



Lessons from the Frontier: Health Chatbots in LMICs

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Acronyms

AI	Artificial Intelligence
API	Application Programming Interface
FT Hub	Frontier Technologies Hub
IRB	Institutional Review Board
LLM	Large Language Model
LMICs	Low- and Middle-Income Countries
mHealth	Mobile Health
ML	Machine Learning
NCD	Non-Communicable Diseases
NLP	Natural Language Processing
PSI	Population Services International
RAG	Retrieval Augmented Generation
SRHR	Sexual and Reproductive Health and Rights
STT	Speech To Text
TTS	Text To Speech

Introduction

Health chatbots are Artificial Intelligence (AI)-powered programmes that simulate human conversations, allowing patients to access healthcare information, support and services through a mobile device. Their use is continuing to expand—particularly due to the COVID-19 pandemic¹—from Global Minority to now Global Majority² contexts, such as in low- and middle-income countries (LMICs). With this growth comes a broad range of challenges as well as considerations for effective use, from access to affordable technologies to trustworthiness in new, non-traditional systems.

¹ Phiri and Munoriyarwa, 2023

² Khan et al., 2022



Since 2016, the [Frontier Technologies Hub](#) (FT Hub) has supported partners to develop and test four chatbot solutions for health use cases in Peru, Kenya and Nigeria:

- [Behaviour Change chatbot to encourage vaccine uptake in Nigeria](#)³
- [Sexual and Reproductive Health and Rights \(SRHR\) chatbot in Kenya](#)⁴
- [EmpatIA chatbot to enhance healthcare in remote areas of Peru](#)⁵
- [mDoc wellbeing chatbot in Nigeria](#) (this was partially supported through [Frontier Technologies COVIDaction initiative](#))⁶

This report synthesises lessons and insights from these pilots, which we believe are potentially useful for others implementing health chatbots across LMIC contexts. For a full summary of the objectives and key insights for each pilot, please refer to the Annex.

The first sections of the report provide an introduction to health chatbot technologies and different use cases and potential benefits for which they are applied. It is followed by a section identifying key lessons and observations on what is required for effective and responsible design, testing and scaling of chatbot solutions based on learnings from the FT Hub pilots. A critical observation of this report is the need for a *whole systems approach* when implementing chatbot interventions in health. The report identifies four critical components of the health system that each need to be considered when implementing chatbot interventions, noting that this list is not exhaustive. The report also identifies a series of risks that can emerge if chatbots are not implemented with a systems approach in mind.

What are chatbots and how do they use Artificial Intelligence?

An AI-based chatbot is a software program that allows for simulated, human-like, natural conversation and other functions. Users can virtually input information or ask questions to the program and receive responses.

Chatbot solutions can adopt AI functionalities in different ways and to different extents. Most chatbots use Natural Language Processing (NLP), which is a field of AI that uses algorithms and models to understand, interpret and generate language. Frequently, chatbots use NLP to ensure their chatbot can understand a user's question. A chatbot might then only act in a limited way to

³ Behaviour change chatbot to encourage vaccine uptake — Frontier Tech Hub

⁴ Sexual and Reproductive Health Chatbot — Frontier Tech Hub

⁵ EmpatIA - AI to enhance healthcare in remote areas of Peru — Frontier Tech Hub

⁶ Lanzara, 2021

triage the user towards a prewritten response, as in the case of the decision-tree chatbot developed by the SRHR chatbot pilot in Kenya.

Alternatively, a chatbot might generate a new response to a question by employing generative AI capabilities. In these instances, chatbots such as the solution developed through the EmpatIA pilot in Peru are increasingly leveraging existing Large Language Models (LLMs), such as [GPT-4](#), which have been trained on vast amounts of data to be able to predict the next word in a sentence, enabling them to produce human-like responses. LLMs can be fine-tuned so that their responses reference carefully curated and accurate data sets and do not consider wider sources of information, which have not been verified by clinical experts and therefore may lack accuracy or contradict the treatment protocols and official guidance of healthcare providers. In the case of EmpatIA, the team used retrieval-augmented generation (RAG) so that their solution was trained on a data set that had been curated by a healthcare team and exclusively drew on that information when talking to patients.

In addition to leveraging generative AI to provide human-like responses to questions, chatbots can also use additional AI processes such as text to speech conversion, where text (initially generated via an LLM model or NLP algorithm) is then converted into speech (through a Text to Speech (TTS) algorithm such as Google TTS or Apple's Siri TTS) that can be played to the end user. Equally, Speech-to-Text (STT) algorithms can be used to enable end users to ask their questions out loud before they are converted to a text format that language models can then process. Video chatbot technology is now also emerging, wherein the chatbot is not only able to interact via speech, but also can be represented as a video avatar, capable of holding human-like video conversations. This functionality is made possible through a further distinct type of generative AI model, in particular models that have been trained on visual data to generate visual content and human-like details such as facial expressions and gestures.

Two critical and related factors shape the type of answers an AI chatbot may provide. These are: (i) the complexity and nature of the algorithm(s) used within chatbots, and (ii) the nature of the data a chatbot has been trained on and has access to. Chatbots can be set up in quite restricted ways, whereby the solution is programmed to reference pre-approved data sets when creating its responses. Equally, they can be set up to be able to access live data sets (usually via Application Programming Interfaces, or APIs), to provide relevant up-to-date responses. More complex chatbot algorithms are programmed so that the chatbot accounts for the wider context of a conversation (including remembering information that a user shared earlier in the conversation such as their location) to inform and shape its response. Alternatively, more simple models are 'single turn,' only considering the last inputted message when responding.

In addition to leveraging machine learning algorithms to understand inputs and generate new responses, chatbots within health systems can also be set up to integrate with and utilise other AI solutions. For example, a chatbot could be integrated with AI image detection algorithms capable of diagnosing potential symptoms based on an image shared by an end user. Equally, chatbots could be integrated with predictive analytics solutions to deliver other functional benefits for health use cases. For example, a chatbot could be set up to take inputs from an end user about their overall health, and via a two-way interface with a predictive analytics model, identify whether the patient is likely to be at risk from certain conditions and require additional support.

Applications and use cases for chatbots in health

In this section, we outline a wide variety of applications of chatbot solutions in health and the use cases these serve. This draws on examples from both high-resource settings, as well as low-resource settings such as the FT Hub pilots.

Increased access to health information

Chatbots can serve as a resource to provide accurate and accessible health information. They deliver responses to common health queries and promote awareness about diseases, preventive measures and health services. They can also increase access to populations with sensitive questions they may feel more comfortable asking to a bot versus a face-to-face provider. Most FT Hub pilot SRHR chatbot users valued the chatbot *Nena* as a confidential and judgment-free source of trustworthy, on-demand SRHR information. The study observed that *Nena* supported SRHR empowerment among users, and that it likely contributed to changes in users' knowledge and attitudes about sexual pleasure, ability to communicate about their SRHR related needs, and ability to engage in safer sexual and reproductive health practices.⁷

Chatbots can provide relevant answers to questions; tackle misinformation about medicines, vaccines and procedures; address concerns about side effects; and accommodate different levels of health literacy.⁸ For example, the Behaviour Change chatbot provided users with information about the costs of vaccines, health centre options, and the vaccination schedule, as well as reminders for vaccine due dates.

Dialogue with chatbots can help users not only gain vital health information they need but also challenge their misconceptions about taboo or misunderstood health topics in a private, accurate, and on-demand manner. Such alternatives to face-to-face care can support users with less access to healthcare facilities due to their location, identity, income level, or other factors.⁹ At the same

⁷ Njogu et al., 2023

⁸ Ranger, n.d.

⁹ Njogu et al., 2023

time, chatbots work best when they are not robotic but have a voice which is adapted to the context and engaging to users, as was with [mDoc](#)'s chatbot *Kem* which provided generated and tailored responses to questions.

From a health system perspective, chatbots can be particularly impactful for health campaigns, especially in LMICs where there can be misinformation and low awareness about and lack of resources for campaigns. In Nigeria where the risk of premature death from cardiovascular disease, cancer, respiratory disease and diabetes is high, many people have limited access to health care and/or self-care guidance needed to manage non-communicable diseases (NCDs). To respond to this pressing need for self-management of hypertension through mobile health (mHealth), the mDoc team developed *Kem* to serve as a wellbeing coach and provide the public with access to general advice on how to stay healthy. *Kem* nudged users toward the adoption of lifestyle modifications and healthier behaviours to support existing chronic health needs and the prevention of future conditions.

Enhanced patient engagement, monitoring and follow-up

The interactive nature of chatbots can encourage greater patient participation in their own health management, improved adherence to treatment plans and better health outcomes overall. When integrated into health information systems, chatbots can increase access to users' own personal records, especially those living outside of major cities, where traditional healthcare services and institutions tend to be centralised. Such access to information can be available 24/7, even when healthcare providers may not be.¹⁰

Chatbots are also fast and accurate, leading to strong response and retention rates of users. Chatbot users may become more willing to learn about their health conditions than before chatbot use and become curious about asking the chatbot questions. For example, mDoc's pilot team found that users were quite excited about the density of the library of answers available, despite the clinical and design teams' reservations about extensive answers. Chatbots can also catalyse users' trust in the public healthcare system and increase receptibility to healthcare technology in the growing landscape of mHealth.

Through regular interactions with patients, chatbots can provide health clinicians with a more informed understanding of a patient's condition, recovery rates and needs. This functionality is particularly beneficial for managing chronic conditions—enhancing patient engagement and self-management. Chatbots can also serve as monitoring tools for users' conditions, helping to understand levels of pain or other symptoms and following up on their progression. Such features

¹⁰ Clark and Bailey, 2024

can improve users' self-management behaviour, enhance users' health outcomes and capacitate providers to deliver evidence-based care.

Where chatbots collect data from end users, such as symptoms they are suffering from—or in the case of EmpatIA, on patients' adherence to care plans—they can provide doctors and nurses with critical information to better understand the health of their patients and inform more tailored interventions to support individual patients. The EmpatIA chatbot *Avatr* collected data from post-surgery breast cancer patients on their levels of pain and anxiety felt each day. *Avatr* helped doctors better understand their patients as the results were different than what was assumed, with patients remaining in pain longer after surgery than expected.

The customisability of a chatbot can allow messaging to be tailored to users' backgrounds, cultures, needs, and beliefs in order to increase personalisation, effectiveness, and ability to scale the chatbot. At the end of the EmpatIA pilot, clinicians suggested that *Avatr* adopt content that would be of interest and help to patients in Peru, including the use of Peruvian music and video guides on health conditions, meditation, exercise and food choices for managing their health. Physicians believed patients would prefer receiving this information on the chatbot over brochures for potential future informational campaigns.

Finally, chatbots can streamline administrative tasks by managing appointment scheduling, sending reminders, and confirming visits—such as in the case of the Behaviour Change chatbot. This can reduce the workload on healthcare staff and potentially improve attendance rates for medical appointments. By alleviating administrative burdens by gathering information and handling routine inquiries such as appointments for minor health issues, chatbots can allow healthcare professionals to concentrate on more complex or urgent cases with greater need for in-person appointments and provide better quality care. However, even in the case of routine support from chatbots, providers' expertise is still necessary to incorporate chatbot data into patients' treatment plans appropriately. By including geolocation features, chatbots can suggest practical solutions to users on the closest qualified providers, services and products and manage any appointment follow-up.¹¹

While potentially aiding patient monitoring and follow-up, it is critical to remember that chatbots still require provider oversight, and none of the information they provide or collect should be used in isolation.

¹¹ Clark and Bailey, 2024

Improved data for decision making for health system actors

Through collecting data from individuals, the solutions piloted through FT Hub also highlighted the potential for chatbots to provide health system actors with critical information for decision making. For example, information chatbots such as the Behaviour Change chatbot and SRHR chatbot can provide aggregate information on the specific type of queries that patients have, which in turn can help those managing local health systems to identify priority areas for interventions such as education and information campaigns.

In the case of the SRHR pilot, the chatbot *Nena* sent 1,119 referrals to a local Kenyan clinic. While the pilot was unable to determine whether any users redeemed their referrals, doing so in the future may support health system actors understand broader interventions that may be needed to shape incentives and support young people to access SRHR services.

Symptom checkers and triage support

AI-powered chatbots can help serve as a first line of healthcare provision by assisting users in assessing their symptoms and determining the urgency of care required. By collecting relevant information, they can guide patients to appropriate healthcare services, effectively acting as a first point of contact. In a mixed-methods study incorporating 29 semi-structured interviews and 216 survey responses with students at the University of Southampton, most participants were willing to use chatbots for minor health issues they felt didn't need face-to-face exams. Chatbots were perceived as free-of-cost and timesaving tools to solicit written health information, which can be easier to understand than verbal information.¹² Additionally, mDoc's chatbot *Kem* has the ability to triage patients to local health clinics if patients enter data about symptoms of potential health conditions.

Therapeutic support

Chatbots can provide an accessible platform to aid behaviour change and mental health support. They may facilitate conversations, provide coping strategies, and direct users to professional help when necessary, thereby potentially reducing barriers to mental health care. An evidence-based mHealth app with an embedded conversational chatbot that delivered cognitive behavioural therapy to adolescents presenting with depression and anxiety demonstrates feasibility, acceptability, usability, and safety of the chatbot, but warrants additional study for effectiveness and identification of adaptations needed for greater use.¹³

¹² Nadarzynski et al., 2019

¹³ Nicol et al., 2022

Training, data collection and research support for healthcare providers

Chatbots can also serve educational purposes within healthcare settings or for those training to become providers, offering medical professionals access to information about best practices, clinical guidelines and ongoing learning opportunities. A study conducted in Italy tested the effectiveness of AI chatbots to answer complex medical questions and provide educational information and demonstrated their role in potentially supporting future medical education.¹⁴

Chatbots can also support providers to collect valuable patient data as the FT Hub pilot chatbots explored. Such chatbots can be used to collect large-scale data for public health studies and even support the provision of clinical research trials. When the Canadian Agency for Drugs and Technologies in Health explored this application in August 2023, they found nearly 60 ongoing clinical trials using health chatbots on [ClinicalTrials.gov](https://clinicaltrials.gov) related to medication adherence, vaccine uptake, wellbeing care, and more.¹⁵

Lessons for effective implementation of early-stage chatbot innovations in LMICs

Each of the FT Hub pilots which developed and tested chatbot innovations surfaced different learnings on what is required to deliver chatbots in ways that meet the needs of health system actors while supporting responsible and equitable outcomes.

Collectively, the insights surfaced from across the pilots indicate the need for a ‘whole systems’ approach to implementing chatbot innovations for health, whereby those implementing solutions look across a range of component parts of the health system—and the needs that must be addressed in each—when implementing solutions.

While these factors do not encompass all the dimensions often covered within systems innovation frameworks¹⁶, the lessons from the FT Hub pilots emphasise the need for an implementation approach which:

- Considers the **needs of users**, and accounts for inequities and differences in the abilities and needs for users to access and engage with solutions
- Involves building effective **partnerships**

¹⁴ Baglivo et al., 2023

¹⁵ Clark and Bailey, 2024

¹⁶ For example, frameworks such as the WHO Building Blocks emphasise additional critical enablers for effective health systems (and interventions within them) such as putting in place sustainable financing approaches. While factors like these are critical to the long-term scale-up and sustainability of chatbots, the FT Hub pilots produced few insights in relation to the importance of these components, so they are not referenced here.

- Establishes the wider **operational model** around the solution
- Is supported by an **enabling policy environment**

Lessons on each of these factors are shared below.

The need for a user-led approach

In innovation, the importance of taking a user-centred approach is well-documented and generally understood to be best practice. This includes the importance of first understanding the different users within an ecosystem (for health systems this could be patients, but also healthcare providers or government actors) and the needs they have that might be addressed by AI innovations, but also the likely behaviours, incentives and barriers they have in relation to interacting with or benefiting from a solution. Taking a user-centred approach also includes understanding the underlying inequities for users to be able to access and benefit from a solution, and that might be reinforced by its implementation.

The FT Hub pilots overwhelmingly identified the value of user research in helping them develop solutions which were responsive to user needs and the problems experienced within health systems. Participants in one of the pilots even identified the costs of not conducting user research early enough. All the chatbots piloted through the FT Hub program had at least a partial focus on supporting end users to access new information, and challenge assumptions or behaviours they might have in relation to health. Where pilots did not conduct sufficient upfront research to really understand existing mindsets and behaviours—and the underlying social, economic and cultural factors which influenced user behaviour—their ability to build a chatbot that was responsive to the needs of users was inhibited. Project participants cited that they believed earlier research to understand norms, beliefs and behaviours of users in more detail was a missed opportunity and would have strongly informed their solution.

Different FT Hub pilots identified common challenges that they needed to address to ensure end users were able to access, interact and benefit from the chatbot. The EmpatIA pilot identified that despite all those who participated in the trial having access to mobile phones and data, several users lacked the digital skills required to interact with the chatbot. This meant the need for a more intuitive digital interface, a finding likewise identified by the Behaviour Change chatbot and mDoc's chatbot, which were implemented with simplified, stripped-back interfaces to support interaction.

In the case of EmpatIA, two participants in the trial relied on a carer to help them use a smartphone and access the chatbot. This finding indicated an outstanding need, alongside chatbots, for the implementation of non-digital channels to support those who cannot use digital services and may not have support at home to engage in digital solutions. Those implementing chatbot interventions should avoid creating a dependency on entirely digital channels as a means of accessing

information or services and look at maintaining or introducing other offline channels to ensure people have equity in access to information and support. Other FT Hub chatbot pilots have looked at innovating in this space—including the eTriage for Social Inclusion pilot in the Philippines¹⁷, which has supported public health aides with digital tools that enable them to identify, reach out to and support vulnerable individuals to navigate the health system and access in-person services.

A common lesson from across multiple pilots was that in addition to many users lacking the skills or confidence to engage with digital solutions, many also struggled to engage with chatbots that provided overly lengthy text-based answers, or technical medical language. This was a finding from the initial testing of mDoc’s chatbot *Kem*, and in response, *Kem* was adapted to provide shorter responses in plain language. More recently, the team has also built and started testing the adoption of STT functionality, as it was discovered through user testing that some users are familiar with using this functionality on other applications and are able to communicate in this way, even in instances where they otherwise struggle with texting.

This was also a finding from the EmpatIA pilot, where the Detecta clinic who helped to pilot the solution shared that they believe patients absorb information more easily when it is presented in alternative formats to text, including as videos. Videos were created and uploaded to the *Avatr* chatbot featuring clinicians who provided answers to common questions that cancer patients ask. The chatbot was also updated with an ability to respond to a patient with images. For example, if a patient asked about their diet and how much meat they should eat, *Avatr* was able to provide a picture with the recommended portion size. The approach taken here involved drawing on pre-approved images, rather than a generative AI approach, to ensure that guidance was based on the clinician's treatment protocols.

Several of the FT Hub pilots also found that the type of language used within chatbots was also a critical barrier to some users adopting the solutions. In the case of Nigeria, where two of the chatbots were piloted, even though English is an official language, a significant proportion of the population do not speak English as their first language and cannot read and write in English. It is critical therefore to adapt chatbots to a range of languages and dialects—and there are some initiatives and language models which are already making this possible in the Nigerian context, including the [Lacuna Fund](#) and [Mozilla Common Voice](#).

In the case of Peru where the EmpatIA pilot took place, indigenous languages such as Quechua and Aymara are predominantly spoken in rural areas and are also recognized as official languages of Peru, alongside Spanish. The EmpatIA team realised that for their chatbot to be accessible in the longer term, there was a need to ensure it could speak these languages. Efforts were made to find

¹⁷ eTriage for social inclusion: navigating out of vulnerability situations — Frontier Tech Hub

an LLM capable of conversing in these languages, but within the scope of the pilot, the team was unable to find an existing model capable of providing high quality conversational responses that they could then adapt to their own purposes. A closer look revealed that the LLMs had only been trained on comparatively small amounts of data, and that adopting these LLMs could therefore create risks of responses being generated that were biased, inaccurate or even toxic. It was not feasible within this pilot to use and adapt existing LLMs, and as a result the focus remained on providing a version of *Avatr* in Peruvian Spanish. The experience nevertheless highlights the importance of wider work to develop regionally relevant LLMs as a means of avoiding a digital divide in terms of who can access and benefit from generative AI. This is critical both for health-related use cases—such as chatbots for providing information or supporting continuity of care—as well as wider use cases more generally.

A last finding across all the pilots was the importance of ‘meeting users where they are’, including identifying a need to integrate chatbots into platforms that already exist and that users use, such as WhatsApp, rather than building a new application for users to download.

The importance of effective partnerships to enable action and knowledge sharing

The FT Hub pilots all realised the importance of having in place the right partnerships to develop and test chatbots meaningfully. This included partnerships with health bodies (for example local or national Ministries of Health), hospitals for testing, and academic institutions for supporting teams to develop and test technologies in an ethical way. It also included partnerships where key leadership figures championed the use of chatbots within existing local health systems.

Pilots with health institutions proved critical in terms of enabling pilots to have access to health professionals to support testing of solutions, and access to health data and records, where necessary for the system. Partnerships enabled pilots to engage directly with both frontline health actors but also decision makers and leaders, and ensure their feedback and priorities were represented in solutions with a view to ensuring solutions were contextually relevant.

Where pilots failed to secure partnerships with key system actors, it inhibited their ability to work effectively within health systems or on the specific use case where there is the greatest potential for impact.

The EmpatIA pilot highlighted the importance of partnerships, as their critical partnership with the Detecta Clinic enabled them to test and adapt the chatbot solution, both through trialling with patients and via engagement and consultation with clinicians. The partnership also proved



instrumental in navigating the regulatory environment and seeking the approvals to pilot the technology in an ethical and responsible way due to Detecta's existing expertise in this area.

However, while for EmpatIA their partnership was instrumental to the pilot, it is worth noting that the pilot was not able to secure the partnership with public or public-private partnership institutions, who typically serve the most vulnerable individuals in Peru—the key target group for their solution.

This is a challenge for many innovation pilots globally, and particularly where approaches to decision making around digital initiatives are complex and emphasise the need for rigour and certainty. Often time, they therefore cannot accommodate new ideas which require support to test, iterate and learn, and cannot provide upfront certainty of efficacy.

A further type of partnership that some pilot actors identified could be helpful in supporting the development of chatbot solutions was partnerships among peers, facilitated by forums such as peer learning networks. In particular, those implementing chatbot solutions across different LMIC contexts cited the value of being able to engage with and share learnings with those operating in similar contexts, who were likely faced by similar health system and contextual challenges—whether regulatory, technical, financial, operational or related to the capacities of end users to adopt the technology. Actors explained that the types of partnerships they required were not necessarily with technologists from High-Income Countries, including conventional partnerships which involve sharing of lessons around Silicon Valley-style ways of working with LMIC actors. In practice, many of those implementing FT Hub pilots were already familiar with these ways of working and their benefits and limitations and were looking instead to share and hear more nuanced lessons and insights about how others had tackled similar contextual barriers and challenges that are not typically present in Silicon Valley.

The need to establish a wider vision—including identifying the operational model and ensuring health workforce needs for adopting the solution are met

Chatbot technologies for health use cases can have limited impact (and can even risk leading to negative impacts) unless work is undertaken to identify and establish their place within the wider health landscape. It is important to identify how to both integrate them with other health services while potentially undertaking necessary work to adapt health processes, workflows, information flows and other functions in order to accommodate the chatbot into the system.

Each of the FT Hub pilots identified the importance of conducting work to understand how their solution might eventually operate in the context of the wider system. Pilot teams learned the importance of having—even at an early stage in the innovation lifecycle—a clear vision for how



their solution would fit within the context of wider operational systems and processes, including identifying what (if any) transformation might be needed to accommodate the new chatbot and realise its benefits.

One critical consideration, identified by pilots looking to integrate their solution into health systems, was the need to consider the digital skills of health actors who might engage directly with the chatbot, or with data flowing from the chatbot, and the need to provide support and training on the use of technology in their working roles. Several of the pilots identified the importance of incorporating health clinicians into the development of the solutions and supporting skills development of clinical actors to enable them to play this role effectively. This includes the need for clinical staff to play a critical and ongoing role in training the chatbot by reviewing the guidance generated by the chatbot and providing feedback and prompts to improve its clinical accuracy.

Another critical consideration across many pilots was around how to find an appropriate balance between using AI to deliver efficiencies in operational processes and an experience that was tailored to the needs of the end user. It was important to understand where essentially to place limits on AI in order to ensure solutions provided accurate, responsible responses. All pilots reflected on the risks associated with using chatbots in health, and none of the pilots used the chatbots to provide patient-specific health advice, or to diagnose patient conditions. Instead, the chatbots were used to provide access to general (non-patient-specific) health information, to provide patients with reminders to take medicines and collect data from patients and to provide coaching on general wellbeing. Pilots also identified clear handoff points between chatbots and existing health system actors, at the point where a patient needed expert advice or care. The SRHR chatbot, for example, put in place a referral mechanism, whereby it referred users to a local clinic based on the questions and topics explored by each user. Equally, mDoc's chatbot triages patients to local health clinics if patients enter data that could indicate that they may be pregnant, or exhibit symptoms of a potential health condition.

One underlying factor that limited the ability for pilots to use chatbots for more complex functions, such as providing more bespoke or patient-specific health advice, was the limitations of the data available for training a chatbot to perform these tasks. When developing chatbot solutions, it is critical to train the algorithm with data that is clinically accurate, so that the algorithm is not only trained to identify patterns in data but also generate responses which are based off comprehensive and accurate information. All the FT Hub pilots took care to engage experts and develop curated and accurate datasets that their chatbot could draw on. This required engagement of clinical experts to help assess and determine which data items (for example journal articles or reports) a chatbot should be trained on, while also ensuring the datasets cover a full range of potential topics and issues an end user may ask about. A critical consideration for each of the chatbot pilots, however, was the extent to which their dataset was sufficient and appropriate for adoption of an



LLM, or whether a lower tech approach was more appropriate. While several of the pilots saw potential benefits to using an LLM, so that their chatbot could provide generated and tailored responses to end user queries, not all went down this route, given the quantity and quality of data available for training an AI solution. In the case of the SRHR pilot, for example, the team decided against using a LLM to create generated responses because they had reservations around whether they could do this in a way that produced accurate responses with the data they had available. Instead, the team chose only to use AI in a limited way—using NLP to understand a user's question so that the chatbot could accurately understand what topic the individual was asking about, before then routing them through to the start of a conversation with pre-written responses. Alternatively, other pilots saw the limitations of rule-based chatbots—including conversational depth offered (when compared to generative chatbots) and expectations of users regarding technology—and opted for using generative AI, but in a managed way.

The value of an enabling regulatory environment

Several of the FT Hub pilots reflected on the value of guiding regulations for chatbot development. Firstly, pilot participants identified the value of having key guardrails and processes to guide the actual research, design and testing of interventions—such as guardrails set down by ethical review boards, and processes for seeking Institutional Review Board (IRB) approval—before conducting pilot activities. Those pilots who had relationships with IRBs (including via universities) felt that they helped them to test solutions and have confidence they were working in an ethical, responsible and inclusive manner, while those who did not use IRBs felt this inhibited their ability to make progress in their work.

A second key area where pilots reflected on the value of regulations was in the need for health system-level policies, frameworks and guidelines that set rules around the use of chatbots. Those teams who were further into the process of delivering and testing chatbot solutions identified the absence of regulations as a constraining factor. One pilot team, for example, learned from EU regulation that it was best practice to let patients know they were interacting with a bot—and appropriated this guidance in their own work—while also observing that it would have been helpful to have regionally and contextually relevant legislation.

Key risks when implementing chatbot solutions in health

While an overarching insight surfaced from across all FT Hub pilots was the need for a *whole systems approach* to implementing chatbot innovations for health, the pilots also surfaced a range of risks that can emerge if different system components are not considered in the implementation of solutions. These risks could mean that rather than produce positive health impacts, innovations can create disruption within health systems, misalignment between different functions of the system and ultimately cause harm.



A lack of consideration on the different needs for users to access technology—including relative differences in access to devices and data, digital literacy and accessibility, language and general literacy (including ability to digest longer technical responses)—runs a clear risk of creating a digital divide between those who can access and benefit from a solution, and those whose needs are not met by a solution. In doing so, chatbots which are not implemented with due care run the risk of exacerbating inequities in access to healthcare, rather than addressing these inequities. This includes the need for ensuring chatbots are accessible, intuitive and translated into different languages and that information and services provided by chatbots are also available to users through non-digital channels.

If operational processes are not put in place to ensure chatbots are trained on verified and accurate data sources, or chatbots are effectively monitored, there are significant risks that chatbots can provide inaccurate information and guidance—and lead to consequences, including individuals failing to seek the care they need. This is particularly the case where generative AI technologies are assumed to be self-aware and capable of distinguishing between accurate and inaccurate information, and where teams adopt LLMs that have been trained on vast amounts of data of unknown provenance without consideration of the need to guide the chatbot towards specific curated datasets when providing health-related responses.

In addition to ensuring that data sets are verified prior to being used to train chatbots, there is also a compelling need to ensure data is representative and that chatbot algorithms are better trained to account for context, including the end users own circumstance, when providing a response. Indeed, if the data used to train chatbots are not representative of different groups of users, and the different needs each may have in relation to health, there is a risk of ‘algorithm bias’ whereby the chatbot provides guidance that is accurate for some users but provide less relevant or potentially dangerous guidance for other groups. Those developing chatbots should conduct ongoing work to check their data for biases, and drift in biases overtime, including through using tools (such as [IBM’s AI Fairness 360](#)) that surface biases the existing model may propagate.

The implementation of chatbots can also create several additional risks, although not all of these were surfaced through FT Hub pilots. This includes:

- Data privacy and security risks—where personally identifiable data is shared by users with a chatbot but is not held securely (and may even be used to support ongoing training of the chatbot without users’ approval). This highlights the need for mitigating measures including encryption, access controls, user-informed consent mechanisms and approaches to implementing the chatbot which reduce and discourage personal data collection.
- Overreliance from patients on chatbots for medical advice, leading to delays seeking face-to-face medical attention, exacerbating medical conditions.



- As a journal paper produced following the AI for TB pilot surfaced¹⁸, the implementation of AI solutions can create risks of dependency and in the longer-term lead to a ‘deskilling’ of the existing workforce, and/or send signals that there is less demand for skills—and therefore destabilise the system in which they are being implemented.

Conclusion

The early and growing implementation of chatbot innovations in LMIC health systems offers both promise and complexity. Our review of FT Hub chatbot pilots and other health chatbots trialled in various contexts reveals that chatbots can enhance access, efficiency and engagement in healthcare delivery. At the same time, realizing their potential requires more than technical deployment. Success hinges on designing for the real-world needs of diverse users, building strong partnerships with health system actors, supporting frontline workers, and aligning innovations with ethical, regulatory and infrastructural realities.

Key lessons from these pilots underscore the importance of inclusive, multilingual design; deep stakeholder engagement; and embedding chatbots into existing care pathways. Risks related to inequity, data quality, privacy and sustainability must be proactively addressed through deliberate governance, transparent practices, and fit-for-purpose regulation. Crucially, these findings highlight that chatbot innovation is not just a technical endeavour, but a systems-level challenge that demands coordination across institutions, disciplines and communities.

As interest in generative AI continues to grow globally, LMIC implementers and their partners have a unique opportunity to shape chatbot technologies that serve their populations. By fostering shared learning, investing in enabling policy environments and grounding innovation in local realities, the next generation of health chatbots can advance equitable and resilient health systems.

¹⁸ Spiegel et al., 2021



Annex: Case studies from the Frontier Technologies Hub

Behaviour change chatbot to encourage vaccine uptake¹⁹

Objectives

During the first few years of the COVID-19 pandemic, routine healthcare services, including delivery of vaccinations, were disrupted in many countries.²⁰ 67 million children missed out on one or more vaccinations over three years due to service disruption caused by strained health systems, a diversion of scarce resources, and conflict and fragility. Confidence in childhood vaccines decreased up to 44% in some countries during the COVID-19 pandemic.²¹ Traditional behaviour change communication interventions alone may not be sufficient to address complex factors influencing vaccine uptake, including knowledge, beliefs, attitudes and behaviours of a targeted population group. Thus, health chatbots can help by providing interactive and personalised experiences to address systemic barriers (access to health services and information; structure and strength of the local healthcare system), individual barriers (perceived efficacy of vaccines, risk perception and health literacy) and social barriers (social support and networks) to vaccine uptake. In a context where WhatsApp usage is quite popular in many developing countries, a chatbot for WhatsApp can help to address barriers to vaccine uptake. In Nigeria, 54% of adults say they use WhatsApp.²²

To leverage the potential of chatbots to address barriers to vaccine uptake in a more comprehensive and personalised manner, [Behavioural Insights Team](#) (BIT) and [HelpMum](#) Nigeria worked with the FT Hub to design and test behaviourally-informed and AI-driven enhancements to HelpMum's existing WhatsApp childhood vaccination chatbot. The objective of this collaboration was to explore whether and how a behaviourally-informed and AI-driven WhatsApp chatbot could help to address Nigerian caregivers' barriers to child immunisation services and ultimately help increase childhood vaccination rates. Specifically, BIT conducted a behavioural audit of the existing chatbot and worked with HelpMum to design and develop a prototype of a behaviourally-informed and AI-enhanced version of the service that produced generated responses to users' questions based on a data set that had been audited by the team.

Key insights from the pilot

BIT and HelpMum tested the newly developed prototype with around 25 users in Lagos, Nigeria in June 2024. The users were organised in four focus groups, mixing users' area of origin (Oyo State

¹⁹ Ranger, n.d.

²⁰ Maltezou et al., 2022

²¹ UNICEF Innocenti - Global Office of Research and Foresight, 2023

²² Poushter, 2024



and Lagos State) and whether they had used the chatbot before. The testing aimed to assess whether the refined chatbot fulfilled its core functionalities and whether users felt the use of AI in the chatbot was appropriate and trustworthy. Users evaluated the functionalities of the AI in the chatbot including the greeting message, questions, location of health centres recommended, planning of appointments, reminders for special arrangements, final messages and the AI agent itself.

In general, users found the information the chatbot gave them useful, especially information about the costs of vaccines, health centre options and the vaccination schedule. Users also found the chatbot to provide relevant and useful answers to their questions. Participants indicated that the reminder messages added value by addressing their tendency to forget about vaccine due dates and frictions to access them. Participants indicated that the chatbot was easy to use and the flow was generally intuitive.

However, users' experience also revealed some areas for improvement. The name of the AI agent *Kemi* was not universally applicable for users coming from different states and speaking different languages in Nigeria. Even though English is an official regional language in the areas where the chatbot was tested, English literacy was not sufficient for the solution to fully reach the targeted population segment.

The format of the personal information question and location question were not entirely clear for users. The chatbot was also not very specific about opening hours and types of health centres for vaccination. Issues were raised by users about the entry of dates for appointments, which generally are written on vaccination cards. The existing chatbot lacked functionality to support users to prepare and comply with their appointment, such as providing reminders to users to request permission off work and pack their vaccine card. Finally, the chatbot did not provide enough information to conclusively debunk misinformation on potential side effects of vaccines, which were a main concern for users in their choice to get their children vaccinated. Further training is required for the chatbot to answer questions about potential side effects more comprehensively and provide end users with the information they need to have confidence in vaccines.

Structured testing to evaluate the chatbot and demonstrate its direct impact did not take place during the FT Hub pilot. Further work is being undertaken with support of additional funding from another partner to iterate the solution and conduct an evaluation to establish its effectiveness at addressing misinformation and improving vaccination rates.



EmpatIA—AI to enhance healthcare in remote areas of Peru²³

Objectives

Today, Peru faces an increasing burden of NCDs including mental health conditions which require ongoing interaction with the health sector.²⁴ However, despite over 99% of Peruvians holding health insurance, thousands still lack access to fundamental healthcare services. The 2022 National Household Survey reveals that 7 out of 10 people who needed medical care did not receive it.²⁵ The centralisation of hospital services in urban areas and disparities among regions makes it incredibly difficult for people in rural areas to access timely health care, despite their insurance status.²⁶ Beyond access, patient adherence to care plans is also inconsistent, partly due to the long-time intervals between treatment appointments with a physician and the following check-up appointment. At check-up appointments, physicians assess patient health against milestones in the care plan, referring to and updating physical printed records held and maintained by the patient, as opposed to a digital record available on a smart device. This means the documents can get damaged or lost and patients may need to ask for another one at their own cost—or at best, try to remember what was on it—or simply carry on and no longer adhere to it.

Project EmpatIA adapted and trialled the use of an existing chatbot *Avatr* to establish whether a chatbot-led solution could help to alleviate some of these long-standing challenges. The pilot worked with Detecta Clinic in Lima, Peru to provide post-surgery breast cancer patients with access to *Avatr* to facilitate communication between patients and physicians. *Avatr*'s functions enabled patients to share information about their wellbeing with their physicians via text exchanges on *Avatr* and receive reminders relating to their treatment plan (for example, to take their medicines). *Avatr* enables physicians to monitor their patients' adherence to treatment plans and their wellbeing against quality-of-life indicators in real time. The objectives of the pilot were to see if *Avatr* could support physicians to manage patients, and support patients to adhere to their treatment plan (e.g. taking medication), which could in turn improve patients' wellbeing. The pilot explored this question through an evaluation in which the *Avatr* chatbot was used with one group of patients who were monitored alongside a control group who did not use the tool.

²³ Wilkinson et al., n.d.

²⁴ Mendoza, 2024. Some data indicate that in 2022, around 42% of people in Peru reported suffering from a chronic health issue.

²⁵ Martens, 2023

²⁶ Carrillo-Larco et al., 2021

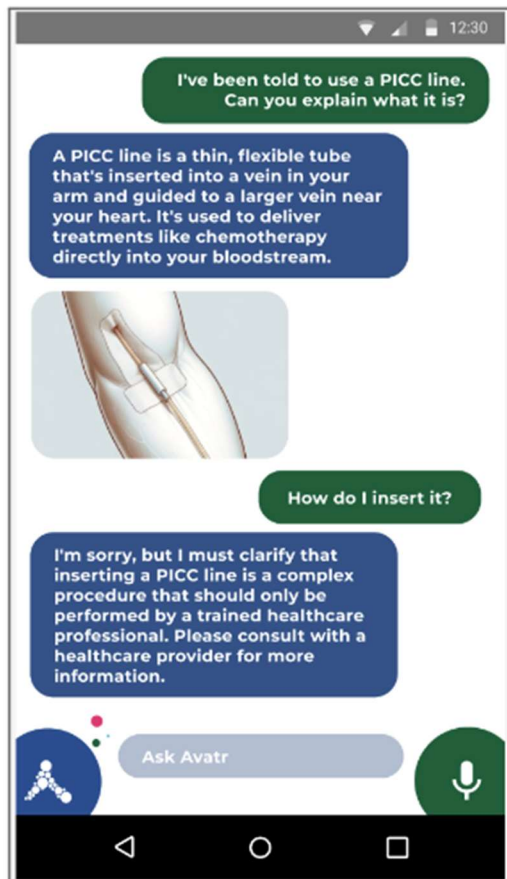


Figure 1: The Avatr chatbot developed through the EmpatIA pilot included multi-modal responses, wherein the chatbot was able to both provide text-based responses and select from a repository of approved images to illustrate its responses.

Key Insights

The findings from the evaluation indicated that *Avatr* could support improved access to healthcare in several ways. The results indicate that the application helped patients adhere to their care plans through timely reminders, and that physicians valued having access to wellbeing indicators sent to them via the mobile application.

Feedback provided by patients who participated in the evaluation of the *Avatr* chatbot suggested that the solution improved access to information on medication and personal records, especially for patients who live outside of Lima. Feedback indicated that patients appreciated receiving medication reminders and given the importance of medication adherence to patient health, this result is encouraging.

Patients also suggested that there could be opportunities to adapt and improve the application. They identified a need for appointment reminders via the application in addition to medication reminders. Interviews with patients outside Lima revealed that indigenous languages are often spoken at home and that *Avatr* would need to be available in indigenous languages for non-Spanish speaking populations to exercise full agency in use of the app. Through testing

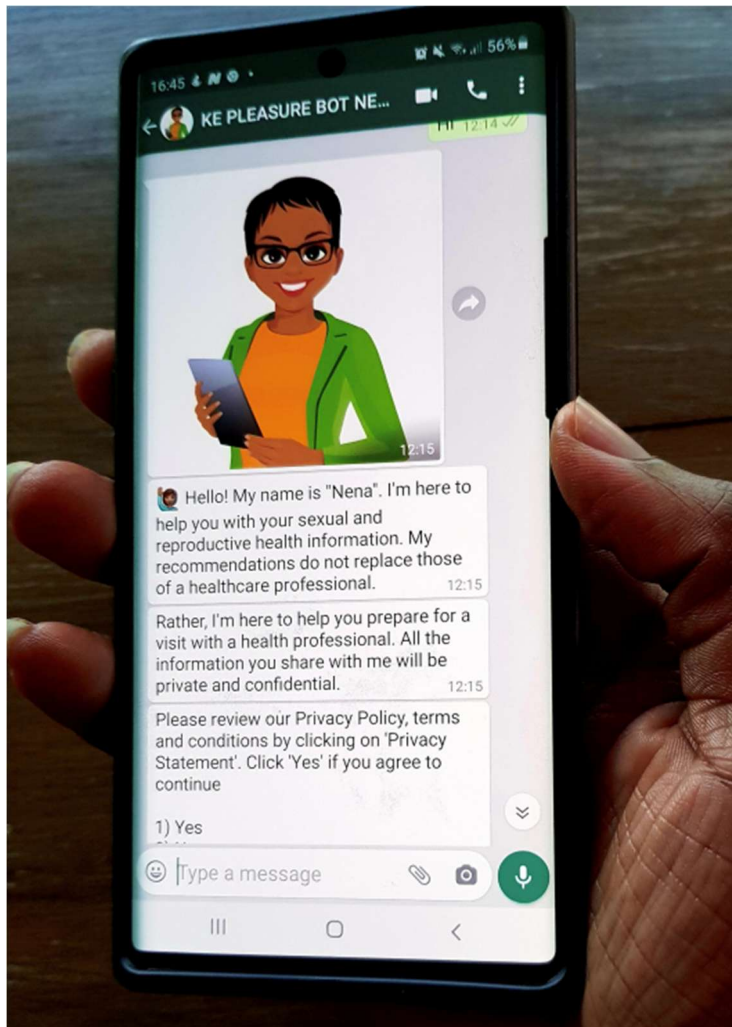
the application, the pilot surfaced challenges with both digital literacy and literacy more generally, which hindered some users' ability to fully engage with the application—with two users who participated in the trial requiring support from carers to use the app.

Physicians at Detecta Clinic shared that the application was useful in accessing the information they needed to follow up with patients, as patients input how they feel (including pain and anxiety levels) on *Avatr*. This information then reaches the physician for further actioning if required.

Suggestions from Detecta clinicians included adaption of *Avatr* technology to include content that would be of interest and helpful to patients in Peru, including the use of Peruvian music, and video guides on health conditions, meditation, exercise and food choices for managing their health, which physicians believed patients would prefer over receiving this information over brochures.



Sexual reproductive health chatbot²⁷



Objectives

The last time new HIV infections in Kenya were monitored by the time this study was initiated in 2019, was in 2015. It revealed that more than half (51%) of all new HIV infections in Kenya in 2015 occurred among adolescents and young adults (aged 15-24 years), a rapid rise from 29% in 2013.²⁸ This is due to a combination of factors including: limited knowledge about HIV prevention, inconsistent condom use, sexual activity starting earlier on, social pressure, poverty, lack of access to sexual and reproductive health services and gender inequalities, which often lead to risky sexual behaviours in this demographic group. To address some of these factors, especially those related to knowledge about HIV prevention and access to sexual and reproductive health services, the FT Hub partnered with Population Services International (PSI) to develop

and test an on-demand chatbot that enabled Kenyan adolescents and young adults (aged 18-29 years) to access private and on-demand sex-positive sexual and reproductive health information and healthcare services.

The key assumption was that if Kenyan young adults can access sex-positive sexual and reproductive health information privately and on-demand with linkages to health services via a chatbot, then they will engage in less risky sexual behaviours, resulting in fewer unwanted pregnancies and sexually transmitted infections and increased contraception use. Thus, the FT Hub partnered with PSI to develop a pleasure-oriented sexual and reproductive health and rights (SRHR) chatbot to test that assumption. An important aspect of the chatbot development was to ensure that it is pleasure-oriented. To develop an SRHR chatbot and test it with Kenyan young

²⁷ Njogu et al., 2023

²⁸ Kenya National Syndemic Diseases Control Council, 2021

adults from May 2019 to March 2022, the FT Hub and PSI followed a journey of four phases: understanding demand, creating awareness of the bot, identifying potential partners and developing the bot and releasing the chatbot to the Kenyan market.

Key Insights

The first phase was aimed at pinning down through existing peer reviewed literature the assumption that sex-positive, pleasure-oriented content results in positive behavioural or health outcomes. From a desk review, the team found limited literature on evidence of impact of sex-positive content in Sub-Saharan African countries and other LMICs. However, they found studies from high-income countries that suggest that sex-positive messaging has a positive effect on sexual health outcomes. Evidence from previous studies and programs has shown the effectiveness of sex-positive and pleasure-focused education in terms of improved attitudes and health outcomes, such as condom use and other safer sexual behaviours. Another finding from the desk review was that programming interventions often omit sexual pleasure. Furthermore, there are distinct barriers to accessing digital media platforms in LMICs, and research indicated mixed (both positive and negative) association between age and digital literacy.

In the second phase to create awareness of the bot, the FT Hub and PSI convened 84 Kenyan university students aged 18-29 from rural, peri-urban and urban backgrounds. In a variety of gender-segmented focus groups, they aimed to understand the nuances of sexual pleasure (from perception to comfort level) and identify how they could integrate digital platforms to reach young people with the information they said wanted, on their own terms. The team found that for young Kenyans, prevention is not top of mind as they will go to a clinic, but only once extreme health risks arise. They will often seek information online because Google is nonjudgmental. Young people use Google to self-diagnose and treat, but it is fear that drives this, rather than proactive measures to make healthy choices well before symptoms are present. In addition, confidentiality is key, and time efficiency is valued. Kenyan youth say they want to engage with sex-positive content, but don't have access to curated content from credible sources. The key takeaway from this phase was that the convergence of sexual pleasure and digital platforms can be promising to reach young people.

The third phase consisted of the development of the *Nena* chatbot as a pleasure-oriented digital companion for young people exploring sexual health. *Nena* was developed through a series of co-creation workshops with Kenyan youth, with content first developed and reviewed by a team including an SRHR expert and the PSI Quality of Care Team. The content was also shaped by a user experience and design team, which aimed to improve the style and process flow and adapt the language to optimize accessibility. Key insights that emerged during the programmatic design process included an interest among Kenyan youth to access information on sexual pleasure topics, including a strong interest in information on how to give and receive sexual pleasure, and a perceived lack of trustworthy sources of information on this topic. User insights from the design

process revealed strong preferences for alternatives to face-to-face interactions with health educators and providers and a desire for the privacy and convenience of on-demand information.

Nena is a structured, decision-tree chatbot, which provides users with an initial menu of content topics and algorithm-driven content sub-branches which they can navigate using designated numeric responses. Through an inbuilt health facility geo-locator feature, users who opt to self-refer for health services or products are provided options of the closest qualified providers offering youth-friendly health services. *Nena* also allows users to share feedback through an embedded self-reporting mechanism, which collects user experience data on the usefulness of the content and on intermediate behavioural and health outcomes related to their interactions with the chatbot. The resulting chatbot includes content on sexual pleasure, including how to have pleasurable sex, how to improve communication with sexual partners and information on orgasms and masturbation; pregnancy prevention, including contraception options and side effects; menstrual and genital health; and prevention of STIs including HIV. In addition to content specific to sexual pleasure, the chatbot aims for a sex-positive tone that normalizes pleasurable sex as a healthy adult behaviour.

In the last phase, *Nena* was introduced to the Kenyan market on WhatsApp, Facebook Messenger, and a microsite. There was a higher engagement rate from users when pleasure content (2,445 total users and 1,204 returning users) was integrated into the chatbot compared to when it was just health content (2,421 total users and 644 returning users). There was also a higher satisfaction rate during this phase. However, a technical difficulty with the technology identified during implementation was that many users assumed it was much more sophisticated than it was. Because the chatbot had structured conversations, it restricts the type of questions users can ask, and since this limitation wasn't conveyed to users, it resulted in some confusion.

Furthermore, an evaluation was conducted from November 2021 to January 2022 to assess the acceptability of *Nena* and describe changes in SRHR attitudes and behaviours among Kenyan young adults engaging with the pleasure-oriented SRHR chatbot. The study observed that the chatbot supported SRHR empowerment among users, and that it likely contributed to changes in users' knowledge and attitudes about sexual pleasure, ability to communicate about their SRHR related needs and ability to engage in safer sexual and reproductive health practices.²⁹

In particular, the study found that there was higher satisfaction at endline versus baseline on reported ability for users to exercise sexual rights, and saw that chatbot users reported higher confidence discussing contraception and sexual feelings and needs with sexual partner(s). Participants also reported improvements in sex-positive communication with partners and safer sex practices due to new learnings from the chatbot. Qualitative interviews indicated that most

²⁹ Njogu et al., 2023

participants valued the chatbot as a confidential and judgment-free source of trustworthy, on-demand SRHR information.

The importance of getting the tech out sooner rather than later was one of the key insights for this project. According to the project team, a lot of time and effort was spent building the content of the chatbot as well as identifying potential partners during the early stage. While this strengthened the foundations of the technology, the most insightful aspect of the journey was when the chatbot was released and the team began seeing users' engagement. By pushing for a minimum viable product sooner, these insights might have been recorded earlier, and the remainder of the pilot journey could have focused on building on these findings rather than ending on them.

One of the biggest challenges for the project team was to tailor the content so that it would resonate fully with the needs of young people. Furthermore, while the chatbot sent 1,119 referrals to a local Kenyan clinic, the pilot was unable to determine whether any users redeemed their referrals, and did not record any instances of this happening. This potentially indicates the limitations of a chatbot alone at supporting behavioural change—beyond wider interventions to shape incentives and support young people to access SRHR services.

mDoc³⁰

Objectives

The World Health Organization estimates that by 2030, chronic, NCDs will be the leading cause of death in Sub-Saharan Africa.³¹ Prevention from death and complications from NCDs are achieved when they access routine monitoring and care services. mHealth applications could be an effective tool in chronic disease management and improve patients' self-management behaviour. A growing body of research demonstrates the health benefits of mHealth interventions for patients with NCDs in terms of enhancing patient self-monitoring and health outcomes such as cardiovascular diseases.³² In Nigeria, the risk of premature death from cardiovascular disease, cancer, respiratory disease and diabetes among Nigeria's 30 to 69-year-olds is 22%.³³ Twenty percent of the population aged 30-70 are dying prematurely from NCDs and approximately 36 million citizens have diabetes and/or hypertension. Many have limited access to health care and/or self-care guidance needed to manage NCD conditions. To respond to this pressing need for self-management of hypertension through mHealth, the [mDoc](#) platform was created in Nigeria in 2017. mDoc is an IT platform that supports people with chronic health needs with self-management techniques (both digitally and in person) and capacitates providers to deliver evidence-based care.

³⁰ Lanzara, 2021

³¹ WHO Regional Office for Africa, 2022

³² Cruz-Ramos et al., 2022

³³ World Health Organization, 2018



From March 2020 to October 2021, the FT Hub provided a grant to mDoc's COVIDaction team to focus on technology augmentation and testing to strengthen their CompleteHealth™ platform to provide self-care support for low-income users. Specific activities included supporting mDoc with ongoing work to build a wellness coach chatbot, *Kem*, that provides the public with access to general advice on how to stay healthy, with a view to nudging them toward the adoption of lifestyle modifications and healthier behaviours. This work included enhancing the conversational design and integrating clinical content for the chat feature. The work involved a clinical team who compiled medical and health information for training the chatbot, machine learning engineers tasked with building the chatbot, and researchers who supported testing of the chatbot, so that it could be iterated following users' feedback. Following the FT Hub pilot, mDoc has worked with other partners to continue developing the chatbot. This work has included leveraging more recent developments, such as the availability of [GPT 4](#), to produce a chatbot capable of producing generated responses with increasing sophistication.

Key Insights

In part through the support offered by the FT Hub, as well as through significant subsequent work, mDoc created their chatbot *Kem* with a persona designed to function as a health coach to help bridge the gap in knowledge of health topics as well as guide and respond to mDoc members' questions.

Through user testing of *Kem*, the mDoc team learned that they needed to be more intentional about making the conversation interesting, user-friendly and less technical, hence the chatbot's extroverted persona. Users were thus willing to read and learn more about their health conditions. They were curious about the depth of *Kem*'s library of answers to different questions, and found that pre-defined (rather than generated responses) limited the conversation and depth of engagement. More complex AI was more appealing, better received and easier to use than the simpler, more familiar technology.

For users without smartphones but with basic phones, mDoc developed Unstructured Supplementary Service Data as well and referred it to an omnichannel, combining integrating multiple channels for a consistent experience in-person and online. This ensures the solution is accessible to a wider range of users.



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