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ABSTRACT

In Burkina Faso, malaria remains a major issue despite the use of insecticide-treated nets (ITNs), especially in underserved communities. A study assessed a mobile phone-based Interactive Voice Response (IVR) service in local languages to improve malaria health literacy. A randomized trial compared users of the local language version with those using a French version. The results showed a 30.33% increase in knowledge, 21.77% in attitude, and 35.38% in practice among the local language group, while the French group had lower improvements. Key factors for adoption included usability, privacy, trust, and compatibility. Participants preferred local language and voice interfaces, with younger users favoring games and older ones preferring text-based interfaces. This study highlights the potential of local language IVR to effectively boost malaria health literacy and combat misinformation in underserved areas.

1. Introduction

Annually, around 200 million malaria cases lead to nearly 500,000 deaths globally, with over 90% of fatalities occurring in Sub-Saharan Africa, where children under 5 are disproportionately affected, highlighting the region's critical healthcare challenges compounded by a severe shortage of healthcare workers (Stonely, 2023). Burkina Faso has one of the highest malaria burdens in sub-Saharan Africa, despite the mass deployment of insecticide-treated nets (ITNs) and the use of seasonal malaria chemoprevention (SMC) in children aged up to 5 years (Yaro et al., 2022). Unfortunately, the high mortality rate occurs in underserved areas with limited health resources and facilities (Quansah et al., 2016). The Internal Displacement Monitoring Centre (IDMC) estimated that violent conflicts and natural disasters resulted in over 59 million people of internally displaced persons (IDP) fleeing their homes in 2021 (Internal Displacement Monitoring Centre (IDMC), 2022) and Burkina Faso accounts for more than 1,580,000 internally displaced people (Internal Displacement Monitoring Centre (IDMC), 2022). These mobile populations, fleeing their homes due to violent conflicts, are difficult to reach and often lack stable health infrastructure. As a result, disease prevention, diagnosis, and treatment efforts may be compromised.

Often living in crowded camps, these Disadvantaged populations have limited access to quality shelter, sanitation, clean water, stable food supply, and healthcare (Barega Birganie, 2010). Under these conditions, malaria prevention and treatment efforts are challenging and malaria transmission increases (Charchuk et al., 2016; Spencer et al., 2004). Furthermore, few medical facilities are available to diagnose and treat individuals living in IDP camps. Disease morbidity in camps and settlements can be greatly reduced if appropriate preventive and treatment measures are implemented promptly (Kirkby et al., 2013). Health education is an effective strategy for disease prevention, especially chronic and communicable diseases (Gautam et al., 2015; Khan et al., 2012). Some knowledge, attitude, and practice (KAP) studies related to malaria have been conducted (Adedotun et al., 2010; Dejazmach et al., 2021; Hlongwana et al., 2009), with most of them finding that almost all target populations at risk for malaria have low levels of participation in prevention activities (Gautam et al., 2015; Hlongwana et al., 2009; Selent et al., 2012). To bridge the knowledge gap, researchers proposed the development of specific educational tools to reduce malaria infection rates (M. Zhang et al., 2011). Regarding the relationship between knowledge and attitude, where behavior change is not always direct and positive, health literacy has emerged as a distinct area of research with the potential to explain such complex relationships (Pleasant & Kuruvilla, 2008).

Health literacy is an achieved level of knowledge or understanding that depends on the skills of the individual and the resources provided by the healthcare system (Baker, 2006). Education is known to be an effective strategy for changing health literacy as well as for changing behavioral risk factors and reducing adverse conditions and their associated diseases (Geboers et al., 2015; Taggart et al., 2012). Although information and communication technologies (ICTs) such as cell phones, particularly text messaging, can be an effective tool for malaria control (Mohammed et al., 2019), the effectiveness and acceptability of multilingual mobile phone-based interactive voice response (IVR) services among IDPs and their preferences have yet to be determined. This study contributes to the existing body of knowledge by focusing on a critical but under-studied aspect of malaria control: the effectiveness and acceptability of multilingual mobile phone-based IVR services specifically tailored for IDPs in Burkina Faso. While previous studies have examined various malaria prevention and control strategies (Grijalva-Eternod et al., 2023; Omam et al., 2021), few have addressed the specific challenges faced by IDPs regarding disease management. This study aims to fill this gap by exploring the potential of IVR services to target health education and intervention among these vulnerable populations, ultimately contributing to the reduction of malaria transmission. By examining these concepts and their complex interrelationships, the study offers insights into the design and implementation of context-sensitive interventions that can alleviate the burden of malaria in underserved and displaced communities.

1.1. Research question

In this study, our objective is to evaluate the effectiveness and acceptability of a mobile phone-based IVR service designed in local languages for IDPs in Burkina Faso, with French as the comparative language. The following research questions guide this investigation:

1. How does the introduction of the IVR service in local languages impact malaria health literacy and prevention practices among underserved communities in Burkina Faso?
2. What are the key factors that influence the adoption and effectiveness of the IVR service based on local languages among IDPs in Burkina Faso?

These questions form the basis of our inquiry into the impact and feasibility of leveraging mobile technology to address health disparities and promote disease management in vulnerable populations.

1.2. Aim of the study

The main objective of this study is to assess the effectiveness and acceptability of the 3-2-1 IVR Service, based on local languages, developed by Viamo as a platform for improving health literacy and promoting effective disease management among IDPs in Burkina Faso. As part of a comprehensive initiative to develop inclusive digital solutions for underserved communities in sub-Saharan Africa, this study aims to shed light on the unique utility of the 3-2-1 service in addressing urgent health challenges for marginalized populations.

In addition, the study aims to explore the specific features of the 3-2-1 service that accommodate local language preferences and provide free access to health-related formation via easily accessible mobile devices, particularly mobile phones. By focusing on the technological dimensions of the 3-2-1 service, the research aims to shed light on the critical role of mobile-based interventions in promoting equitable access to essential health services and information in disadvantaged communities, thereby contributing to the overall goal of reducing health inequalities in Burkina Faso.

1.3. Theoretical basis and contributions of the study

This research is rooted in the dynamic theoretical framework of Information and Communication Technologies for Development (ICT4D), which emphasizes the central role of technology in addressing complex socio-economic challenges and promoting holistic development of marginalized populations (Assar et al., 2010; Mamba & Isabirye, 2015; Smith et al., 1989). Based on these frameworks, the study seeks to explore the transformative potential of the 3-2-1 IVR service in improving health literacy and disease management among IDPs in Burkina Faso.

Building on the rich discourse on digital literacy and its impact on healthcare access and outcomes, the research aims to contribute to the growing body of knowledge by exploring the intricate relationship between technological interventions, health education and behavior change in the context of malaria prevention and control (Huerta & Sandoval-Almazán, 2007; Negash et al., 2018; Rana et al., 2020). By expanding the theoretical implications of the study, the aim is to underscore the critical role of technology in bridging the healthcare gap and promoting equitable access to essential health services for vulnerable populations in resource-limited settings. In addition, the study fits into a broader discussion on the socio-economic impact of technological advances, particularly in the context of health information systems and their impact on community well-being and sustainable development (Jacucci et al., 2006; Qureshi, 2021). By exploring the nuances of technology adoption and acceptance among IDPs, the research aims to provide nuanced insights into the design and implementation of tailored health interventions that can effectively address the unique health challenges faced by marginalized communities in Burkina Faso.

1.4. Related works

The role of perceived e-health literacy in the continued use of mobile health apps has been highlighted in recent empirical studies (X. Zhang et al., 2018). These studies emphasize the importance of digital literacy in the health context and suggest that it plays a critical role in addressing various health challenges, particularly among older populations (Q. Zhang et al., 2022). Similarly, research on the challenges faced by telecentre users in Mexico has highlighted the critical role of digital literacy in ensuring equitable access to key health information (Huerta & Sandoval-Almazán, 2007). These findings are consistent with the broader discourse on the importance of health information technology for development and highlight its potential to transform healthcare access and delivery, particularly in underserved communities (Negash et al., 2018). The COVID-19 pandemic has further underscored the need for robust digital interventions that address systemic inequities in access to

health care, particularly in marginalized communities (Qureshi, 2021). Studies looking at the diffusion of global knowledge and technology adoption in different contexts such as Nepal have shed light on the complex interplay between technological advances and local socio-economic realities (Gregson & Upadhaya, 2000). Similarly, discussions on the standardization of health information systems in South Africa have highlighted the challenges and op- opportunities associated with the local sustainability of information technology (Jacucci et al., 2006). With the increasing penetration of smart-phones in sub-Saharan Africa, where usage rates are projected to be high, the importance of mobile health (mHealth) solutions has increased significantly (GSMA, 2020). IVR systems have emerged as a widely used form of mHealth technology that is particularly effective among people with lower levels of education (Mj et al., 2022). Previous research has demonstrated the effectiveness of IVR systems in educating and engaging users with limited literacy skills, particularly during public health crises such as the Ebola epidemic and the COVID-19 pandemic (Winters et al., 2021; Wolfe et al., 2015). Despite the potential of IVR systems to improve health literacy, there are still research gaps regarding the perception and acceptance of such systems by their actual users. This study seeks to fill this gap by examining the impact of the '3-2-1 IVR Service' on the health literacy of IDPs in Burkina Faso. The study aims to analyse the factors influencing the adoption of the different language versions of the service and to explore the technological preferences and requirements of IDPs in the development of health information technology.

2. The 3-2-1 service: the Viamo platform

The 3-2-1 Service is a mobile service developed by a social enterprise called VIAMO (Sandwidi, 2020). In early 2022, the 3-2-1 Service concept offered its services in 20 countries to more than 130 million mobile subscribers. The 3-2-1 Service is an IVR system that allows users to interact with a company's host system using a telephone keypad and a toll-free number (3, 2, and 1). It is an automated mobile hotline service that provides information in six languages on a wide range of development topics (e.g. health, agriculture). The 3-2-1 Service includes French, the official language of Burkina Faso, as well as Moré, Dioula, Goulmacema, Fulfulde, and Marka, among the over 60 local languages spoken in the country (Yameogo, 2020). The system is designed to allow callers sufficient time to make their selections and provides the option to repeat instructions if needed. Menu navigation instructions are included to improve user interaction. Furthermore, the IVR 3-2-1 service incorporates serious games such as SwaziYolo in Swaziland and Tumaini in Kenya, which blend entertainment with educational content focused on HIV prevention and malaria (Lukhele et al., 2016; Winskell et al., 2018). Users can engage with these games and a variety of pre-recorded audio scenarios by dialing toll-free 3-2-1 numbers. Available in local languages, these interactive experiences enable users to actively participate by inputting responses through their phone keypads, thereby enhancing their comprehension of critical health issues. As shown in Figure 1, the initial interactions are as follows. When the user presses the toll-free numbers 3, 2, and 1, they are welcomed with the message,' Welcome to the 3-2-1 IVR Service! To continue with the Moré language press 1, for the Dioula language press 2, for the Goulmacema language press 3, for the Fulfulde language press 4, for the Marka language press 5, and for the French language press 6, and to exit press *.' The service is largely operated in partnership with Orange Burkina Faso. In 2021, it received more than 4.5 million calls from 350,000 subscribers who listened to 7.2 million key messages.

3. Methods

3.1. Study design and sample

An experimental study was conducted to evaluate the effectiveness of a multilingual mobile IVR service in health education, to enhance malaria health literacy among IDPs in the Pazani Camp in
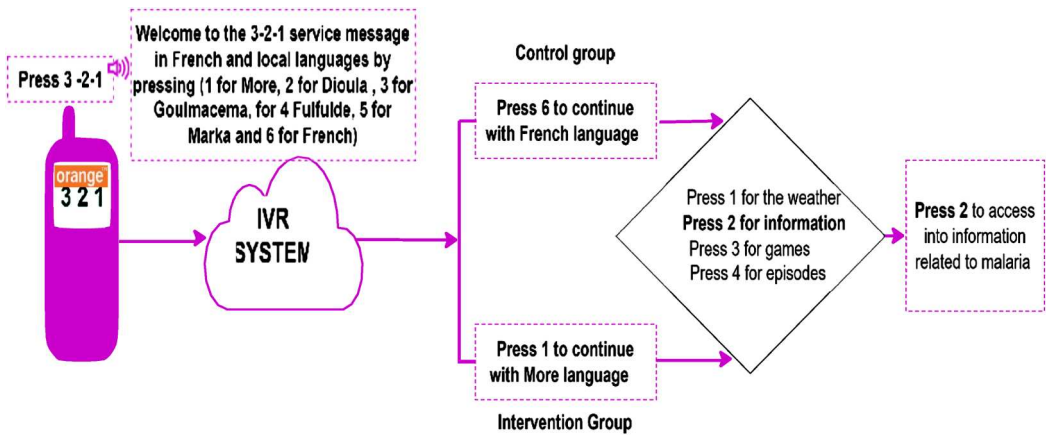
Figure 1. 3-2-1 IVR Service usability procedure in the study.

Burkina Faso. IDPs were chosen for this study due to their frequent encounters with distinct challenges, such as limited access to healthcare services and information (Sambo, 2017). Focusing on this demographic allows the study to assess how efficiently the phone-based Interactive Voice Response (IVR) system addresses the specific needs and obstacles faced by IDPs. The Pazani Internal Displaced Camp, located in an unplanned area of Arrondissement 9, approximately 15 km from Ouagadougou, Burkina Faso, accommodates a significant number of internally displaced persons who have fled due to insecurity. Ninety-seven (97) IDPs from the Pazani Camp were randomly selected. Out of the total participants, 48 were assigned to Group 2 (intervention, utilizing the Moré language version of the 3-2-1 Service), while the remaining 49 were designated as Group 1 (control, utilizing the French language version of the 3-2-1 service). Given that Pazani Camp is located near Ouagadougou, where Moré is the most spoken local language, the Moré language version of the 3-2-1 Service was chosen to better cater to the linguistic preferences of the IDP population. The inclusion criteria for both groups were as follows:

- being a displaced person from Pazani Camp.
- willing to participate in the study; and
- having a feature phone with an Orange Burkina SIM card.

Those who were not displaced persons from the Pazani Camp, who could not participate for the entire study period of two weeks, who refused to participate or were unwilling to use the 3-2-1 Service were excluded.

Health literacy questionnaires were administered twice, before and after the education intervention. The malaria health literacy levels were evaluated before the intervention in a random sample in both the intervention group and the control group. Before the intervention, participants were briefed on how to use the 3-2-1 Service as shown in Figure 1. Each participant was also given a leaflet describing how the 3-2-1 Service was used. After this process, participants from each group were invited to call the 3-2-1 Service to learn about malaria-related health information. The intervention group participants were invited to use the Moré local language version of the 3-2-1 Service and the control group participants to use the French language version of the 3-2-1 Service. After two weeks of intervention, the malaria health literacy level was re-evaluated with the same assessment tool in both intervention and control groups. Thereafter, the acceptance questionnaire was administered to participants to identify significant factors that may influence the adoption of the 3-2-1 Service. Finally, participants were asked to state their technology

preferences and requirements for using mobile health for health information access. The study flowchart is shown in Figure 2.

3.2. Justification of methods used for this study

The choice of a randomized controlled trial (RCT) as the research method in this study offers several advantages in exploring the proposed research question and in improving our understanding of IT for development in the context of improving malaria health literacy among IDPs in Burkina Faso.

First, the RCT design allows for a rigorous evaluation of the effectiveness of the multilingual IVR service on malaria health literacy in different language groups within the IDP population. By comparing the intervention and control groups, the study can draw meaningful conclusions about the impact of the technology-based intervention on health literacy levels. This approach facilitates the identification of specific language- based nuances and preferences and contributes to a deeper understanding of how language influences the uptake and use of IT for development in underserved regions.

Second, the use of validated questionnaires and standardized measurement tools ensures the reliability and validity of the data collected. By using established instruments, the study can provide comprehensive insights into participants' level of health literacy, technology acceptance and preferences, offering a holistic view of the factors influencing IVR service adoption. In addition, the inclusion of various demographic data such as age, gender, education level and income level allow for the exploration of potential differences in technology acceptance based on socioeconomic and educational background. This approach helps identify disparities or inequalities in access to and use of technology, contributing to a better understanding of the challenges and requirements for inclusive IT for development initiatives.

Overall, the research methodology adopted in this study allows for a comprehensive investigation of the effectiveness of the IVR service in improving malaria health literacy among IDPs in Burkina Faso. It contributes to the broader knowledge base in IT for development by highlighting the importance of language, technology acceptance and demographic factors in the adoption and impact of IT interventions in underserved communities.

3.3. Data collection

3.3.1. Demographic data
General demographic data were collected, which included age, gender, education level and income level. Three (3) questionnaires were used to collect these data: the malaria health literacy questionnaire, the technology acceptance questionnaire, and the technology preferences questionnaire.

3.3.2. Malaria health literacy measurement instruments
The questionnaire was adapted from previous studies (Flatie & Munshea, 2021; Hlongwana et al., 2009; Mekowa & Larissa, 2021; M. Zhang et al., 2011). The Delphi method, onsite-pilot testing and validation processes (Rowlands et al., 2013) were used to develop and evaluate the reliability and validity of the questionnaire. The questionnaire was first developed in French, translated into the local language (Moré), and then translated back to French to check the consistency and phrasing of difficult concepts. There were three aspects and 15 questions addressing malaria health literacy (Table 1). The questionnaire comprised the following content: Knowledge related to the causes, transmission, and symptoms of malaria (9 questions); Attitude towards the prevention and treatment of malaria (3 questions) and Practice toward malaria diagnostics, treatment and prevention. Participants had to answer 'Yes' 'No', or 'Don't Know.' The malaria literacy scores of the participants were determined as follows (Flatie & Munshea, 2021): A correct response to each question was given a score of 1 while a wrong or unsure response was scored as 0. A score between 80% and 100% of
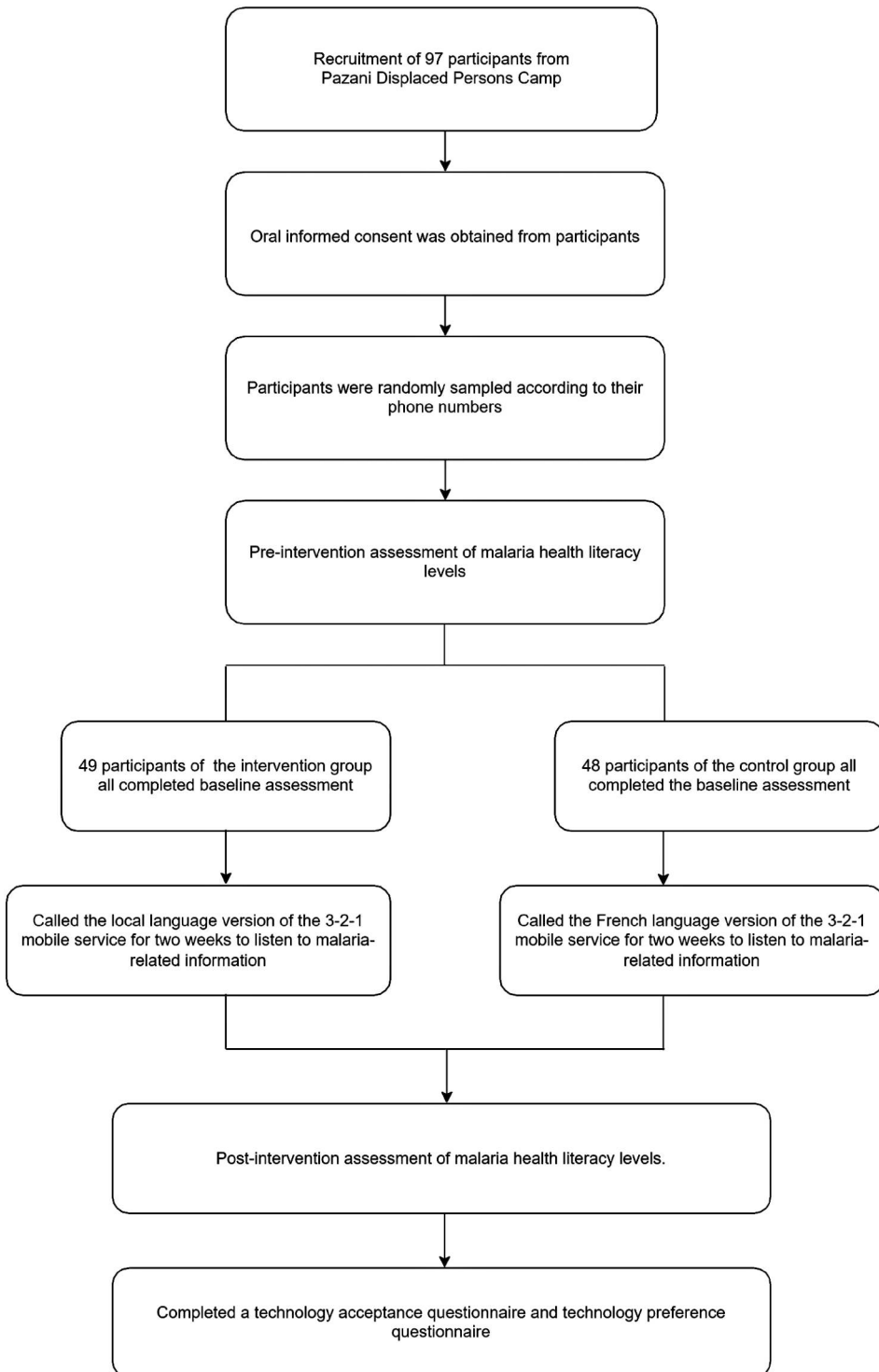
Figure 2. Study protocol flowchart.

Table 1. Content of the malaria health literacy questionnaire KAP.

Constructs	Questions
Knowledge (K)	(1) Malaria causes serious health consequences
	(2) Cause of malaria: Diet
	(3) Cause of malaria: Sun
	(4) Cause of malaria: Dirty environment
	(5) Cause of malaria: Lack of personal hygiene
	(6) Transmission of malaria: Female mosquito bites
	(7) Transmission of malaria: Bad spell or spirit, supernatural or mystical cause
	(8) Transmission of malaria: Work Fatigue
	(9) Signs or symptoms of malaria: fever, headache, diarrhoea
Attitude (A)	(10) To prevent malaria, sleep under a mosquito net
	(11) Pregnant women should wait 2 days before visiting the hospital
	(12) Only severe cases of malaria should be treated in a hospital
Practice (P)	(13) Treatment of malaria is free for children under 5 in Burkina Faso
	(14) Malaria prevention activities are only carried out during the rainy season
	(15) The best practice for malaria diagnosis and treatment is self-medication

correct responses was regarded as a good malaria literacy level; a score between 60% and 79% as a satisfactory level; and a score less than 60% was considered a poor level (Flatie & Munshea, 2021).

3.3.3. Participant's technology acceptance measurement

The questionnaire was adapted from Oyibo et al.'s (2021) prior study, which was based on the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003). Table 2 shows the various constructs we measured and their items. Apart from Perceived Ease of Use which has 2 constructs and the target constructs (intention to use) with 1 construct, other constructs are composed of 3 items. Their scales range from 'Strongly Disagree (1)' to 'Strongly Agree (5).' The definition of each item is presented in Table 3.

Table 2. Measurement items for the extended UTAUT constructs.

Constructs	Items
Perceived usefulness (Venkatesh et al., 2017)	1. Using the 3-2-1 Service improves my performance in seeking healthcare information. 2. Using the 3-2-1 Service makes it easy for me to seek healthcare information. 3. I find the 3-2-1 Service useful in seeking the healthcare information I need.
Perceived ease of use (Venkatesh et al., 2012)	1. Learning to use the 3-2-1 Service is easy for me. 2. I found it easy to use the 3-2-1 Service.
Privacy concern	1. Using the 3-2-1 Service to seek healthcare information is secure. 2. Using the 3-2-1 Service to consult does not disclose my private information. 3. Government laws, regulations, and legislations are important to guarantee the security and privacy of the 3-2-1 Service.
Perceived Trust (Venkatesh et al., 2017)	1. I overall trust the services that are provided via the 3-2-1 Service. 2. I expect that the 3-2-1 Service to seek healthcare information is available for use without interruption of service. 3. The level of service in adverse or hostile conditions (e.g. natural disasters, rural areas, and refugee camps).
Perceived enjoyment (Venkatesh et al., 2012)	1. Using a 3-2-1 Service is fun. 2. Using the 3-2-1 Service is enjoyable. 3. Using the 3-2-1 Service is entertaining.
Perceived compatibility (Kukuk 2020)	1. I have the necessary knowledge and skills to use the 3-2-1 Service. 2. I have used a system that has a similar feature to the 3-2-1 Service. 3. I am familiar with this type of system.
Intention to use (Trang et al., 2020)	1. I will continue to use the 3-2-1 Service.

Table 3. UTAUT constructs and their definitions Adapted from Oyibo et al. (2021).

Constructs	Definitions
Perceived usefulness	The degree to which users believe that an IVR will accomplish its purpose.
Perceived ease of use	The degree to which users believe that the usage of IVR will be free of effort.
Security and privacy	The concern about the loss of privacy due to the use of IVR and disclosure of user data.
Perceived trust	The belief that an IVR is credible and trustworthy.
Perceived enjoyment	The fun or pleasure users derive from using IVR.
Perceived compatibility	The degree to which an IVR is perceived as being consistent with past user experience.
Intention to use	The plan or intention to use (or continue using) IVR to curb the spread of malaria.

3.3.4. Participants' technology preferences questionnaire

In addition to the measured UTAUT constructs, we asked participants to indicate their language, user interface and type of design preferences in using mobile health for health information services (Table 4).

3.4. Data analysis

We analysed data using IBM SPSS Statistics software (SPSS28) (IBM Corp, 2021). First, simple descriptive statistics were performed on the demographic information. The chi-squared statistic was used to test statistical differences between different demographic groups, with $p < 0.05$ considered statistically significant. Participants' preferences were analysed using a simple descriptive statistic. To determine factors that influence the adoption of the 3-2-1 Service, we calculated the mean and standard deviation of each item combined with linear regression to test the hypotheses in our model shown in Figure 3.

3.4.1. Utility value

In our study, utility refers to the degree to which the user believes that the 3-2-1 Service serves their health information need and/or facilitates access (Ahn & Park, 2022; Famolari et al., 2002; Park, 2020). The first two relationships in the research model relate to utility: Perceived Usefulness (H1) and Perceived Ease of Use (H2). Both relationships are based on earlier findings in the literature. They represent the two most important determinants of technology acceptance in the traditional TAM model (Kukuk 2020; Oyibo & Vassileva, 2020) For example, in the context of health, Van der Heijden (2003) found that Perceived Ease of Use has a positive influence on the intention to use health websites. Moreover, in the contact tracing app domain, Kukuk (2020) found that Perceived Usefulness has a positive relationship with intention to use. Moreover, in a systematic review of the factors that

Table 4. Participant's preference questionnaire.

| Construct	Items
Language preference	In which language do you prefer to use the mobile service for access to health information? 1. I prefer French. 2. I prefer Moré
Interface preference	What type of mobile interface do you prefer to use for the accessibility of health information? 1. I prefer text 2. I prefer Voice 3. I prefer Graphics/images
Type of design	Which types of design content do you prefer? 1. Content with serious games 2. Content without serious games
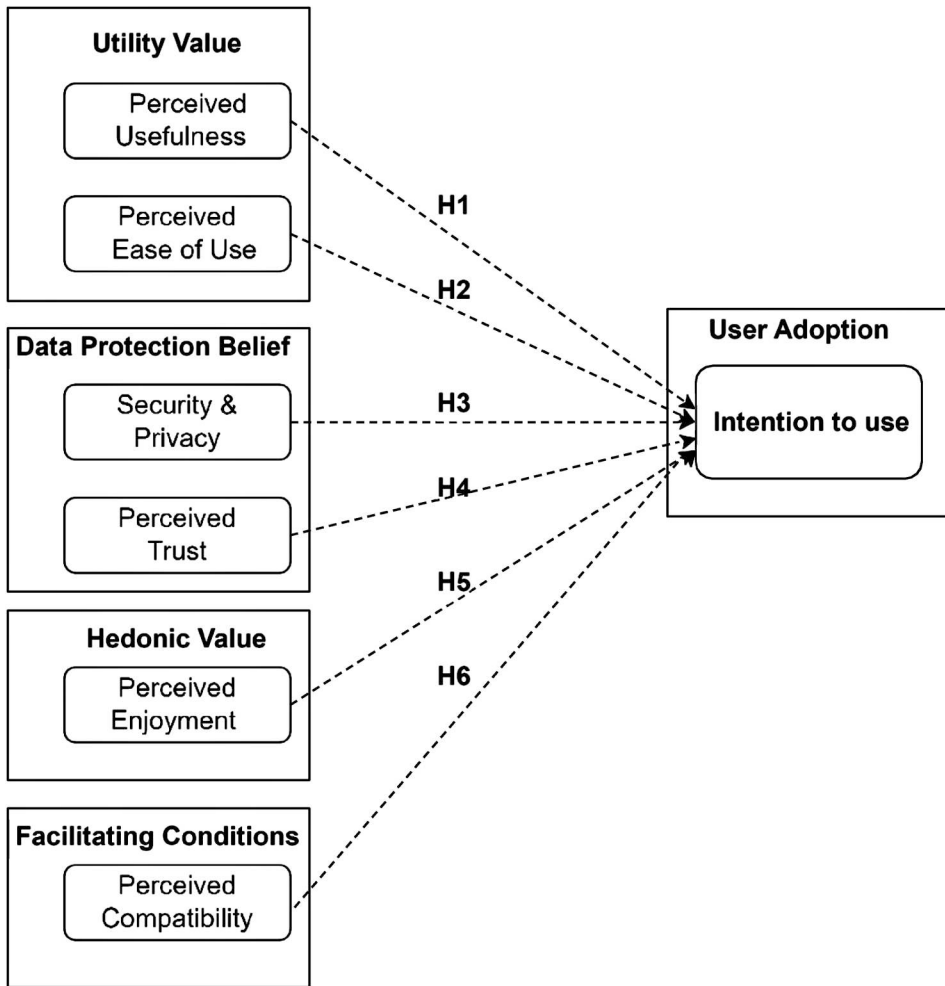
Figure 3. Hypothesized UTAUT model of the adoption of 3-2-1 Service.

influence contact tracing app adoption, Oyibo and Morita (2022) reported many studies that found Perceived Usefulness and Perceived Ease of Use to be significant. Based on these previous findings, we hypothesize the following:

- H1: Perceived Usefulness of the 3-2-1 Service will have a significant influence on the intention to use it.
- H2: Perceived Ease of Use of the 3-2-1 Service will have a significant influence on the intention to use it.

3.4.2. Data protection beliefs

In this study, data protection beliefs entail privacy, security, and trust. Privacy, in the context of eHealth, refers to the individual's right to control the collection, use, or disclosure of their identifiable health information (Avancha et al., 2012; Faqih & Jaradat, 2015). Moreover, security refers to the physical, technological, or administrative safeguards or tools used to protect identifiable health information from unauthorized access or disclosure (Avancha et al., 2012; Faqih & Jaradat, 2015). More importantly, trust refers to the individual's trust in a service and/or operator in terms of

protecting their best interest. The second set of hypotheses addresses users' data protection concerns Security and Privacy concerns (H3) and Perceived Trust (H4). They are based on previous findings in the literature (Oyibo et al., 2022). For example, in a study of contact tracing app adoption, Boon-it found that trust in health websites improves the intention to use them for seeking health information (Boon-itt, 2019). Based on these prior findings, we hypothesize the following:

- H3: Security and Privacy Concerns about the 3-2-1 Service will have a significant influence on the intention to use it.
- H4: Perceived Trust in the 3-2-1 Service will have a significant influence on the intention to use it.

3.4.3. Hedonic value

Hedonic value refers to intrinsic motivation such as fun, enjoyment or pleasure derived from using technology. Research shows that it can impact the acceptance and use of technological tools (Alazzam et al., 2015). According to a study conducted by Svendsen and colleagues, the most significant predictor of the intention to use a Mobile System Motivating for Physical Activity was found to be the user's intrinsic motivation (Svendsen et al., 2009). In other words, the extent to which individuals perceive the system as enjoyable and fun to use plays a crucial role in determining their intention to utilize it (Svendsen et al., 2009). Based on these prior findings, we hypothesize the following:

- H5: Perceived Enjoyment of the 3-2-1 Service will have a significant influence on the intention to use it.

3.4.4. Facilitating conditions

Facilitating condition refers to the degree to which an individual believes that an organizational or technical infrastructure exists to support the use of the system (Venkatesh et al., 2003). The fourth set of hypotheses (H6) entails the Perceived Compatibility of the 3-2-1 Service with similar technological tools that the users had used in the past. According to a study conducted by Wu et al., it was found that Perceived Compatibility directly influences the behavioral intention to use mobile healthcare systems (Wu et al., 2007). In other words, if individuals perceive that a mobile healthcare system is compatible with their needs, preferences, and existing technologies, they are more likely to have the intention to use it. Based on this prior finding, for H6, we hypothesize as follows:

- H6: Perceived Compatibility of the 3-2-1 Service will have a significant influence on the intention to use it.

3.5. Ethical considerations

The study protocol was ethically approved by the Nazi Boni University Doctoral School Ethics Committee in September 2021 and adhered to the principles outlined in the Declaration of Helsinki. Verbal consent was obtained from each participant before the interview. Participants' names were not recorded; identification numbers were used instead. All information was kept confidential and was only available to those directly involved in this study. Each participant received a meal valued at $5.

4. Results

4.1. Participants' general information

A total of 97 displaced persons participated in the present study. Of these, 79 (81.4%) were women and 18 (18.6%) were men. The age of 30 participants (30.9%) ranged be- between 18 and 24 years

old, and 47 participants (48.5%) were between 25 and 50 years old. Moreover, 14 participants (14.4%) were over 50 years old, and 6 participants (6.2%) were less than 18 years old. Most of the participants (65, 67.0%) were uneducated; 32 (33%) had primary school or high school levels. Regarding socio-economic status, 87 participants (89.7%) had a monthly income below the poverty line, i.e. US$ 2.15 per day (40 000 CFA), equaling less than US$ 66.65 per month. Only 10 participants (10.3%) had a monthly income above the poverty line. Regarding demographic characteristics, there were no significant differences between the health education intervention group (users of the Moré language version of the 3-2-1 Service) and the control group (users of the French language version of the 3-2-1 Service). As shown in Table 5, p values ($p = 0.110$, $p = 0.456$, $p = 0.210$, $p = 0.957$) were >0.05.

4.2. Effectiveness of using a Moré local language-based mobile IVR as a health education intervention strategy for reducing misinformation among displaced persons in the Pazani camp

At baseline, the score for knowledge about malaria was 52.6% in the intervention group and 51.84% in the control group. The malaria attitude score was 70.74% in the intervention group and 74.3% in the control group. The practice score was lowest at 25.16% in the intervention group and 24.3% in the control group. Although the baseline scores, especially for knowledge and attitude, seem to be high, we found that there is some misinformation or misunderstanding about malaria. The statistics indicate that a significant percentage of participants in both the intervention and control groups attributed the cause of malaria to factors such as nutrition (81.63% intervention, 72.91% control), sun exposure (71.42% intervention, 75% control), and believed in the transmission of malaria through evil magic spirits, supernatural, or mystical causes (91.83% intervention, 89.58% control), as well as associating work fatigue with malaria transmission (69.38% intervention, 70.83% control).

After utilizing the 3-2-1 Service, participants in both the intervention group (using the Moré local language) and the control group (using the French language) showed improved malaria health literacy, as indicated in Table 6 and Figure 4. However, the intervention group experienced a significantly greater improvement in knowledge, attitude, practice, and overall malaria health literacy compared to the control group, with a statistically significant difference ($p < 0.01$). Following the intervention, the accuracy scores for knowledge and attitude aspects of health literacy surpassed 60%, while the practice aspect scored 38.88%. The intervention group, particularly those using the local language version,

Table 5. Sociodemographic characteristics of displaced women in Pazani camp in Burkina Faso: intervention group (Users of the Mor´e language version of 3-2-1 IVR Service) versus the control group (users of the French language version of 3-2-1 IVR Service).

Contents	Group	Baseline total (N = 97) n (%)	Control group (N = 48) n (%)	Intervention group (N = 49) n (%)	χ^2	P
Gender					22.556	0.110
	Female	79 (81.4)	39 (81.3)	40 (81.6)		
	Male	18 (18.6)	9 (18.8)	9 (18.4)		
Age (years)					8.796	0.456
	>18	6 (6.2)	3 (6.3)	3 (6.1)		
	18–24	30 (30.9)	23 (31.3)	15 (30.6)		
	25–50	47 (48.5)	7 (47.9)	24 (49.0)		
	50+	14 (14.4)	7 (14.6)	7 (14.3)		
Education					5.860	0.210
	Uneducated	65 (67.0)	32 (66.7)	33 (67.3)		
	Primary school	16 (16.5)	8 (16.7)	8 (16.3)		
	High school	16 (16.5)	8 (16.7)	8 (16.3)		
Income					0.649	0.957
	>40,000 CFA	87 (89.7)	43 (89.6)	44 (89.8)		
	40,000–100,000 CFA	4 (4.1)	2 (4.2)	2 (4.1)		
	<100,000 CFA	6 (6.2)	3 (6.3)	3 (6.1)		

demonstrated the highest improvements in accuracy, with 30.38% in knowledge, 21.77% in attitude, and 35.38% in practice. In contrast, the improvements for users of the French version were 15.98% in knowledge, 14. 58% in attitude, and 14.5% in practice. Figure 4 compares the changes in malaria health literacy hit rate between the intervention and control groups.

As shown in Figure 4, there were improvements in all three aspects of malaria health literacy (KAP) in both the intervention (Moré local language) group and control (French language) group after using the 3-2-1 Service. However, the Moré language version users showed a greater improvement than the French language version users. The local language group made 30.33%, 21.77%, and 35.38% improvement regarding Knowledge, Attitude, and Practice, respectively. The improvements among the French version users (15.98%, 14.58%, and 14.5%, respectively) were relatively lower than those of the local language version users.

4.3. Factors influencing the adoption of 3-2-1 IVR service

4.3.1. Instrument reliability
Reliability analysis was conducted using SPSS 28 to check the internal validity and consistency of the items used in measuring the study constructs. Based on the results in Table 7, Cronbach's alpha score for each construct was equal to or above 0.7, indicating that each construct was reliably measured by their respective items (DeVon et al., 2007).

4.3.2. Verification of the hypotheses
To test the hypotheses, a linear regression analysis (Ratna & Mehra, 2015) was conducted to calculate the unstandardized coefficients β and other metrics such as F- F-statistics, t-statistics, and p-values

Table 6. Comparison of accuracy rate of malaria-related health literacy between the two groups, before and after intervention.

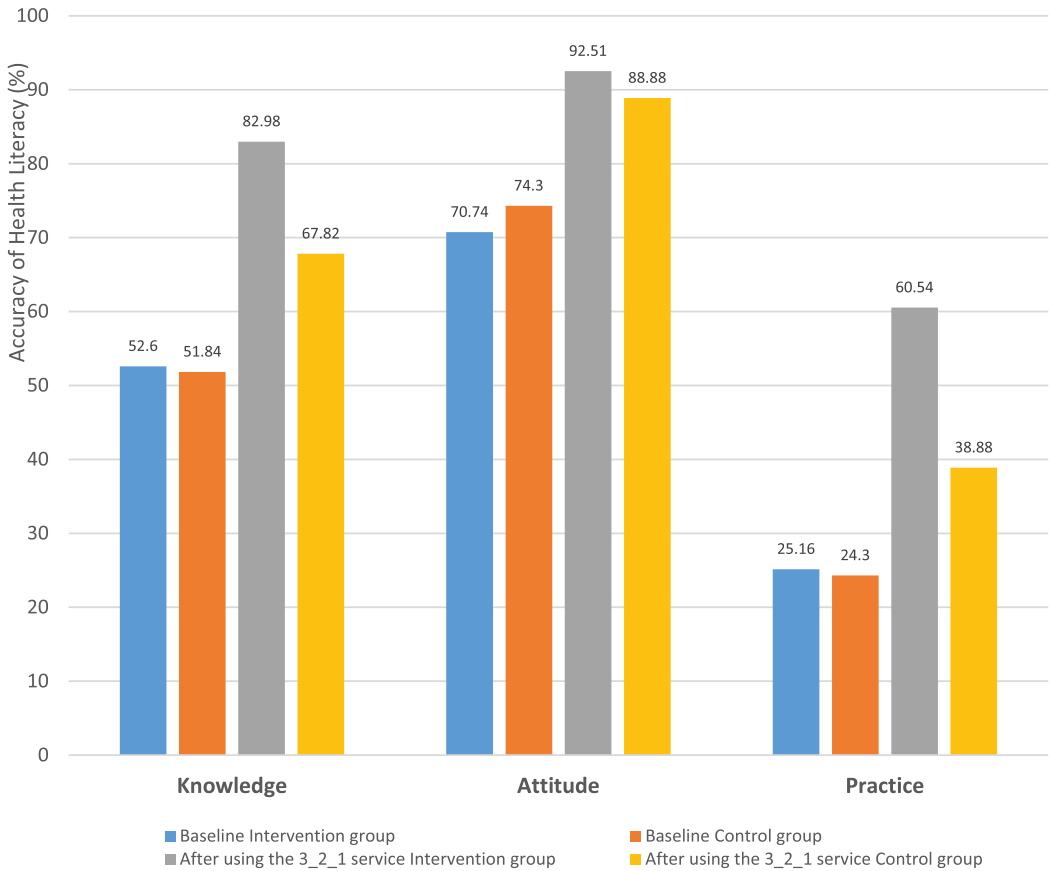| Contents		Before intervention Intervention (N = 49) n (%)	Before intervention Control (N = 48) n (%)	After intervention Intervention (N = 49) n (%)	After intervention Control (N = 48) n (%)
Knowledge					
	Malaria causes serious health consequences	49 (100)	48 (100)	49 (100)	48 (100)
	Cause of malaria: Diet	7 (14.28)	9 (18.75)	25 (51.02)	13 (27.08)
	Cause of malaria: Sun	9 (18.36)	12 (25)	45 (91.83)	24 (50)
	Cause of malaria: Dirty environment	30 (61.22)	29 (60.41)	40 (81.63)	40 (83.33)
	Cause of malaria: Lack of personal hygiene	25 (51.02)	23 (47.91)	47 (95.91)	40 (83.33)
	Transmission of malaria: Female mosquito bites	48 (97.95)	46 (95.83)	48 (97.95)	47 (97.91)
	Transmission of malaria: Bad spell or spirit, supernatural or mystical cause	2 (4.08)	2 (4.16)	1 (2.04)	0 (0)
	Transmission of Malaria: Work Fatigue	15 (30.61)	14 (29.16)	25 (51.02)	19 (39.58)
	Signs or symptoms of malaria: fever, headache, diarrhoea	47 (95.91)	41 (85.41)	48 (97.95)	46 (95.83)
Attitude	To prevent malaria, sleep under a mosquito net	49 (100)	48 (100)	49 (100)	48 (100)
	Pregnant women should wait 2 days before visiting hospital	40 (81.63)	42 (87.5)	47 (95.91)	45 (93.75)
	Only severe cases of malaria should be treated in hospital	15 (30.61)	17 (35.41)	30 (61.22)	35 (72.91)
Practice	Treatment of malaria is free for children under 5 in Burkina Faso	20 (40.81)	18 (37.5)	42 (85.71)	30 (62.5)
	Malaria prevention activities are only carried out during the raining season	7 (14.28)	7 (14.58)	25 (51.02)	14 (29.16)
	The best practice for malaria diagnosis and treatment is self-medication	12 (24.48)	10 (20.83)	22 (44.89)	9 (18.75)

Figure 4. Comparisons of changes in malaria-related health literacy accuracy rate between intervention and control groups.

Table 8. Figure 5 shows the overall model of the intention to use the 3-2-1 Service. The coefficient of determination (R^2 value) indicates how much of the variance of the target construct (intention to use) is explained by the predictor variables (Oyibo & Morita, 2022). The unstandardized coefficient represents the strength of the relationship between a predictor and the target construct.

4.4. Understanding participant's technology preferences and requirements for health information

Table 9 presents participants' technology preferences according to their demographic profiles. Regarding language preference, the study found that a majority of participants favored using the local language for mobile health services. Specifically, 94.94% of female participants and 88.89%

Table 7. Cronbach's alpha reliability.

Construct	Number of items	Cronbach's alpha
Perceived usefulness	3	0.86
Perceived ease of use	2	0.84
Security and privacy	3	0.80
Perceived trust	3	0.78
Perceived enjoyment	3	0.84
Perceived compatibility	3	0.70
Intention to use	1	0.70

Table 8. Verification of the hypothesis.

Hypothesis	Predictor variable	β	Std. Error	F	t	p	Supported
H1	Perceived usefulness	0.404	0.170	2.869	2.381	0.019	Yes
H2	Perceived ease of use	0.575	0.156	11.993	3.691	0.001	Yes
H3	Privacy and security	0.279	0.085	4.014	3.301	0.001	Yes
H4	Perceived trust	0.417	0.137	3.135	3.042	0.003	Yes
H5	Perceived enjoyment	0.357	0.159	2.342	2.241	0.027	Yes
H6	Perceived compatibility	0.191	0.057	5.768	3.346	0.001	Yes

of male participants preferred the local language. Similarly, all participants aged less than 18 years (100%) and those above 50 years (100%) chose the local language. Among the participants with different education levels, 95.38% of the uneducated participants selected the local language. In contrast, only a small percentage of the uneducated participants (4.84%), participants with primary school education (6.67%), and participants with at least high school education (14.29%) chose French. In terms of income, 93.10% of participants earning less than 40,000 West African CFA franc (the poverty line) opted for the local language. In 2014, the national poverty line in Burkina Faso was set at approximately 45,600 West African CFA francs per person per year (World Bank, 2020).

As for the design interface, 64(81.01%) of the female and 14 (77.78%) of the male participants preferred the voice interface. Participants aged less than 18 years, between 18 and 24, between 25 and 50 and more than 50 years respectively 5(83.33%), 24(80%) 38(80.85%) and 11(78.57%) of the participants preferred the local language.54(83.08%) of Uneducated, 13(81.25%) of primary school level and 11(68.75%) of participants having at least High school level preferred the local language. Regarding the type of design, 31(39.24%) preferred a mobile service with a serious game, while 48 (60.76%) preferred games. Men, 8(44.44%) preferred a mobile service with a game and then 10 (55.56%) preferred without a game. Young people aged less than 183(50%) and between 18 and 24 and 19(63.33%) prefer serious games. As for people older than 50, 39(60%) preferred a mobile service which doesn't include serious games.
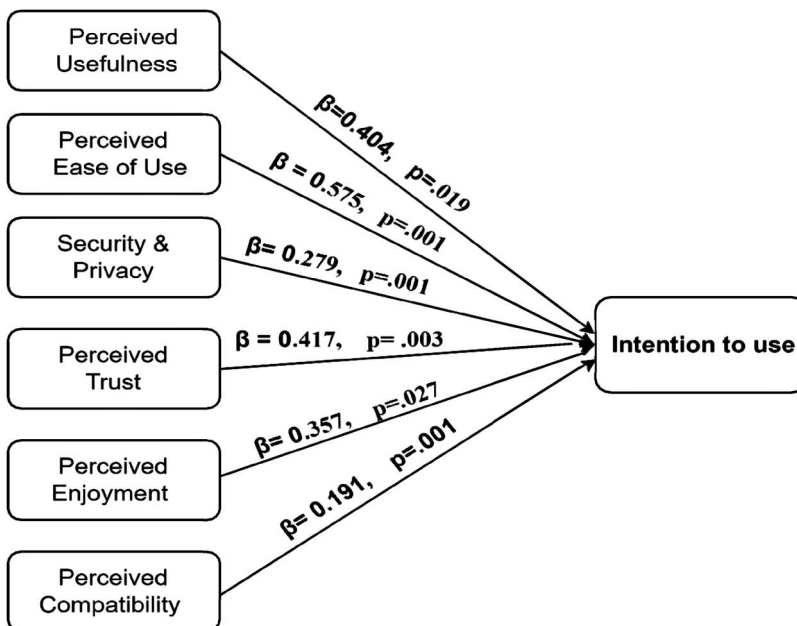

Figure 5. UTAUT overall model of the intention to use the 3-2-1 Service.

Table 9. Participants' technology preferences.

Contents	Group	Language preference French language n (%)	Language preference Moré language n (%)	Interface preference Text-based UI n (%)	Interface preference Voice-based UI n (%)	Interface preference Image-based UI n (%)	Content preference Contents with games n (%)	Content preference Contents without games n (%)	N
Gender	Female	4 (5.33)	75 (94.94)	14 (17.7)	64 (81.01)	1 (1.27)	31 (39.24)	48 (60.76)	79
	Male	2 (12.50)	16 (88.89)	3 (16.67)	14 (77.78)	1 (5.56)	8 (44.44)	10 (55.56)	18
Age (years)	<18	0 (0.00)	6 (100)	1 (16.67)	5 (83.33)	0 (0.00)	3 (50)	3 (50)	6
	18–24	3 (11.11)	27 (90)	6 (20)	24 (80)	0 (0.00)	19 (63.33)	11 (36.67)	30
	25–50	3 (6.82)	44 (93.62)	7 (14.89)	38 (80.85)	2 (4.26)	19 (40.43)	28 (59.57)	47
	50+	0 (0.00)	14 (100)	3 (21.43)	11 (78.57)	0 (0.00)	6 (42.86)	8 (57.14)	14
Education	Uneducated	3 (4.84)	62 (95.38)	10 (15.38)	54 (83.08)	1 (1.54)	26 (40)	39 (60)	65
	Primary school	1 (6.67)	15 (93.75)	3 (18.75)	13 (81.25)	0 (0.00)	6 (37.50)	10 (62.50)	16
	High school education	2 (14.29)	14 (87.50)	4 (25)	11 (68.75)	1 (6.25)	7 (43.75)	9 (56.25)	16
Income	<40,000 CFA	6 (7.41)	81 (93.10)	15 (17.24)	70 (80.46)	2 (2.30)	36 (41.38)	51 (58.62)	87
	40,000–100,000 CFA	0 (0.00)	4 (100)	1 (25)	3 (75)	0 (0.00)	1 (25)	3 (75)	4
	>100,000 CFA	0 (0.00)	6 (100)	1 (16.67)	5 (83.33)	0 (0.00)	2 (33.33)	4 (66.67)	6

5. Discussion

5.1 Malaria health literacy assessment

This study focuses on internally displaced people living in Pazani Camp, Burkina Faso, and aims to assess their malaria health literacy level and evaluate the effectiveness and acceptability of using a multilingual IVR service for health education. IDPs often settle in overcrowded suboptimal living conditions, placing them at a higher risk of infectious diseases, including malaria (Polonsky et al., 2013). Malaria is a major cause of morbidity and mortality in low-income countries, particularly in sub-Saharan regions like Burkina Faso. The lack of access to modern medical care and the barriers of distance and security make it challenging to provide timely assistance to IDPs.

Previous studies have shown that health education strategies can improve KAP-related malaria prevention and reduce morbidity (Amoran, 2013; Ghahremani et al., 2014). However, there is limited research on malaria KAP and prevention strategies specific to IDPs. Health literacy, which assesses individuals' ability to obtain and understand health information, is crucial for making appropriate health decisions (Jacobs et al., 2016). Low health literacy is associated with poor health practices and outcomes (Al Sayah et al., 2013). MHealth strategies, including IVR systems, can be used as educational tools for behavior change, and they have the potential to curb the spread of epidemics and reduce related deaths (O'Donovan & Bersin, 2015). The multilingual IVR service allows IDPs to access and request information on malaria prevention and treatment in their preferred language (Kraft & Androwich, 2012). The study seeks to determine the malaria health literacy level of IDPs and evaluate the effectiveness and acceptability of the multilingual IVR service for health education in Pazani Camp, Burkina Faso. The study found that the overall malaria health literacy among internally displaced persons (IDPs) is low, with less than 50% demonstrating adequate knowledge, attitudes, and practices (KAP). Particularly, the scores for malaria practices were very low, below 35%. These results are similar to other studies on malaria related KAP (Li et al., 2016). Before implementing the 3-2-1 Service, the intervention group had a knowledge score of 52.6%, while the control group had a score of 51.84%. Attitude scores were 70.74% for the intervention group and 74.3% for the control group. Malaria practice scores were the lowest, with only around 25% for both groups. However, there was a high level of knowledge regarding the use of mosquito nets as a prevention measure (97.95% for intervention and 95.83% for control), as well as the link between mosquitoes and malaria/fever (95.91% for intervention and 85.41% for control). This is likely due to the mass distribution of Long-Lasting Insecticidal Nets (LLINs) in Burkina Faso, which helps raise awareness about mosquito nets and the causes of malaria, such as fever (Finlay et al., 2017). This shows that although the baseline scores for knowledge and attitudes were relatively high, there were still some misconceptions or misinformation about malaria among the IDPs. According to the study, a significant proportion of participants held certain beliefs about the causes and transmission of malaria. Approximately 81.63% (40 participants) believed that diet is one of the causes of malaria, while 71.42% (35 participants) attributed it to the sun. Furthermore, 91.83% (45 participants) and 89.58% (43 participants) believed in bad spell spirits, and supernatural, or mystical causes for the transmission of malaria. Additionally, 69.38% (34 participants) believed that work fatigue can transmit malaria. It's important to note that while these beliefs were held by the participants, they do not align with scientific understanding. Malaria is primarily caused by the transmission of the Plasmodium parasite through the bite of infected mosquitoes, and not by factors such as diet, sun exposure, supernatural causes, or work fatigue.

To effectively prevent and manage malaria, it is essential to focus on evidence-based strategies such as mosquito control, the use of bed nets, and appropriate medication. It is also crucial to raise awareness and provide accurate information to address misconceptions surrounding the causes and transmission of malaria. Malaria is caused by five types of Plasmodium parasites through the bites of infected female Anopheles mosquitoes or 'night-biting' mosquitoes as they mostly bite their prey between dusk and dawn. After the use of the 3-2-1 Service, there were improvements in the malaria health literacy of participants in both the intervention (Moré local language)

and control (French language) groups. However, we found that the intervention group showed a greater improvement than the control group. Knowledge-related malaria for the intervention group was 52.6% before the use of the 3-2-1 Service. After the use of the service, it increased to 82.93%, which is a 30.33% improvement. For Attitude, the score was 70.74% before the use of the service. After the use of the service, it rose to 92.51%, which is a 21.77% improvement. For Practice, the initial score was 25.16%. After the use of the service, it increased to 60.54%, which is an improvement of 35.38%. Even though improvements were observed among the control group (users of the French version of the 3-2-1 Service), they were relatively lower. The French version users had respectively for Knowledge from 51.84% to 67.82% (an improvement of 15.98%), Attitude from 74.3% to 88.88% (an improvement of 14.58%) and Practice 24.3% to 38.88% (an improvement of 14.5%).

This study serves as evidence that IVR services in local languages can be an effective tool in implementing health education programs for reducing misinformation and improving the health literacy levels of IDPs. Local language IVR-based service can therefore be considered an important health promotion tool among underserved communities in sub-Saharan Africa. Figure 4 demonstrates the changes in accuracy rates of malaria health literacy scores for the intervention and control groups. The results indicate that users of the local language version of the 3-2-1 IVR Service experienced more significant improvements compared to users of the French version. Specifically, the local language group demonstrated improvements of 30.33%, 21.77%, and 35.38% in malaria Knowledge, Attitude, and prevention Practice, respectively. On the other hand, the users of the French version showed relatively smaller improvements of 15.98%, 14.58%, and 14.5% in knowledge, attitude, and practice, respectively.

5.2. Adoption of 3-2-1 IVR service

We have presented the UTAUT model of the intention to use 3-2-1 Service to uncover the key factors that drive adoption by examining the relationship between predictors (such as Perceived Usefulness and Perceived Ease of Use) and intention to use. Regression analysis results showed that users' intention to use the 3-2-1 Service is mostly determined by the Perceived Ease of Use of the system, which explains 20.3% of the Intention to Use the system. This result is consistent with prior research (Campbell et al., 2017), in which Perceived Ease of Use was found to have a significant impact on the intention to use a mobile service of lowly literate users. A plausible explanation is that participants with more education were more likely to possess advanced digital skills and knowledge (Ali & Qazi, 2022), they are more willing to adopt a technology-driven mobile service for ease of use, as this could facilitate health information access. The finding also aligns with that of (Campbell et al., 2017). The authors found that to foster the intention to use technology among low-literacy end-users in resource-limited settings, a positive perception of the technology's usefulness and ease of use is crucial. Secondly, in line with previous studies, we found a positive correlation between Perceived Compatibility and intention to use the 3-2-1 Service. As shown in Table 8, Perceived Compatibility explained 15.7% of the intention to use the service. This means that using the 3-2-1 Service for health information access was seen to be compatible with the IDPs or similar technologies they knew or used in the past (Klingberg et al., 2020). Thirdly, our results indicate that privacy and security concerns can influence IDP's use of the 3-2-1 Service, with the predictor explaining 11.5% of the intention to use. This finding corroborates prior research that found a significant relationship between confidentiality and mHealth acceptability in resource-limited settings (Chang et al., 2013) and that patients' fears about losing privacy have to be dispelled for their acceptance of any newer technology (Dhagarra et al., 2020). Fourthly, Perceived Trust explained 9.2% of the intention to use Dhagarra et al. in their study suggesting that trust contributes to shaping patients' attitudes towards technology acceptance and directly influences perceived utility (Dhagarra et al., 2020). Ebnehoseini et al.'s study (Ebnehoseini et al., 2020) demonstrated that Perceived Enjoyment has a significant influence on the behavioral intention to use a hospital Electronic Health Record (EHR).

Our study aligns with their findings, revealing that Perceived Enjoyment accounts for 7% of the intention to use the 3-2-1 Service. These consistent results emphasize the crucial role of Perceived Enjoyment in shaping users' intentions to adopt the 3-2-1 Service. The results of this study confirm that Usability (Perceived Ease of Use), Security and Privacy, Trust, Reliability, Enjoyability and Compatibility influence the adoption of 3-2-1 Service and therefore must be considered when designing and deploying a mobile-based solution among underserved communities.

5.3. Participant's technology requirements

Low utilization of health information technology suggests that the preferences of patients may not be adequately guiding the development of these technologies (Crossnohere et al., 2021). In our study, we identified participants' language preference for mobile health information services (French or Moré language), design interface preference (text, voice or graphic) and type of design preference (with serious games or without). The findings indicate that when it comes to language preference, a significant majority of female participants (94.94%) and a majority of male participants (88.89%) expressed a preference for using the local language (Moré language) for the mobile health service. These results align with previous studies, suggesting that participants were enthusiastic about engaging with the system in their native language isiXhosa (Edim et al., 2013). The Local language-based system was easy to understand and provided adequate information to aid navigation on the interfaces (Edim et al., 2013). In terms of the design interface, a majority of female participants (81.01%) and male participants (77.78%) expressed a preference for a voice interface. When considering participants' age groups, the preference for the local language was observed among 83.33% of participants under 18 years, 80% of participants between 18 and 24 years, 80.85% of participants between 25 and 50 years, and 78.57% of participants over 50 years. Regarding educational background, 83.08% of uneducated participants, 81.25% of those with a primary school level of education, and 68.75% of participants with at least a high school level of education preferred the local language. Furthermore, when assessing the usability of the voice user interface among low-literacy users, it was found to be simple, easy to use, and capable of providing a natural user experience. These findings suggest that a voice interface and the use of the local language were well-received by participants, particularly among female participants, different age groups, and those with varying levels of education (Edim et al., 2013). In terms of the type of design, 39.24% of participants (31 individuals) preferred a mobile service with a serious game, while 60.76% (48 individuals) preferred a mobile service with games in general. Among men, 44.44% (8 individuals) preferred a mobile service with a game, while 55.56% (10 individuals) preferred a mobile service without a game. Among young people aged less than 18 and between 18 and 24 years, 50% (3 individuals) and 63.33% (19 individuals) respectively preferred serious games. On the other hand, among participants over 50 years old, 60% (39 individuals) preferred a mobile service that did not include serious games. Kevin et al. conducted a study that found gamification and serious game design approaches to be effective in increasing learner engagement (Browne et al., 2014). Additionally, the MANTRA mobile educational health game project, which targeted individuals with low literacy, demonstrated high levels of engagement, motivation, and usability of the game (Mueller et al., 2020). These findings highlight the varying preferences among participants regarding the inclusion of serious games in mobile services and the positive impact of gamification and serious game design approaches on learner engagement and motivation.

5.4. Recommendations for designing Mobile Health Information Service (MHIS) for underserved low-literate communities

In the context of encouraging interest in healthcare information via mobile health such as IVR, users can have access to health information with no limitations of time or location. Before designing mobile health information, it is important to identify some functional and non-functional

requirements of the solution. For an inclusive mobile solution for lowly literate people in under-served communities, the functional requirements for the system should be available in the most dominant spoken languages by local communities. Incorporating local language in the mobile solution contributed to improving access to healthcare in remote areas in Ghana (Brinkel et al., 2017). The system should also support voice-based users. This will allow users to interact with the system through voice or speech commands. In prior work, Medhi et al. found that textual interfaces are unusable by low-literacy users and difficult to use accurately by novice users (Medhi et al., 2011). Low-literate and non-literate users were rather comfortable with the voice interface (Brinkel et al., 2017). Depending on the end users' profile, serious games could be incorporated into the mobile health information service, as they can motivate behavior change subtly while the player is having fun (Kuipers et al., 2017). Previous findings suggest that mobile serious games could enhance access to health information and therefore contribute to healthy behavior change among young people (Kuipers et al., 2017). When designing mobile health information services in low-resource settings, understanding the local environments and barriers that hamper the sustainability of the solution is important (Greve et al., 2022). Low-resource settings are facing challenges such as limited funding, infrastructure, power and Internet connectivity, and high mobile data costs (Ouedraogo et al., 2022). Therefore, mobile health information services should consider the target users' lack of Internet access or limited connectivity. Integrating offline capabilities into the mHealth intervention can solve this problem. Ensuring a synchronization feature that syncs data when Internet connectivity is available again allows the mHealth project to stay connected even when data transmission is delayed (Greve et al., 2022). The non-functional requirements were identified based on the significant determinants Technology Acceptance Model. Table 10 summarizes the key factors/requirements, stakeholders should focus on. First and foremost, mobile health information service designers should focus on addressing the usability of the system for end users. For novice and low-literate people, the system should be easy to use. It therefore should be designed in a manner that facilitates the end-user's life. The system should consider integrating features such as voice commands and local languages to improve the usability of the system for low-literate people. Secondly, the mobile health information service should be designed to minimize the collection of personal data (e.g. location, name, address, cell phone number, etc.). In addition, they should be designed to ensure the privacy, confidentiality, and protection of users' data (Oyibo & Morita, 2022). Thirdly, designers and stakeholders should focus on building trust in the design of the mobile health information service. Especially for people who have not yet adopted the mobile health information service (who are the focus of a technology adoption study), as shown in Table

Table 10. Requirements for designing a Mobile Health Information Service (MHIS) for underserved low-literate communities.

Functional requirements	Description
Content in the local language	The system must incorporate the national language of the local population
Voice User Interface	The system must include interfaces that allow the use of audio and voice tools for information sharing
Incorporate serious games	The system must include the possibility of serious games for young end users
Energy consumption and electricity	The system must have low power consumption by using minimal animation and graphics and less background activity
Internet connectivity	The system must have minimal internet dependency or operate offline or with minimal bandwidth usage
Non-Functional Requirements	**Description**
Security and privacy	The system shall ensure that users' data are protected by security measures appropriate to the sensitivity level of the data
Reliability	The system shall ensure that the information provided is accurate and trustworthy
Usability (Ease of Use)	The system shall be designed to be easy to use, effective, and efficient while satisfying users
Enjoyability	The system must be designed based on the culture and demographic profile of the target population to ensure that it will appeal to users
Compatibility	The system must be compatible with low-literate needs and skills

9, fostering trust should be the most important issue for designers to address. Thus, the MHIS should be designed to enhance user trust. This includes making it voluntary and being transparent about what data is collected and used, when and how, and with whom it is ultimately shared. Fourthly, designers should focus on making the mobile health information service very useful to users. One way to spread the word about the perceived usefulness of a mobile health information service is to highlight its benefits to the health and safety of individuals, the community, and the public at large Finally, some end users not only want to use the system, but also want to have fun and enjoy using it. Adding a serious game option to the mobile health information service has the potential to make this a reality. As found in this study, Perceived Enjoyment of the 3-2-1 Service has a significant impact on intention to use.

5.5. Contributions

This study makes a tangible contribution to IT for Development by demonstrating the tangible impact of a multilingual IVR service on improving health literacy and prevention practices in Burkina Faso. The study's findings not only underscore the effectiveness of the technology but also highlight the importance of local languages, user interface design and factors influencing adoption. By shedding light on the role of ICTs in addressing critical health-related challenges, this study expands the toolkit of strategies that can be used for development initiatives worldwide. For academics, this study provides insights into the practical applications of ICTs to further development goals, particularly in the health sector. It contributes to academic discussions on technology adoption, user preferences and the intersection of technology and health literacy. For practitioners, the study provides a proven model for implementing a multilingual IVR service in similar contexts. The findings guide the design and deployment of ICT-based interventions to ensure they meet the needs and preferences of the target population. This research strengthens the connection between academic study and real-world application, making knowledge more accessible and increasing the practical impact of IT for development.

6. Limitations and future work

Our study has several limitations. The first limitation is that our results are based on the perceptions of IDPs. This may limit the generalizability of our findings to real-life contexts. The second limitation of our study is that our sample is relatively small ($n = 97$) compared with the population of Burkina Faso, which is over 20 million. This warrants further study with a larger sample to examine how well our results generalize to the larger population. The third limitation of our study is that we did not examine the interactions between key demographic factors such as gender and their impact on adoption. Future work should aim at addressing these limitations.

7. Conclusion

Malaria eradication is the common goal of WHO and many countries worldwide, including Burkina Faso. WHO's goal to end the malaria epidemic by 2030 is rooted in a commitment to 'continue to invest in people's behaviour change' (WHO, 2016). In our study on a phone-based literacy improvement, results indicate that overall malaria health literacy in terms of knowledge, attitude, and practice (KAP) among internally displaced persons (IDPs) is not high at 49.82% (<50%), especially for malaria practice (<35%). Although baseline for malaria Knowledge (>50%) and Attitude (>70%) scores were higher, we found that there is some misinformation or misunderstanding about malaria among participants. Many participants, 40 (81.63%) believed that diet is one of the causes of malaria, also sun 35 (71.42%) intervention and control 36 (75%); transmission of malaria: evil spell spirit, supernatural or mystical cause 45 (91.83%) and 43 (89.58%). 34 (69.38%) and 34 (70.83%) also answered that Malaria Work Fatigue can transmit malaria. After using the 3-2-1 IVR

Service, participants' malaria health literacy (KAP) levels improved in both the intervention group (more local language group) and the control group (French language group). However, users of the local language version of the 3-2-1 IVR Service showed greater improvement compared to users of the French version. The local language group showed a 30.33%, 21.77%, and 35.38% improvement in knowledge, attitude, and practice, respectively. The improvements among the users of the French version were relatively small at 15.98%, 14.58%, and 14.5% for knowledge, attitude, and practice, respectively.

We also presented the key factors that determine the acceptance of IVR systems in vulnerable populations. The results show that Perceived Usefulness, Perceived Ease of Use, Privacy and Security, Perceived Trust, Perceived Enjoyment, and Perceived Compatibility are significant determinants of intention to use the 3-2-1 IVR Service. We surveyed to determine participants' language preferences for mobile health information services. Participants preferred the local language and voice interface, and most young people preferred the serious game option. These findings suggest that local languages and voice-activated mobile health interventions can improve awareness and knowledge of malaria among underserved populations with low educational status when used as an educational tool. Mobile health is a promising approach to reducing misinformation and improving malaria health literacy. However, mobile health developers should carefully consider functional requirements (local language, voice user interface, serious games, energy consumption, and power consumption) and non-functional requirements (security and privacy, reliability, ease of use, usability, portability, and compatibility) to develop an inclusive solution, especially for underserved, low-education populations. Interactive voice response systems are known to be an effective mobile health tool for underserved, low-education communities. By making a phone call to an automated system and conversing with it in their local language, the low-literate user can access the information they need. The system is easy to learn and simple to use, providing access to a potentially large amount of health information as quickly and effectively as possible, and affordable on a large scale for vulnerable people. Viamo's partnership with telecommunications companies and organizations makes it a good and sustainable business model, enabling the 3-2-1 Service to be accessible to underserved communities at a low cost.

In summary, the contributions of this study highlight the significant impact of a multilingual IVR service on improving health literacy and prevention practices in Burkina Faso. By demonstrating the effectiveness of the technology and emphasizing the importance of local languages and user preferences, this study enriches the field of IT for development. The study's findings provide valuable guidance to both academics and practitioners, fostering a symbiotic relationship that supports the real-world impact of technology-enabled development initiatives.

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