apps were available in both operating systems.

Step 3—Stakeholders' Point of View: The International Advisory Committee

We established an Advisory Committee of national and international stakeholders, including:

- the Chief of the Unit of Non-communicable Diseases, Violence, and Injuries Prevention Pan-American Health Organization from the WHO;
- the Head of Prevention and Implementation Group at the International Agency for Research on Cancer from the WHO;
- the Head of Oncogenic Viruses Laboratory HPV National and Pan-American Health Organization Regional Reference Laboratory for the WHO HPV-LabNet National Institute of Infectious Diseases-ANLIS "Dr Malbrán";
- the President of the Argentinean Society of Lower Genital Tract and Colposcopy;
- the Head of the National Program on Cervical Cancer Prevention, National Cancer Institute (Argentina);
- the Coordinator of the Working Group on Communication and Health, "Gino Germani" Institute, University of Buenos Aires; and
- a renowned female gynecologist and influencer with high expertise in social media.

Key comments of the Advisory Committee were the need to include in the app's implementation a training plan for PHC providers and the importance of considering potential confidentiality issues and data protection regulations not only in Argentina but also in other countries. They also emphasized the importance of the app as a tool to enhance women-health professionals' relationships and to provide clear and evidence-based information to women. Additionally, they highlighted the app as an opportunity to contribute to evidence dissemination not only among women but also among health professionals.

Step 4—Women's Interviews

Twenty-nine individual online semistructured interviews were conducted among HPV-tested women (see *Participants*). We collected information about use of technology (use of mobile phones, Internet; health apps, preferences regarding apps' features) and women's personal experiences during HPV testing and result delivery.

The results showed that women used their mobile phones daily. Most mentioned the use of apps to record their menstrual cycle, and some used apps to improve their physical activity. Although most women preferred to get first-hand information from doctors, almost all googled health information. Most women felt that they lacked time during the medical consultation to ask questions about HPV

TABLE 1. KABs Mapping About HPV and CC (Themes and Verbatim)[a]

Themes	Subthemes	Verbatim Examples
Knowledge	Information needs	"[The meaning of an HPV positive result] What is it? Can you live your whole life with it [HPV]? Are white spots dangerous?"[14]
		"I wanted to ask: What is the origin of the virus? Is it an infection? Is it something that comes with us or what?"[14]
		"How did I get [HPV]?"[7]
	Barriers to meet information needed	"I didn't ask anything. Because I didn't dare, they were all male physicians."[14]
		"There are things I haven't asked that I remember later. […] The thing is, that at this moment, I can't—I get blocked. It must be fear. Then I remember."[14]
Beliefs on susceptibility of having HPV and CC	All women are at risk	"As a woman, we are prone to get infected."[35]
	Sexually active women	"Who has sexual relations?"[35]
		Who has doubts about partner faithfulness: "He infected me."[35]
	Personal/family history of gynecological issues	"My mother had uterine cancer at 47 years old, and I thought it can happen to me… I can have some issues. I always did the Pap, for that very reason."[35]
Beliefs on severity of HPV and CC	Perceived severity	HPV: "Where does the virus come from? Then you say, 'It is like AIDS'."[35]
		"For me, it was if HPV is cancer, HPV is death …"[35]
		"Cancer is death."[35]
Beliefs on risk of having HPV/CC	Personal/family history of gynecological issues	"My sister had already tested positive, so I wanted to do it. I can have it too."[35]
		"My mother had cervical cancer; I can have it."[7]
		"I had endometriosis; I can have CC."[35]
		"I have had more than one partner, two… some partners. Then I had the intrigue about…"[35]
		"I did the test mostly because… I had lost a baby, I said… "maybe they left something inside of me…"[35]
Attitudes after HPV testing	Avoidance	"I avoid hearing what it's about [HPV]."[34]
	Uncertainty	"Not knowing [the results] makes me uncertain."[7]
	Fear	"Fear that the results will say that I'm sick, that I have cancer."[34]
	Feeling sick	"I felt like getting sick."[7]
Attitudes when HPV test is positive	Feeling anxiety and depressive thoughts	"I felt anxiety because of what I had."[7]
		"I didn't sleep well at all."[7]
	Fear	"I was afraid." "I felt fear."[7]
		"It's a lot of things that come to mind. Your children, your life…."[7]
	Concern about infidelity	"And this caused an argument between us because my children are his. And as a woman, my active sexual life, since I started until now, has been with him, not with other people."[14]
	Embarrassment	"I felt shame." "I felt embarrassment."[7]
	Concern about "what people will say"	"I was ashamed to have a (positive) result because I said, 'What are they going to say? That I'm an easy woman who has sex with everyone.'"[35]
		"It happens… it is not you. You can take it well, but it is society. Imagine they come to you: 'You caught it (HPV) because you are dirty.' Look if they find out that you have HPV?"[35]
Attitudes when get abnormal pap results	Fear	"You go around wondering if you are sick, what the results will show, what they're going to tell you. Fear of knowing the results."[34]
		"I was blocked and I didn't listen to anything anymore [what the doctor told me]" "I didn't ask many questions. I was terrified. Fear doesn't let you know"[7]
	Fear of death	"I started to realize, 'Positive is cancer,' it is the first thing I thought. 'I have a daughter, she is a girl, and cancer is to die. I cannot die…' Life felt overwhelming… Until…"[35]
	Fear of infertility	"I was afraid of not having more children. They would take everything away from me, and I don't want to lose anything."[35]

(Continued on following page)

TABLE 1. KABs Mapping About HPV and CC (Themes and Verbatim)[a] (Continued)

Themes	Subthemes	Verbatim Examples
Perceived benefits and barriers to undergoing follow-up procedures	Benefits of Pap	None mentioned
	Barriers to undergoing Pap	Pap requires time: "You miss a day at work."[33]
		"You must do it yearly."[33]
		"I felt shame." "I felt embarrassment."[33]
		"Pap is painful, torture."[33]
		"Some professionals had rude behaviors."[33]
		"I don't have time; I have small children and I'm taking care of them. I have no one to leave them with."[35]
	Lack of privacy during consultations	"You have to undress in front of strangers" "[Doctors] yell at you: 'Open your legs' (imperative tone)."[35]
		"All your intimacy is exposed."[35]
	Lack of accessible language, use of technical words	"They talked about medical issues that you don't understand at all. I mean, I got scared because they didn't give me clear explanations."[7]
Perceived self-efficacy	To not be able to do HPV test self-collection	"If self-collection was a positive result, maybe I did wrongly."[35]
	To be capable to do Pap	"I felt embarrassed, but there is no other way."[35]
Cues to perform Pap and follow-up procedures		"My sister had already tested positive, so I wanted to do it."[35]
		"My gynecologist, in particular, says if you have a good PAP result, other doctors recommend you every three years, but she makes me go every year [to perform Pap]."[35]
		"There are women who for example forget to do medical checkups…The CHW is for that… they are sometimes for that, they are mostly …If you forget to do it, they knock on your door …"[35]

Abbreviations: CC, cervical cancer; HPV, human papillomavirus; KABs, knowledge, attitudes, and beliefs.
[a]Reanalysis made from published data.[7,14,33-35]

positivity and to clarify their doubts. Many felt overwhelmed by the HPV test results and were not able to understand the information provided by the physician. Others did not get much information from the provider. We used these findings to fit the Persona and their scenarios (step 5).

Step 5—Potential User's Profiles

Five archetypical profiles of HPV-tested women who might be potential app end-users were identified. We used the Persona method,[36] which is a description of fictitious users on the basis of the categorization of relevant information about real people to build typologies. It was based on the KABs mapping data (step 1) and results of the individual interviews with HPV-tested women (step 4).

We built five Personas on the basis of the following dimensions: sociodemographics, personal interests, partnership situation, common attitudes and behaviors related to health, information needs on HPV testing and CC prevention, structural factors that might deter access to health care (child-caring, geographical distance, etc),[33] previous experiences that could shape women-provider interaction,[35] use of technology, and likelihood to adhere to follow-up.[14]

We used Personas as potential app users main characters of different scenarios (Fig 2), presented as short stories that
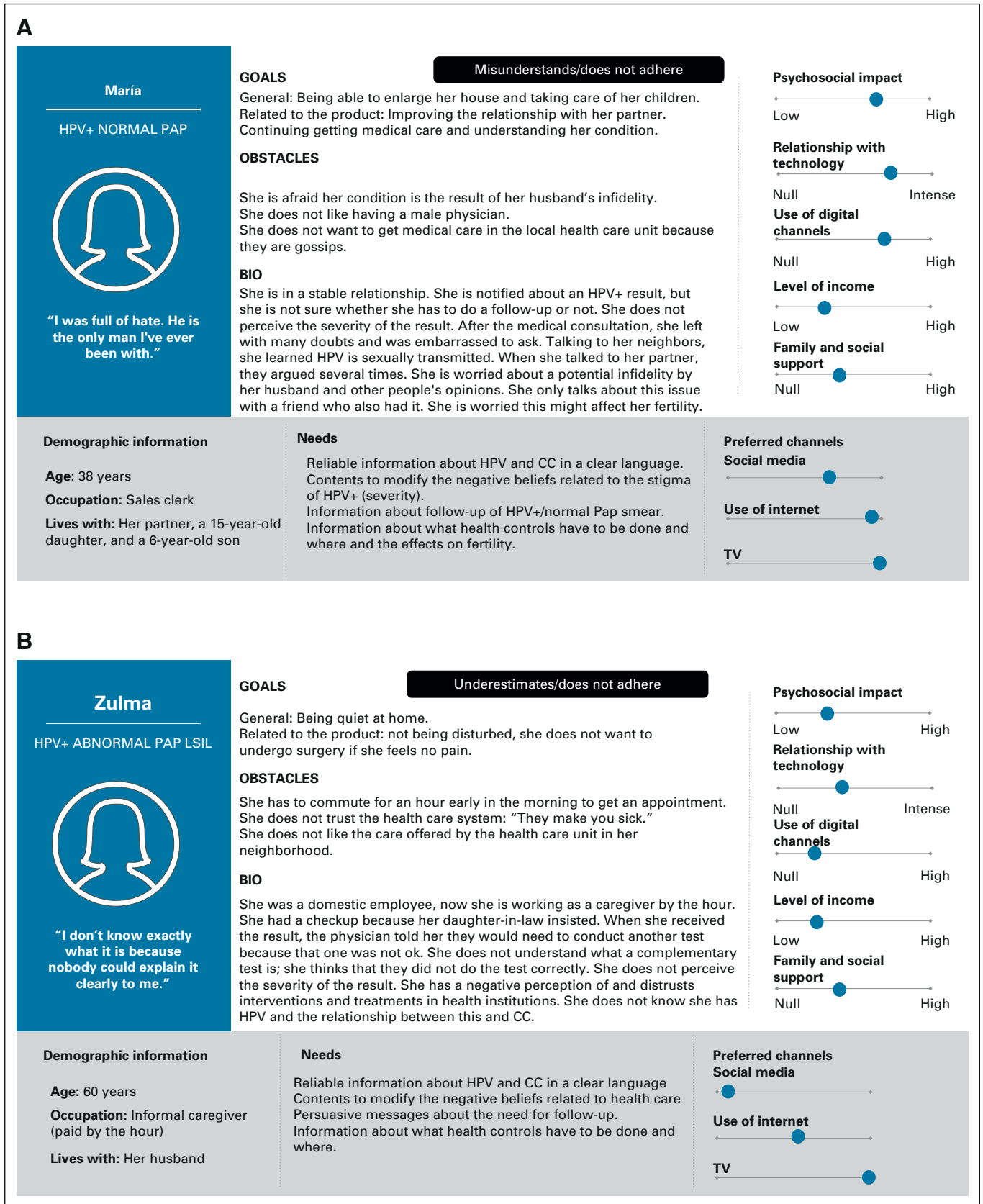
described a context where someone might use the app.[26,36] App components were created as a tool to respond to these Persona/scenario needs (steps 7, 8, 9, and 10).[36]

Step 6—Scoping Review to Select App's Features

We conducted a scoping review to identifying app-based interventions evaluated in randomized controlled trials with demonstrated efficacy in changing the psychosocial impact of health problems. This review allowed us to map apps with demonstrated effectiveness in influencing intention toward behavior change. We used this list to discuss the app's design during FGs (step 8).

We searched in PubMed, Cochrane, Scopus, SciELO, Embase, British Nursing Index, and PsycInfo databases, where 258 articles were initially found. After eliminating duplicates and applying inclusion criteria, 59 articles were selected and systematized using the PICO format (population, intervention, control group, and outcomes).

We identified 21 interventions using apps reported as effective for KABs and/or behavior change. They offered the following features: sliding cards with texts, audios, videos, or infographics to provide information; chat rooms/forums with health counselors and/or other patients; learning video games (referred to as serious games); links to websites; texts listing things that please the user (eg, photos of loved

A

María

HPV+ NORMAL PAP

"I was full of hate. He is the only man I've ever been with."

GOALS

General: Being able to enlarge her house and taking care of her children.
Related to the product: Improving the relationship with her partner.
Continuing getting medical care and understanding her condition.

OBSTACLES

She is afraid her condition is the result of her husband's infidelity.
She does not like having a male physician.
She does not want to get medical care in the local health care unit because they are gossips.

BIO

She is in a stable relationship. She is notified about an HPV+ result, but she is not sure whether she has to do a follow-up or not. She does not perceive the severity of the result. After the medical consultation, she left with many doubts and was embarrassed to ask. Talking to her neighbors, she learned HPV is sexually transmitted. When she talked to her partner, they argued several times. She is worried about a potential infidelity by her husband and other people's opinions. She only talks about this issue with a friend who also had it. She is worried this might affect her fertility.

Misunderstands/does not adhere

Psychosocial impact

Low ———————●——— High

Relationship with technology

Null ————————●—— Intense

Use of digital channels

Null ———————●——— High

Level of income

Low ——●——————— High

Family and social support

Null ——●——————— High

Demographic information

Age: 38 years

Occupation: Sales clerk

Lives with: Her partner, a 15-year-old daughter, and a 6-year-old son

Needs

Reliable information about HPV and CC in a clear language.
Contents to modify the negative beliefs related to the stigma of HPV+ (severity).
Information about follow-up of HPV+/normal Pap smear.
Information about what health controls have to be done and where and the effects on fertility.

Preferred channels
Social media

——————●———

Use of internet

—————————●—

TV

—————————●—

B

Zulma

HPV+ ABNORMAL PAP LSIL

"I don't know exactly what it is because nobody could explain it clearly to me."

GOALS

General: Being quiet at home.
Related to the product: not being disturbed, she does not want to undergo surgery if she feels no pain.

OBSTACLES

She has to commute for an hour early in the morning to get an appointment.
She does not trust the health care system: "They make you sick."
She does not like the care offered by the health care unit in her neighborhood.

BIO

She was a domestic employee, now she is working as a caregiver by the hour. She had a checkup because her daughter-in-law insisted. When she received the result, the physician told her they would need to conduct another test because that one was not ok. She does not understand what a complementary test is; she thinks that they did not do the test correctly. She does not perceive the severity of the result. She has a negative perception of and distrusts interventions and treatments in health institutions. She does not know she has HPV and the relationship between this and CC.

Underestimates/does not adhere

Psychosocial impact

Low ——●——————— High

Relationship with technology

Null —————●————— Intense

Use of digital channels

Null ——●——————— High

Level of income

Low ————●——————— High

Family and social support

Null ——●——————— High

Demographic information

Age: 60 years

Occupation: Informal caregiver (paid by the hour)

Lives with: Her husband

Needs

Reliable information about HPV and CC in a clear language
Contents to modify the negative beliefs related to health care
Persuasive messages about the need for follow-up.
Information about what health controls have to be done and where.

Preferred channels
Social media

—●—————————

Use of internet

————————●————

TV

—————————●—

FIG 2. (A and B) Illustrative examples of end-users built using the Persona method. CC, cervical cancer; HPV, human papillomavirus.

ones); recording activities or setting tasks with a goal of improvement; reminders; a function to store health data; and a function to provide information on nearby health centers and the name of the attending physician.

Step 7—The User Journey

We created a roadmap visualizing the ideal user-gynecological service app interaction. We used a technique called User's Journey Map[26] to display all potential contact points with health providers during HPV testing, results delivery, and follow-up from the end-user point of view. We identified when the app should be offered and used by women.

We produced scripts of an ideal woman gynecological service interaction on the basis of the KABs mapping (step 1) and Personas (step 5). We debated how counseling by a health provider might be translated into the app's features. As a result, we displayed the ideal user journey of a fictitious woman while using the app (Fig 3).

Step 8—Women's Focus Groups

Nineteen HPV-positive women participated of the online FGs. Women's age was the segmentation criterion: two FGs included women age 30-49 years and two included women age 50 years or older.

FGs included two participatory activities. First, participants were asked to comment on two different Personas and scenarios that presented two different HPV results delivery situations.[26,36] On the basis of the steps 4, 5, and 7, scenarios depicted an encounter between a woman and the health care system for HPV testing, cytology triage, and results delivery. We asked participants the following questions: After receiving the results, how did this woman feel? What did she do next? Did/would she use an app to cope? If yes, what characteristics should the app have to be useful?

A second activity, described elsewhere,[29] was aimed at understanding women's views on an app's model called mock-up. The mock-up consisted of seven screens that included labels of the content, menus of options, and draft illustrations. This allowed us to show women understandable visual triggers to debate the concepts presented on each screen. We asked them about their preferences for app features and screen organization.

The results of FGs indicated that women accepted the app as a tool to obtain information and reduce fears related to HPV-positive results. For them, the app should primarily provide information about HPV and CC, over other functions such as coping strategies that we suggested. The women stressed the importance of the app conveying an empathetic communication style ("as if we were being listened to by an empathetic counselor, with a warm attitude"). They suggested that the app could facilitate connections between women going through a similar process. Finally, women asked for the inclusion of a reminder function of medical appointments and to pick up results.

Step 9—Women's Design Sessions

A DS has a FG format where participants provide feedback regarding app prototypes, contribute to design ideas, and explain their preferences regarding app functions and tasks.[23] We conducted two DS with women who had participated in the interviews and FGs (steps 4 and 8): one DS included women age 30-49 years, and the other included women age 50 years or older.

First, we used a card-sorting technique to understand how participants organize and label concepts[37] and classified topics that fell under information needs. On the basis of women's common doubts or concerns identified in steps 1, 7, and 8, we built cards with different questions about HPV. We showed participants these cards and a list of categories that simulated the labels of the application's menus. Then, women were asked to match each card with a label, ie, with which of the labels they associated the content of the card. Women shared and justified their choices and criteria used in their classification. Finally, the session moderator summarized the group's agreements. The results were used to select the final labels included in the IA. A main finding of this activity was that, to obtain information and resolve doubts, women preferred to use the questions and answers and tests and controls categories.

Second, we used a low-fidelity clickable prototype using a PowerPoint presentation to assess two critical elements: (1) comprehension of the Agenda section (functionality, navigation, and wording) and (2) women acceptability to use a log in username and password to protect confidentiality. We presented an interactive prototype, and we invited women to simulate the setting of a reminder to pick up the HPV test result. When the required fields were completed, the prototype app provided them with information about the next steps. During the process, we used open-ended questions to assess comprehension and preference elicitation.

The results from the prototype assessment showed that women accepted the Agenda features to obtain synchronized information. They also considered that the sequence of the proposed screens was easy to understand and navigate. Additionally, they highlighted the importance of including a feature to store data and/or files related to their gynecological consultations and HPV test results. Some suggested displaying a graph visualizing their progress in treatment (ie, woman's progress along the continuum of care).

Regarding confidentiality issues, women described it as annoying to use a username and password to log in and retrieve clinical information. Nevertheless, they agreed on the importance of preserving their data and acknowledged that they were familiar with this type of log in and passwords functions.

Step 10—Team's Design Sessions

The team DS was aimed at translating results of previous steps into a set of app's screens with detailed features (Fig 4). The project team included five sociologists, two
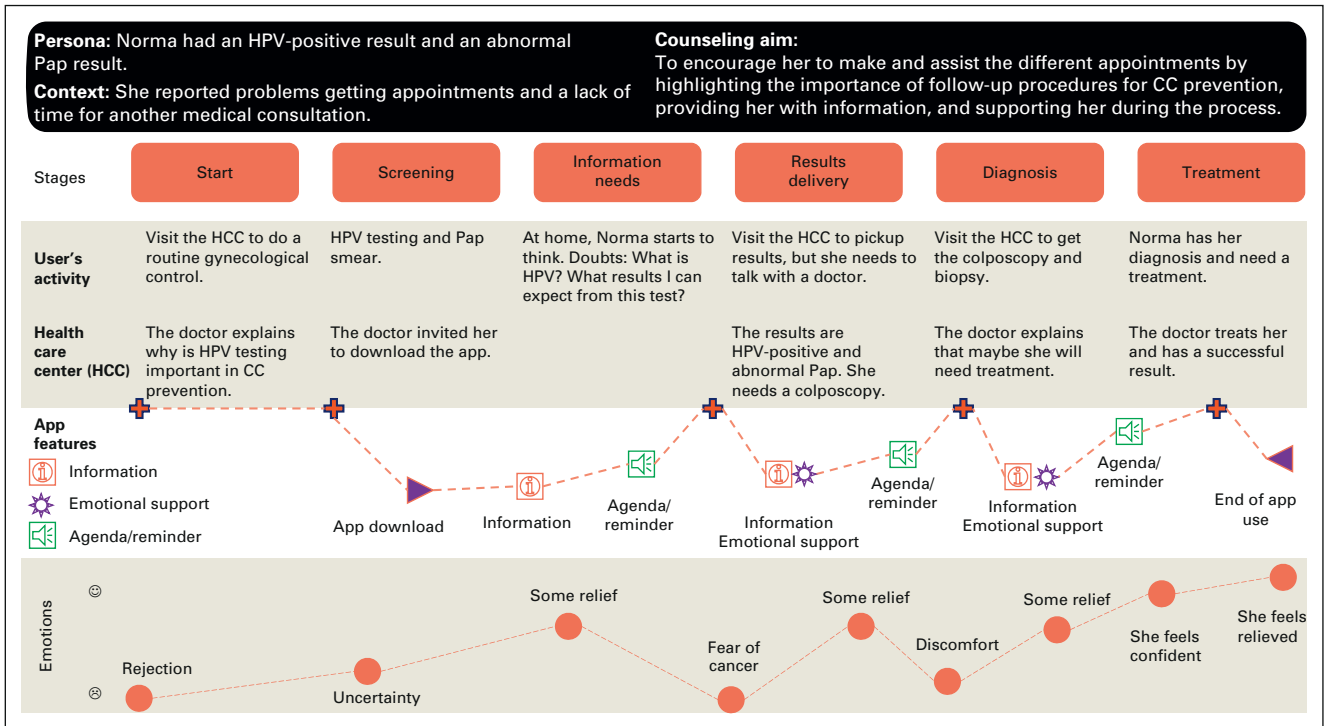
FIG 3. Ideal journey map to HPV-positive and abnormal Pap smear result women. CC, cervical cancer; HPV, human papillomavirus.

psychologists, a user-experience/graphical design expert, a philosopher, and a gynecologist who works in PHC. We used the Crazy 8[38] technique, an exercise suitable for multidisciplinary groups where participants have 8 minutes to sketch the app screens and provide innovative solutions. The main results of this activity were as follows:

The app's main objective should be to provide information on HPV and CC. This objective turned out to be the organizing axis of the design, and it became a prominent element in the different screens. A visual hierarchy of the informational contents was developed by the team. Thus, the main menu (Home Menu) was designed to contain a clickable box with highlights from the HPV Information section that is visually bigger than other buttons.

Women's demand to be heard by an empathic counselor was translated into the app's different design components. Thus, illustrations and wording of the screens emulated an empathic dialogue of a fictitious health professional with the user. We also included a feature where women could type their doubts using keywords to get specific information (feature Search by term and Step-by-step agenda).

Women's demand to connect with other HPV-positive women was translated into a section called Stories and testimonies where they would be able to watch stories on the basis of real stories, narrated in the first person and a feature to share the content of the app with other women.

Final Information Architecture

The final IA (Fig 5) presents the screen sequence and content organized into three sections: Information, Step-by-step Agenda, and Stories and testimonies. The information section will provide medical/scientific information about HPV and CC prevention, explained in clear and accessible language. It is composed of two subcategories: Questions and Answers; and Screening and Follow-up. The Step-by-step Agenda section will provide women with synchronized information regarding medical appointments. Finally, the Stories and testimonies section will include the stories of HPV-positive women regarding HPV and CC in clear language.

DISCUSSION

In this study, we described the 10 steps to produce the IA of an app aimed at providing information, reducing the psychosocial impact of HPV testing, and counseling HPV-tested women. We used a UCD approach that implied identifying the users' needs, design preferences, and the facilitators for uptake and sustained use of the app. For an app aimed at a behavior change intervention, the design needed a balance between the users' preferences and an evidence-based and theory-driven design. We relied in design thinking framework to face this challenge, and we described how we translated it into a coherent IA.

The app design was based on formative research conducted among urban women living in the Metropolitan Area
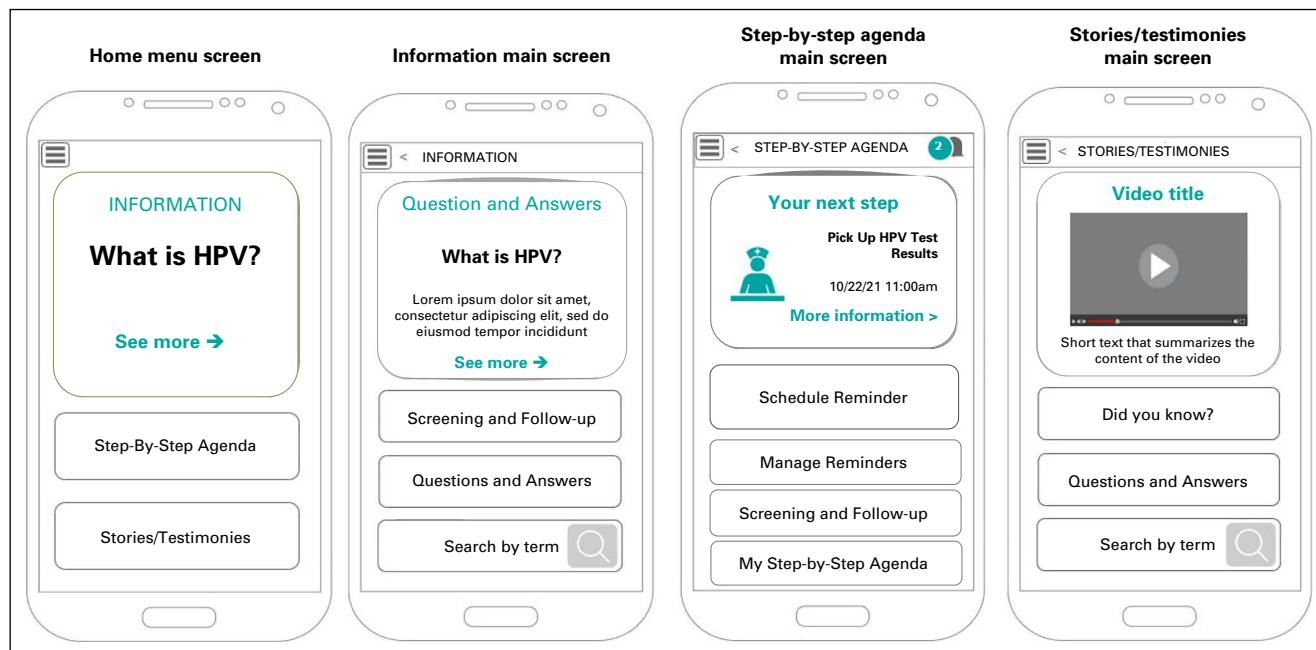
FIG 4. Paper prototypes of main screens. HPV, human papillomavirus.

of Buenos Aires. The results showed that women reported unmet information needs regarding HPV and follow-up steps[29] and that is why for them the app's main objective should be to provide information on HPV, CC, and steps to follow after different HPV test results. This turned out to be the organizing axis of the design, and it became a prominent element in the different screens.[29] Studies carried out in several rural and urban settings from Argentina[7,14,33] and Latin America and among Hispanic women from the United States[39-41] found similar information needs. Therefore, our IA on the basis of the information needs and psychosocial concerns of urban women from Argentina might be also usable in other regional contexts, whether rural or urban. Clearly, some app adaptations will be needed regarding specific aspects highly influenced by the sociocultural and health system environment.[42] Thus, in certain settings, it might be necessary to test the wording to adjust the language to the variations of Spanish within LA or translate it into Portuguese for the Brazilian audience. In addition, diagnosis/treatment algorithms might vary, so specific adaptations will be needed to provide women with information about how to continue the line of care. Thus, the app IA has provided a design map about how content should be organized and navigated, but the specific, locally dependent information that will be included could be adapted to different settings.

mHealth interventions are particularly suited to assist underserved people accessing health services irrespective of time, place, and person.[43] Previous research[44] has shown that mHealth-based interventions can be more effective among rural women as they constitute a powerful tool to connect rural women with the health system. Thus, the app

might be an intervention particularly suitable to increase rural women access to HPV-related information and resources. Some concern exists regarding lower mobile phone use in rural areas,[45] which might hinder use of the app in those settings. At present, around 73% of the Latin American population has a mobile phone,[46] and in Argentina, this figure is 84%.[47] Additionally, the mobile phone penetration rate is rapidly increasing in the region, especially after the COVID-19 pandemics.[46] Therefore, it is possible to hypothesize that even if at earlier stages of the app implementation some rural women might not be reached, on the long-term, as the urban-digital divides closes, the app might be used equally implemented both in rural and urban settings.

Dissemination refers to how evidence-based practices are communicated among potential adopters and implementers to produce uptake and effective use.[48] Our study showed that women would use the app specially if recommended by health professionals and endorsed by health authorities. Thus, we envisaged the app as a tool to be offered by health professionals to women during screening-related consultations, enhancing provider-patient communication. Research has shown that early involvement of implementers in intervention design is a facilitator of its adoption.[49,50] In our study, both potential adopters and decision makers views were included in the IA design phase mainly through its inclusion in the Advisory Committee, where they commented and provided advice on the design process. Very importantly, they were favorable to the app design and implementation and considered that it would fill a gap in the screening process. There was also agreement in visualizing the implementation of the app as potentially integrated into the set of strategies included in municipal/
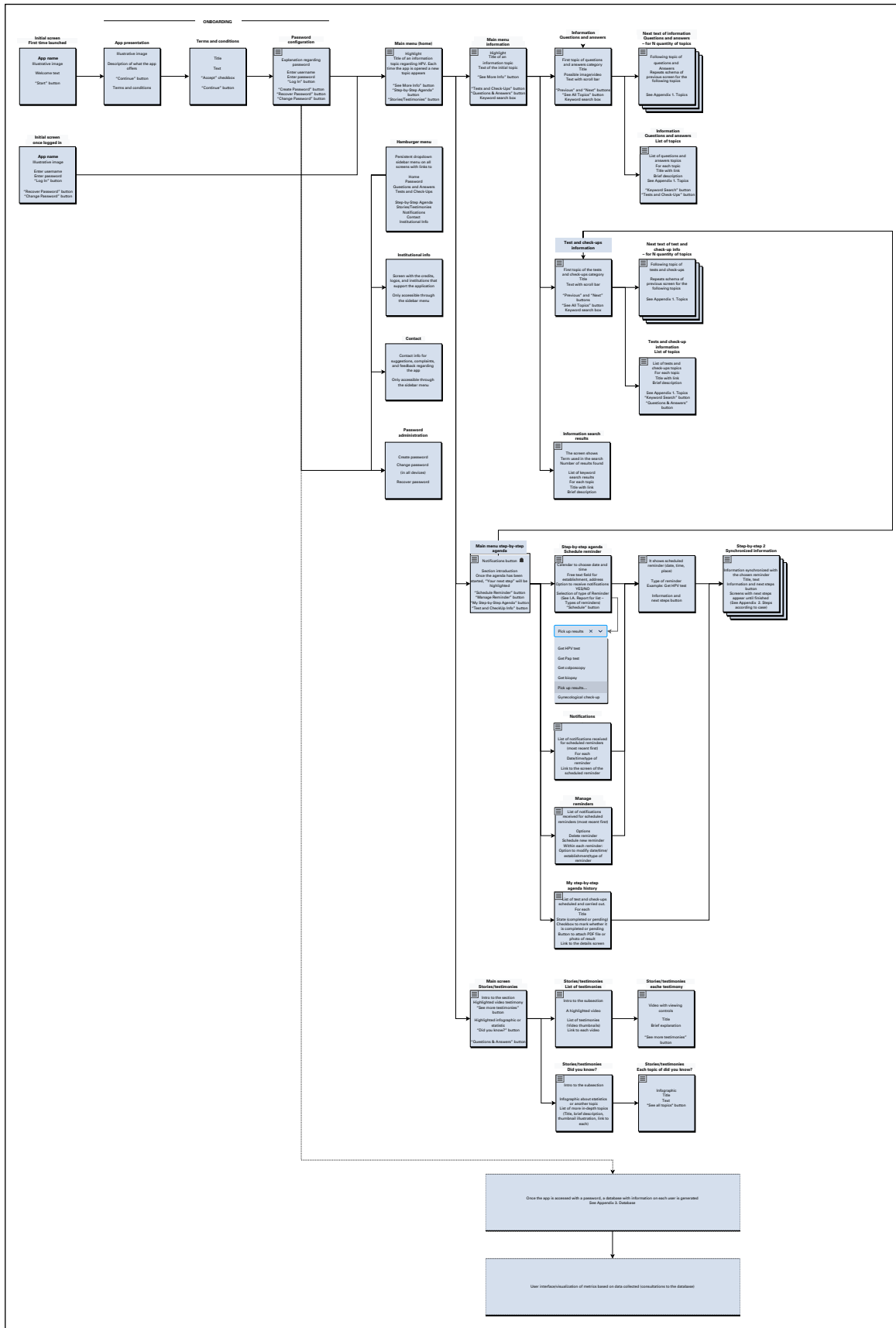
FIG 5. Information architecture (screens and features) map.

provincial/national screening policies. In addition, we are at present carrying out formative research to incorporate health professionals' views about obstacles and facilitators of the app implementation/dissemination. This will allow design of strategies to address contextual barriers and guarantee successful adoption of an app-based intervention.[51,52]

A main barrier to incorporating an app as part of health services provision is a potential low rate of app download/ use. To reduce this problem, we used a UCD approach, as it allows considering needs of users, app design preferences, and barriers and facilitators that prohibit or encourage app uptake and sustained use.[27] Increasing the app download/ use can also be achieved through appropriate implementation strategies. In a study that found that an app-based intervention was effective to increase mammograms among Korean American immigrant women,[53] study staff downloaded the app into women's mobile phones during the enrollment consultation. The results of that study underscore the importance of developing the app as a tool that should be offered and downloaded during the screening consultation with support by health providers.

Translation of our results into an effective app that is part of a programmatic strategy to prevent CC implies an evaluation of its implementation at different levels. In addition, developing app features and multimedia content involves an iterative process between researchers and potential users to reflect their needs in the app design.[54] Thus, the evaluation phase will start with usability and quality testing of the app prototype by potential adopters and end-users.[55] This will include women assessment of the app's content comprehension and interaction experience, with the aim of obtaining a product to be validated in real-life contexts and with larger numbers of women. Finally, evaluation of the strategy will be key to determine if the app implementation is effective to increase women knowledge about HPV testing and decrease the psychosocial impact of HPV positivity. On the basis of Implementation Science frameworks, the evaluation will use quantitative and qualitative methods to assess the app effectiveness, acceptability and adoption, and identify and understand barriers and facilitators of its implementation.

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AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST
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