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Developing a mHealth intervention to redesign the current journey for people living with HIV: A qualitative study

Desarrollo de una intervención mHealth para rediseñar la ruta asistencial de las personas que viven con VIH: Estudio cualitativo

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Abstract

Objective: People living with human immunodeficiency virus could particularly benefit from mobile health (mHealth). The objective of the study was to contribute to the design and development of a new standard of care for people living with human immunodeficiency virus and the mHealth app needed to support it by 1) exploring the view of people living with human immunodeficiency virus and healthcare professionals on the possibilities of mHealth tools on HIV care, and 2) implementing their feedback into the new app and into the new journey of people living with human immunodeficiency virus.

Method: The study was conducted in two different phases: phase one was to apprise patients' and healthcare professionals' perspectives on mHealth using the qualitative methodology of the focus groups, whereas phase two aimed to implement their feedback into the application.

Results: A total of five people living with human immunodeficiency virus and nine healthcare professionals (three clinical pharmacists, three nurses, two physicians, and one pharmacy technician) participated in the focus groups. The patients identified the following main aspects to be

KEYWORDS
Human immunodeficiency virus; mHealth; Telemedicine; Telepharmacy; Focus groups; PLWH; Qualitative research; Standard of care.

PALABRAS CLAVE
Virus de la inmunodeficiencia humana; Salud móvil; Telemedicina; Telefarmacia; Grupos focales; PVV; Investigación cualitativa; Modelo asistencial.

Resumen

Objetivo: Las personas que viven con el virus de la inmunodeficiencia humana podrían beneficiarse de nuevas estrategias de salud móvil (mSalud). El objetivo del estudio fue contribuir al diseño y desarrollo de un nuevo modelo asistencial en la población con virus de la inmunodeficiencia humana y de la aplicación móvil necesaria para apoyarlo mediante: 1) la exploración de la visión de personas que viven con el virus de la inmunodeficiencia humana y profesionales sanitarios sobre las herramientas digitales en la atención a este colectivo, y 2) la implementación de sus perspectivas en la nueva aplicación y en la nueva ruta asistencial.

Método: El estudio se realizó en dos fases: la primera tenía como objetivo conocer las perspectivas de los participantes sobre la salud móvil mediante la metodología cualitativa de los grupos focales, y la segunda implementar estas valoraciones en la aplicación.

Resultados: Participaron cinco pacientes y nueve profesionales sanitarios (tres farmacéuticos clínicos, tres enfermeras, dos médicas y una técnico de farmacia). Los pacientes consideraron que debían mejorarse los siguientes aspectos en su ruta asistencial: información insuficiente ($n = 5$), improved in the current patients' journey: insufficient information (*n* = 5), lack of general population disease awareness (*n* = 5), and medication dispensation model (*n* = 3). Moreover, healthcare professionals identified the next health outcomes to be enhanced with mHealth tools: patients' quality of life (*n* = 7), control of the disease (*n* = 5) and comorbidities (*n* = 3), and adherence to medication (*n* = 5). According to these needs, the new healthcare model was designed. The mHealth was provided with different features, such as information about the disease, health promotion and prevention, the possibility of two-way patient-healthcare professionals communication, or synchronization with other devices. The new human immunodeficiency virus care journey and the app are currently being tested in a group of people living with human immunodeficiency virus in real-world conditions in our hospital.

Conclusions: Improving patients' quality of life, therapeutic adherence, or disease control are key objectives for optimizing people living with human immunodeficiency virus care. Our digital health tool and the new healthcare model have been implemented based on end-users' feedback to achieve better patients-healthcare professionals communication and patient engagement with their care.

falta de conocimiento de la enfermedad (*n* = 5) y modelo de dispensación de la medicación (*n* = 3). Los profesionales identificaron que debían mejorarse: la calidad de vida de los pacientes (*n* = 7), el control de su enfermedad (*n* = 5) y de sus comorbilidades (*n* = 3), y la adherencia terapéutica (*n* = 5). De acuerdo con estas necesidades, se diseñó el nuevo modelo asistencial. Las siguientes características se incorporaron a la mHealth: información sobre la enfermedad, promoción y prevención de la salud, posibilidad de comunicación bidireccional profesional-paciente o sincronización con otros dispositivos. La nueva ruta asistencial y la aplicación están siendo estudiadas en un grupo de personas que viven con el virus de la inmunodeficiencia humana en condiciones de vida real y en seguimiento en nuestro hospital.

Conclusiones: La mejora de la calidad de vida, la adherencia terapéutica y el control de la enfermedad son factores clave para la optimización de la atención de las personas que viven con el virus de la inmunodeficiencia humana. Nuestra herramienta de salud digital y el modelo asistencial han sido diseñados en base a la opinión de pacientes para mejorar la comunicación profesional-paciente sanitario y conseguir un mayor compromiso de los pacientes con su cuidado.

Introduction

The use of digital health (eHealth) has a promising potential in delivering healthcare services to patients living with chronic conditions, especially with the opportunity to apply mobile phones technology (mHealth)[1]. The irruption of the novel coronavirus (COVID-19) outbreak in 2020 has increased the adoption of eHealth, mHealth, or other Telemedicine technologies as a practical solution to continue with chronic patients' healthcare while restricting presential appointments to healthcare facilities. Besides, previous experiences with eHealth and mHealth in chronic patients resulted in a better quality of care, enhanced clinical outcomes, and patient experience, in addition to a reduction in medical costs[2-6].

People living with human immunodeficiency virus (PLWH) could significantly benefit from mHealth tools since they necessitate close clinical monitoring and effective interdisciplinary care: they require lifelong antiretroviral therapy (ART), regular follow-up visits, and laboratory tests, and often accumulate multiple clinical comorbidities[7]. In addition, some of them have a high prevalence of comorbidities and polypharmacy[8]. Thus, implementing a mHealth tool to assist the PLWH management might help improve disease monitoring and treatment adherence, optimizing the current health care delivery.

The implementation of mHealth tools targeting complex populations such as PLWH is challenging. The mHeart application (app), recently implemented in our heart transplant outpatient clinic, is already a consolidated eHealth tool designed to help enhance chronic-stage heart transplant recipients' clinical care. The mHeart implementation has increased medication adherence in heart transplant recipients and has enhanced patients' experience and satisfaction with care[9-11].

Based on this previous experience, we are currently developing a new standard of care for PLWH and the mHealth app needed to support it, the EMMASalud (eHealth Medical Multiplatform Aid) MyPlan version. EMMASalud MyPlan is grounded on the theoretical framework of mHeart; therefore, it has been designed to promote targeted disease management.

The study was set out as part of a global project to implement a strategy for improving the current PLWH' journey using an interdisciplinary technology-based behavioral app. The study described in this article has two specific objectives: 1) to explore the view of patients and healthcare professionals (HCPs) on the possibilities of mHealth tools on HIV care, 2) and to implement their feedback into the new EMMASalud MyPlan and into the new standard of care for PLWH.

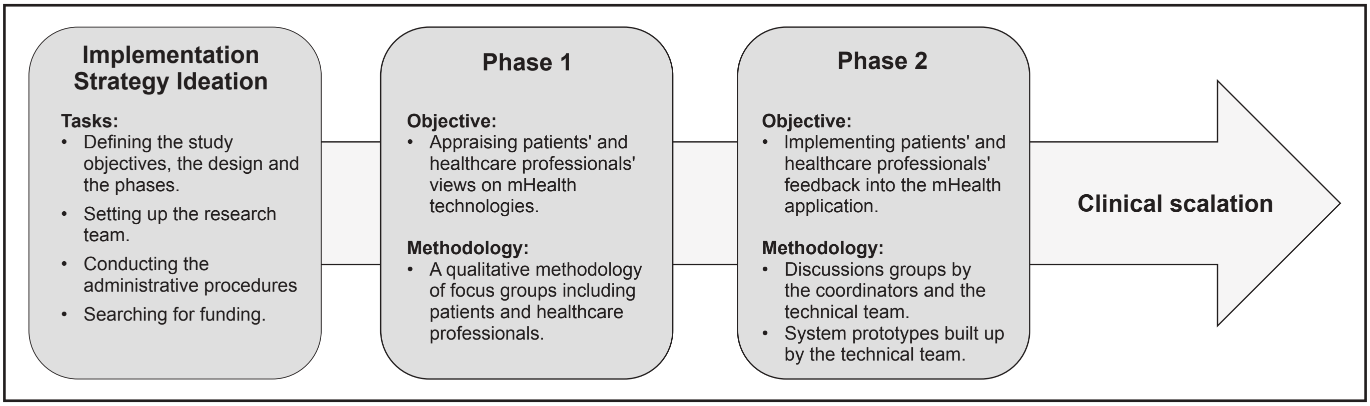
Methods

The present study is part of an implementation strategy of a clinical practice improvement model. It was conducted by the pharmacy service together with the infectious disease unit at a tertiary university hospital between 2020 and 2022. The coordinator team comprised two clinical pharmacists with extensive experience in implementing digital health strategies and in the guidance of focus groups. The study was approved by the referent Ethics Committee (IIBSP-ARV-2020-78).

The study had two different phases: phase one was to apprise PLWH' and HCPs' perspectives on mHealth using the qualitative methodology of the focus groups, whereas phase two aimed to implement their feedback into the app and the new standard of care for PLWH.

The project's ideation was carried out between 2019 and 2021 (before starting phase 1: focus groups). This preliminary step of the project aimed to define the study objectives, design, and phases, set up the research team, conduct the administrative procedures (approval of the ethics committee) and search for funding. A summary of the phases of the study is described in figure 1.

Figure 1. *Summary of the phases of the study within the development of the EMMASalud MyPlan approach.*



Phase 1: Focus groups

Phase 1 consisted of the qualitative methodology of the focus groups and lasted from September to October 2021. The focus groups were held at hospital facilities, lasted between one and two hours, and were guided by the coordinator team. The COREQ (Consolidated criteria for reporting qualitative Research) guidelines were followed to report the content of focus groups[12] (Supplementary Material, Table 1).

Participants in the focus groups, PLWH and HCPs, were recruited by direct invitations. The patients' sample comprised subjects under ART treatment followed by the infectious disease and the pharmacy team, whereas HCPs' sample consisted of professionals from different specialties. All participants provided written informed consent.

During focus groups, PLWH were asked to identify aspects to improve their journey, whereas HCPs were required to determine positive health outcomes obtained using mHealth tools. Both groups also had to establish what characteristics and tools EMMASalud MyPlan should have in our healthcare setting.

Focus groups were structured in the following stages: metaplan, prioritization (only for HCPs), open discussion, and discussion. Before the discussion, a demonstration of EMMASalud MyPlan tool was made (See the Supplementary Material, Figure 1, for more information about focus groups methodology)**.**

Phase 2: Implementation of people living with human immunodeficiency virus and healthcare professionals' feedback into the new mHealth app

Phase 2 lasted from November to December 2021. It was intended to assess PLWH and HCPs' feedback, identify unmet needs in the PLWH pathway, and the app functionalities that would meet those needs for its implementation into the new app and standard of care. Together with the technical team, the coordinators identified and prioritized the most important features to be implemented in the app and tested the resulting system prototypes. Additionally, the Hospital Information System Department and the technical team worked on the interoperability between the app and the hospital clinical record.

Finally, a multidisciplinary team guided by the coordinating team coordinated the redesign of the current PLWH' journey and designed a pilot study to evaluate the new care model in clinical practice.

Results

Phase 1: Focus groups

Patients' focus groups

Of 14 patients contacted, 5 male patients participated in the focus group with a mean age of 39 (range 27-54 years). The patients' focus group results are summarized in table 1.

PLWH considered that current PLWH' journey has the following problems: insufficient information (*n* = 5), lack of general population disease awareness (*n* = 5), and treatment dispensation (dispensation for a short period [*n* = 3] and need to pick up medication at the hospital [*n* = 2]). Accordingly, patients believed they received insufficient information about their disease, prognosis, and therapeutic management. They also believed in the need to improve society information about HIV to mitigate stigma and discrimination. In addition, most PLWH expressed their preference for home delivery or dispensation at community pharmacies instead of hospital pharmacies and wished to be provided with medication for a longer period.

Patients identified the following features in a mHealth to overcome their unmet needs: information about their disease and medication; direct com-

Table 1. Summary of the main findings of the participants focus groups

Patient focus group (N = 5)
Aspects for improvement in the current HIV-infected patients' standard of care (most frequent answers)
Insufficient information about their disease, prognosis, and therapeutic management, *n* = 5 (100%)
Lack of awareness of the disease in the general population (need destigmatization of the disease), *n* = 5 (100%)
Be provided with medication for a longer period, *n* = 3 (60%)
No need to pick up medication at the hospital, *n* = 2 (40%)
Having more HIV references and other people with HIV to talk to, *n* = 2 (40%)
Strategies to achieve these improvements (most frequent answers)
More information during and after diagnosis about their disease, prognosis, therapeutic management, and availability of contrasted sources of information In particular, more specific information on: o What it means to be HIV positive o Clinical trials o Drug interactions o Health pathways (e.g., consultations to the pharmacy service) o Viral load o CD4 and CD8 counts are o What is monitored in the blood test and why o The difference between HIV and AIDS o Survival rates o Lifestyle habits o Sexuality o Medication dispensation options
Greater discretion in the healthcare environment (avoidance of the term infectious and greater anonymity)
Domiciliary and longer-term medication dispensation

Table 1 ***(cont.).*** Summary of the main findings of the participants focus groups

Features that mHealth must have to obtain these results	**Implemented**	**Postponed to subsequent improvement phases**
Ease of access and use	✔	
Information about the disease	✔	
Direct two-way patient-professional communication (messaging and video-call)	✔	
Visits and medication management (medical appointments, prescriptions, etc.)		✔
Ability to generate medical history report		✔
Synchronisation with other institutional health apps		✔
Synchronisation with other devices (i.e., apple watches)	✔	
Chat/forum other patients		Not programmed
Healthcare professionals (N = 9)		
Health outcomes benefit obtained from the use of mHealth tools (most frequent answers)		
Improved patients' quality of life, *n* = 7 (77.8%)		
Improved disease control, *n* = 5 (55.5%)		
Improved patients' adherence to therapy, *n* = 5 (55.5%)		
Improved comorbidities' control, *n* = 3 (33.3%)		
Increased patient awareness of their pathology (expert patient), *n* = 3 (33.3%)		
Prioritization • Quality of life • Disease control		
Role that PLWH should adopt to achieve these objectives (most frequent answers)		
Increased patients' engagement, *n* = 6 (66.7%)		
Increased patients' confidence in the professionals who attend them, *n* = 4 (44.4%)		
Increased clinical follow-up, *n* = 3 (33.3%)		
Improved communication between patients and HCPs, *n* = 2 (22.2%)		
Healthier lifestyle habits, *n* = 2 (22.2%)		
Prioritization • Confidence in HCPs • Increased clinical follow-up		
Features that mHealth must have to obtain these results	**Implemented**	**Postponed to subsequent improvement**
Ease of access and use	✔	
Information about the disease	✔	
Direct two-way patient-professional communication (messaging and video-call)	✔	
Visits and medication management (medical appointments, prescriptions, etc.)		✔
Reporting of patient symptoms and adverse events	✔	
Communication with other professionals and the possibility of referral		✔
Emotional support to the patient		✔

AIDS: acquired immunodeficiency syndrome; HIV: human immunodeficiency virus.

munication with HCPs (via messages or video calls); access to medical appointments, prescriptions, laboratory tests, or medical history reports; synchronization with other health apps or other electronic devices; and chats or forums with other patients.

Healthcare professionals' focus groups

In total, nine HCPs of different specialties participated in the focus group: clinical pharmacists (*n* = 3), nurses (*n* = 3), physicians (*n* = 2), and pharmacy technicians (*n* = 1). The HCPs' focus group results are summarized in table 1.

Participants identified different health outcomes to be enhanced from the use of mHealth tools: patients' quality of life (*n* = 7), control of the disease (*n* = 5) and comorbidities (*n* = 3), and adherence to medication (*n* = 5). According to HCPs, achieving these goals requires greater patients' willingness to have a closest clinical follow-up and a greater engagement and trust in the professionals.

For HCPs, mHealth should provide: educational information; direct communication with patients (via messages or video calls); visits and medication traceability management; monitor patients' self-report symptoms, adverse events and therapeutic adherence; consultations with other specialists, and referrals.

Phase 2. Implementation of patients' and healthcare professionals' feedback into the new mHealth app

Functionalities of the new app adapted to people living with human immunodeficiency virus

Based on the results of the focus groups, mHealth features and functionalities were identified and prioritized to be applied in the EMMASalud MyPlan prototype. Concretely, disease information, health promotion and prevention, two-way patient-HCPs communication and synchronization with other devices were implemented (Figure 2 shows screenshots of the EMMASalud MyPlan and its functionalities). Other functionalities will be applied in future phases (Table 1).

As a result, EMMASalud MyPlan was designed as a patient app and a professional support website for the follow-up of PLWH. PLWH module permits them to register health controls (such as blood pressure, weight, glycemia, or exercise), symptoms (fever, diarrhea, constipation, insomnia, vomiting, nausea, asthenia, headache, pain, skin problems, and others), medication adherence and medical appointments or other relevant citations for the user. The app also permits them to receive reminders of medication and appointments and establish synchronous and asynchronous communication with their health providers.

On the other hand, the providers' module permits to consult patients' symptoms and adverse events, treatment adherence, and other health controls. It also allows synchronous and asynchronous communication with patients.

Table 2 shows the details about patients' and providers' modules functionalities and their clinical applications. More details are provided in a video link to the app for patients (https://www.youtube.com/watch?v=q_RU03Zrxoo) and the web for HCPs (https://www.youtube.com/watch?v=hUpZ6VoKGco). The app can be downloaded free from the online Google[13] and Apple[14] stores. The general layout is represented in the Supplementary Material (Figure 2). The behavioral framework of the EMMASalud MyPlan is based on the mHeart model and has been published previously[9-11].

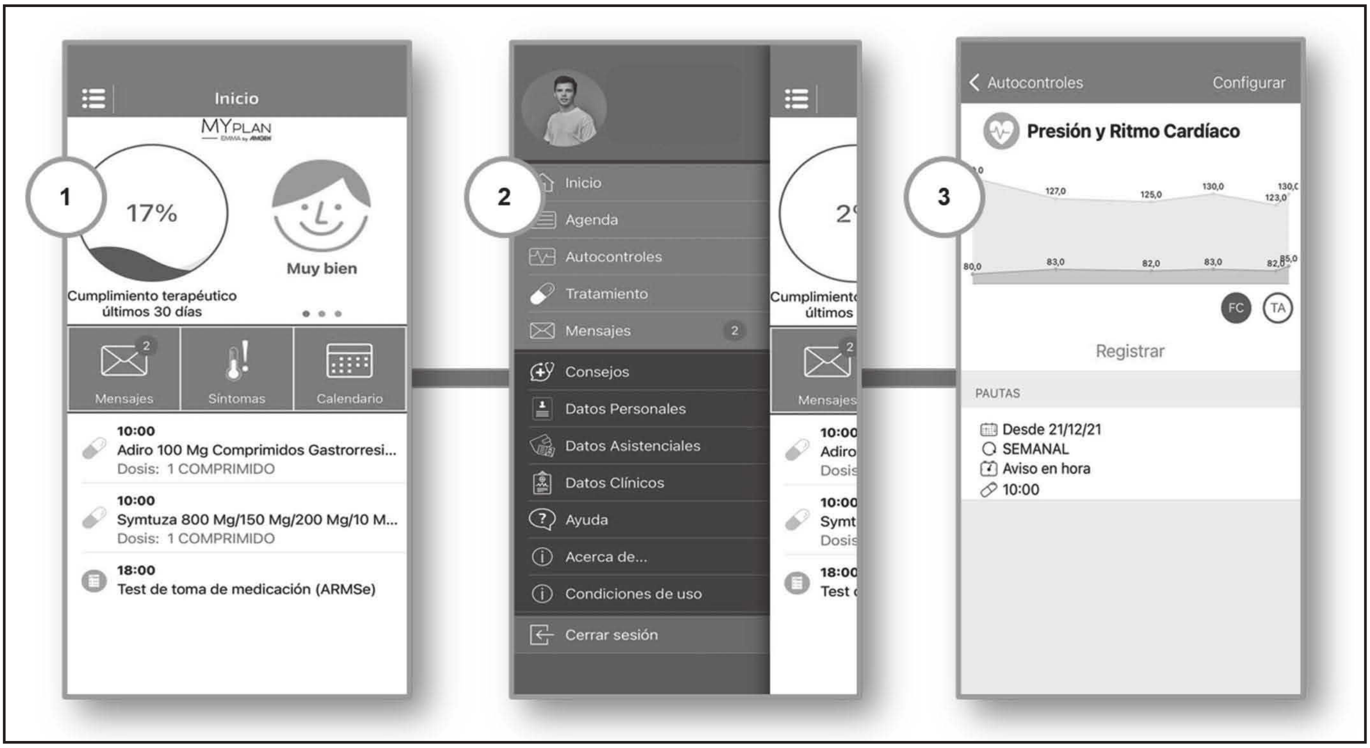
Implementation of the new app adapted to people living with human immunodeficiency virus

EMMASalud MyPlan has been designed for phone, computer, or tablet users. In addition, interoperability between the app and the hospital information system (hospital clinical records) has been solved. Consequently, it is possible a two-way data exchange: firstly, the app can incorporate sociodemographic data from the hospital patient's clinical records. Secondly, a report containing patients' information registered in the app is uploaded weekly to the hospital information system.

The EMMASalud MyPlan tool is currently being tested in a pilot study for its future incorporation into the PLWH' journey. The medical team selects patients to participate in this pilot study. Patients who accept to participate are then referred to the pharmacy department. Patients are randomly assigned to routine or mHealth follow-up through a pharmaceutical care visit. Patients in the intervention group are trained on the use of EMMASalud MyPlan. During the interview, pharmacists collect patients' sociodemographic and lifestyle data, treatment adherence, and a complete medication profile. Patients can use asynchronous communication with their clinical team. Patients are invited to answer some questionnaires periodically scheduled in the app and related to the medication adherence (SMAQ, Hayness-Sackett), quality of life (EuroQoL-5D [EQ-5D]), anxiety and depression (Hospital Anxiety and Depression Scale [HADS]) or insomnia (Insomnia Severity Index [ISI]).

The multidisciplinary team (pharmacists, pharmacy technicians, doctors, and nurses) monitors patients' health status through the app. If any serious adverse event is detected, a coordinated response is given. Patients are instructed that this app is not for urgent issues or consultations.

Figure 2. *Application EMMASalud MyPlan screenshots. 1) Home screen. 2) System menu (agenda, self-controls, treatment consultation and management, messages, health information, personal data, healthcare data, clinical data, help, about the app and terms of use. 3) An example of self-control (i.e., cardiac frequency measure): view of the data provided by the patient and the pattern prescribed at the agenda.*



10:00
Adiro 100 Mg Comprimidos Gastrorresi...
Dosis: 1 COMPRIMIDO

10:00
Symtuza 800 Mg/150 Mg/200 Mg/10 M...
Dosis: 1 COMPRIMIDO

18:00
Test de toma de medicación (ARMSe)

Desde 21/12/21
SEMANAL
Aviso en hora
10:00

Table 2. EMMASalud patient and professional profile modules, components, and clinical use

Patient Module	Components and clinical use
Treatment	Medication list includes information on inactive drugs. Drug catalog synchronized with the Spanish National Formulary Enquire about interactions consultation (i.e., ask the pharmacist about new therapies) Medication dispensation traceability by QR code scan
Patient-Centered Module	Consulting and recording data (manually or using wearables or data collected by other apps available on the smartphone). Reminders can be scheduled in Agenda: 1. Vital signs (i.e., blood pressure, temperature, pulse, and respiratory rate) and biomeasurements (i.e., weight, height, glycemia) 2. Dietary intake, exercise data, general wellness, smoking cessation, and pain scale 3. Health instruments: adherence to medication (Haynes-Sackett, Morisky-Green 4-item scale, SMAQ), insomnia (ISI), anxiety and depression (HADS) quality of life (EQ-5D-3L) 4. Symptoms or adverse effects. Some symptoms are connected with an alert to clinicians. A color code (red-orange-green) of the alert helps the clinitian to prioritize their intervention
Agenda	The content of diverse modules is uploaded. A Push text alert can be activated on the patient's mobile phone for the following aspects: 1. Medication timing and consultation of recommendations 2. Drug intake recording (single or several drugs at the same time) and reasons for non-adherence (drop-down list) 3. Non-pharmacological prescriptions (including dietary or physical recommendations) 4. Tasks from the Patient-Centered Module programmed 5. Health reminders (e.g., appointments, blood tests) 6. Personal appointments
Communication Aids	1. Synchronous communication: individual teleconference session 2. Asynchronous communication: private patient-provider chat. Images, files, audio records can be attached
Health Advice	Healthy lifestyle and health promotion information (e.g., texts, photographs, multimedia files, links to videos)
Personal and Clinical Data	Sociodemographic data, documented allergies, and provider profiles (including affiliation and picture)
Help	1. A help center service to solve both technical and functional problems 2. Clinical contact data
About	Information about the developers, the aim of the tool, and the team in charge of it and the sponsors
Terms of Use and Privacy Policy	All the legal requirements already accepted should always be available for consultation
Provider Module	**Component and clinical use**
Patient View	List of active patient filters to organize the list and perform a rapid search
Patient Registration	1. The Center identification number is used to download patient data from the hospital information system 2. The patient receives a private message with login credentials 3. Providers individualize the patient-reported outcome measures schedule and the treatment plan and recommendations for each new patient
Treatment Prescription	1. Pharmacological treatment is prescribed from a drop-down list of drugs updated from the Spanish National Formulary. Tailored recommendations can be added (e.g., "It is recommended that you take this on an empty stomach") 2. Non-pharmacological therapies can be prescribed in free-form data entry by the multidisciplinary team (e.g., non-salty diet)

Tabla 2 *(cont.)*. EMMASalud patient and professional profile modules, components, and clinical use

Provider Module	Component and clinical use
Patient-Centered Data Consultation	All the data recorded in the Patient-Centered Module can be tracked graphically in tables and diagrams. Timeframes filters can be used. Traffic lights and alerts on the main page help the clinician to prioritize their intervention. The app allows to trace the following aspects: 1. Patient inactivity (by filtering by the last activity date) 2. Patient's weekly adherence. List of patients can be sorted by adherence rate to prioritize interventions Adherence rates are presented graphically and through tables (for each drug and for the overall treatment) 3. New medication is included by the patients (waits for the pharmacist's validation of the treatment) 4. Symptoms and adverse events 5. Completion of questionnaires 6. Pending messages 7. Heart rate and blood tension
Communication Aids	1. Individual patient-provider chat 2. Group messaging. Filters are available. Large-scale interventions can be scheduled (e.g., preventive health promotions) for specific time periods 3. Teleconsultation patient/s-provider/s for individual or group visit
Reports	All PROMs and PREMs registered by the patients can be downloaded, filtered by dates, by any team member in an Excel format
Incident Report	A external incident manager that allows the HCPs to trace their reported incidents or their suggestions to the technical team

EQ-5D-3L: EuroQol-5 Dimension; HADS: Hospital Anxiety and Depression Scale; HCPs: healthcare professionals; ISI: Insomnia Severity Index; PREMs: patient reported experience measures; PROMs: patient reported outcomes measures; QR. quick response; SMAQ: simplified medication adherence questionnaire.

Discussion

The use of mHealth systems —and, more specifically, mobile apps— to support chronic patients' management improves quality of care, health outcomes and patient experience and also reduces medical costs in some settings[2-6]. Our study has contributed to develop an interdisciplinary technology-based behavioral app for PLWH patients.

In general, patients and HCPs shared common viewpoints on the possibilities of mHealth tools on HIV care. For example, both agreed that a mHealth tool could promote patients' education, improve patients-HCPs communication, or integrate medical appointments and drug prescription and dispensation. In line with our results, in a previous focus group conducted in the United States[15], young PLWH thought that a mHealth app might ease access and communication to HCPs and provide them with updated health education. In addition, it could help them schedule medical appointments or track personal data. Similarly, a group of physicians considered that mobile medical apps would be useful for informing and educating their patients and assisting their clinical decision-making or patient monitoring[16].

Patients and HCPs in the study agreed on important aspects. However, they focused on diferent aspects of mHealth tools for PLWH. HCPs placed special focus on the use of mHealth technology to improve health outcomes, including patient quality of life, disease control, and patient adherence. Conversely, patients were centered on the fact that mHealth technology may help them be treated more discretely and change the dispensation medication model out of the hospital environment. Previous experiences demonstrated that digital health interventions might allow for greater PLWH anonymity and more flexibility in scheduling appointments[17]. They might also improve the efficiency of pharmacy follow-up visits or facilitate medication home delivery[18,19].

Results of the focus groups enabled us to gain an in-depth understanding of the app end-users' needs and incorporate them into the app as functionalities. Among these functionalities is the information about the disease, health promotion, and prevention, the possibility of direct patient-HCPs communication, or synchronization with other devices.

A key aspect of the development of any healthcare technology is its validation under real-life conditions and its implementation into the patients' care pathway. Accordingly, this new tool is currently being implemented in our institution. The app is being tested in a group of PLWH in real-world conditions and compared with routine care. With the implementation in clinical practice, we expected an improvement in the PLWH' journey in terms of patients' and HCPs' communication, medication adherence, patient empowerment, and healthy lifestyles. This has been corroborated in other technology-based interventions and settings[20-23]. Adherence to ART is crucial in HIV management to avoid drug resistance, disease progression, and complications[24]. In line with this, different interventions show that digital health help PLWH comply with ART[25-27]. Additionally, our experience with digital health intervention (mHeart) with chronic-stage heart transplant recipients resulted in higher adherence rates[9-11].

Another challenge is to improve patients' monitoring through mHealth. PLWH require lifelong and close follow-up as they might accumulate age-related comorbidities and polypharmacy[7,8]. In that respect, we believe that the use of mHealth might facilitate close and long-term monitoring of clinical parameters (i.e., blood pressure, heart rate, weight, glycemia, etc.), symptoms, and adverse effects. Clinicians may take clinical actions in response to these patients' reports. Furthermore, we expect that our intervention might facilitate the monitoring of Patient-Reported Outcomes (PROs) and Patient-Reported Experiences (PREs) such as patients' quality of life and satisfaction with their care, which might help to improve patients' experience and ultimately strengthen their engagement and retention in their care as previously shown[28,29].

Our study has some limitations. First, the PLWH's- sample was small. However, due to the qualitative nature of the study, the small sample did not limit the obtention of rich and detailed information about patient's view. Secondly, all patients were men. Nevertheless, most PLWH treated in Spain are men, what makes this sample a good representation of the end-users of the mHealth in our center[30].

In conclusion, improving patients' quality of life, therapeutic adherence, or disease control are key objectives for the optimization of PLWH' journey. We are currently implementing our technology-based behavioral app EMMASalud MyPlan into our clinical protocols to establish a new PLWH' journey. In addition, the app is being tested in real-world conditions. With the fully implementation of the app and the new healthcare model we expected to overcome these important challenges in HIV management through better patients-HCPs communication, patients' monitoring and satisfaction, and engagement with their care.

Funding

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The current sponsor Amgen has supported the Hospital to fund the technical development of the app EMMASalud MyPlan (EMMA, eHealth Medical Multiplatform Aid).

The funders mentioned above and the firm in charge of the technological development of the software (Trilema Salud Group S.L.) played no role in the study design, data collection, analysis, decision to publish, or preparation of the manuscript.

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Conflict of interests

The authors declare no conflicts of interest. The technological development of the EMMASalud MyPlan application was carried out by a private Spanish firm specializing in health care system apps (Trilema Salud Group S.L.). Most of the authors of this study participated as consultants of the application design. Neither the funding entities mentioned above nor the technical developers played any role in study design, data collection and analysis, publication decision, or manuscript preparation.

Contribution to the scientific literature

Our study has contributed to implementing a new digital health model to improve people living with human immunodeficiency virus' journey.

Our digital standard of care might improve people living with human immunodeficiency virus' quality of life, therapeutic adherence, and disease control.

Supplementary material

Supplementary Table 1. COREQ (Consolidated criteria for reporting qualitative Research) checklist

Domain	items	HCPs' Focus Group	Patients' Focus Group
Domain 1: Research team and reflexivity			
Personal Characteristics			
1- Interviewer/facilitator	Which author/s conducted the interview or focus group?	M.G. and A.D.	A.D.
2- Credentials	What were the researcher's credentials? E.g., Ph.D., MD	M.G. and A.D. are clinical pharmacists	A.D. is a clinical pharmacist
3- Occupation	What was their occupation at the time of the study?	M.G. and A.D. are associate pharmacists in the cardiology and cardiac surgery unit. M.G. digital health coordinator. A.D: digital health project manager.	A.D. is an associate pharmacist in the cardiology and cardiac surgery unit and digital health project manager
4- Gender	Was the researcher male or female?	Both women	Woman
5- Experience and training	What experience or training did the researcher have?	Both researchers have participated, designed, and mediated focus groups.	She has participated (as a listener) in designing and mediating focus groups.
Relationship with participants			
6- Relationship established	Was a relationship established before study commencement?	Close working relationship with pharmacy service participants. Occasional previous working contact with the medical team. No previous contact with nursing.	No previous contact

Supplementary Table 1 ***(cont.)*****.** COREQ (Consolidated criteria for reporting qualitative Research) checklist

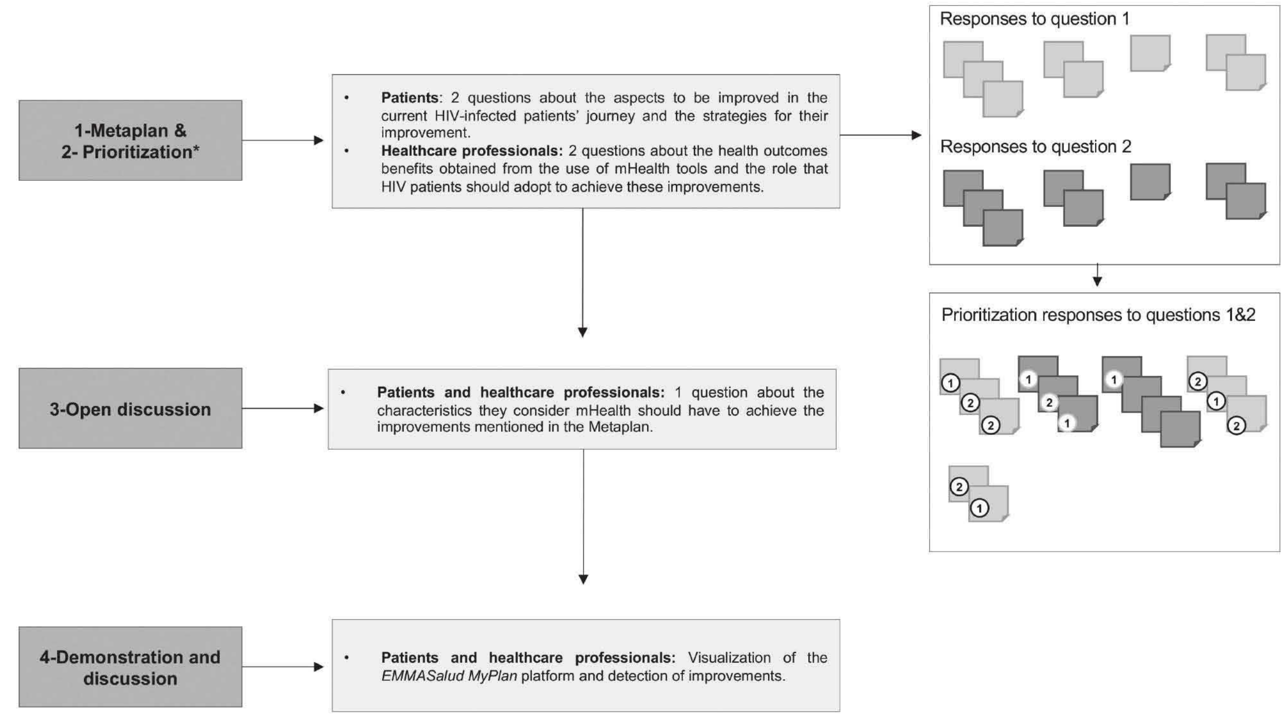
Domain	items	HCPs' Focus Group	Patients' Focus Group
Domain 1: Research team and reflexivity			
Relationship with participants			
7- Participant knowledge of the interviewer	What did the participants know about the researcher? e.g., personal goals, reasons for doing the research	The interviewers were introduced and informed of the purpose of the study (orally + signature of the informed consent) during recruitment and before the focus group session.	The interviewer was introduced and informed of the purpose of the study (orally + signature of the informed consent) during recruitment and before the focus group session.
8- Interviewer characteristics	What characteristics were reported about the interviewer/facilitator? e.g., Bias, assumptions, reasons, and interests in the research topic	The previous experience of the interviewers in the use and implementation of digital health and the possible bias that this could entail were reported.	The previous experience of the interviewer in the use and implementation of digital health and the possible bias that this could entail were reported.
Domain 2: study design			
Theoretical framework			
9- Methodological orientation and Theory	What methodological orientation was stated to underpin the study? e.g., grounded theory, discourse analysis, ethnography, phenomenology, content analysis	Phenomenology	Phenomenology
Participant selection			
10- Sampling	How were participants selected? e.g., purposive, convenience, consecutive, snowball	Their field of HIV experience was considered, in addition to the variability of gender, age, and professional category.	HIV patients. A varied sample was targeted (men, women, different ages, etc.). Patients were also intended to be good communicators.
11- Method of approach	How were participants approached? e.g., face-to-face, telephone, mail, email	Face-to-face and by e-mail	Face-to-face, by e-mail, and by telephone
12- Sample size	How many participants were in the study?	9	5
13- Non-participation	How many people refused to participate or dropped out? Reasons?	None	9; reasons: the stigma of the disease (not wanting to participate in a group where people might know you are HIV positive) and incompatibility with the schedule.
Setting			
14- Setting of data collection	Where was the data collected? e.g., home, clinic, workplace	Hospital	HIV patients. A varied sample was targeted (men, women, different ages, etc.). Patients were also intended to be good communicators.
15- Presence of non-participants	Was anyone else present besides the participants and researchers?	No	No
16- Description of sample	What are the important characteristics of the sample? e.g., demographic data, date	Sample varied in terms of gender, age, professional category. They all dedicate their work activity (full or partial) to HIV patients.	All patients were males of different ages (27 to 54 years old) and followed-up at the center.

Supplementary Table 1 ***(cont.).*** COREQ (Consolidated criteria for reporting qualitative Research) checklist

Domain	items	HCPs' Focus Group	Patients' Focus Group
Domain 2: study design			
Data collection			
17- Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot-tested?	The initial approach was a structured guide based on open-ended questions and interspersed with other types of questions. The initial script was adapted to the participants' answers. This scheme was similar to that used by the research team in another population.	The initial approach was a structured guide based on open-ended questions and interspersed with other types of questions. The initial script was adapted to the participants' answers. This scheme was similar to that used by the research team in another population.
18- Repeat interviews	Were repeat interviews carried out? If yes, how many?	No	Yes, twice
19- Audio/visual recording	Did the research use audio or visual recordings to collect the data?	Yes (audio)	Yes (audio)
20- Field notes	Were field notes made during and/or after the interview or focus group?	Yes	Yes
21- Duration	What was the duration of the interviews or focus group?	Approximately 2 hours	Approximately 2 hours
22- Data saturation	Was data saturation discussed?	No	No
23- Transcripts returned	Were transcripts returned to participants for comment and/or correction?	No	No
Domain 3: analysis and findings			
Data analysis			
24- Number of data coders	How many data coders coded the data?	NA	NA
25-Description of the coding tree	Did the authors describe the coding tree?	NA	NA
26- Derivation of themes	Were themes identified in advance or derived from the data?	Themes were identified in advance but derived from the responses as they emerged.	Themes were identified in advance but derived from the responses as they emerged.
27- Software	What software, if applicable, was used to manage the data?	Not used, not necessary	Not used, not necessary
28- Participant checking	Did participants provide feedback on the findings?	Yes	Yes
Reporting			
29- Quotations presented	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g., participant number	No	No
30- Data and findings consistent	Was there consistency between the data presented and the findings?	NA	NA
31- Clarity of major themes	Were major themes presented in the findings?	Yes	Yes
32- Clarity of minor themes	Is there a description of diverse cases or a discussion of minor themes?	Yes	Yes

Abbreviations: HCPs (Healthcare professionals); HIV (human immunodeficiency virus); NA (not applicable).

Supplementary Figure 1. *Summary of the methodology used in patients and HCPs focus groups*



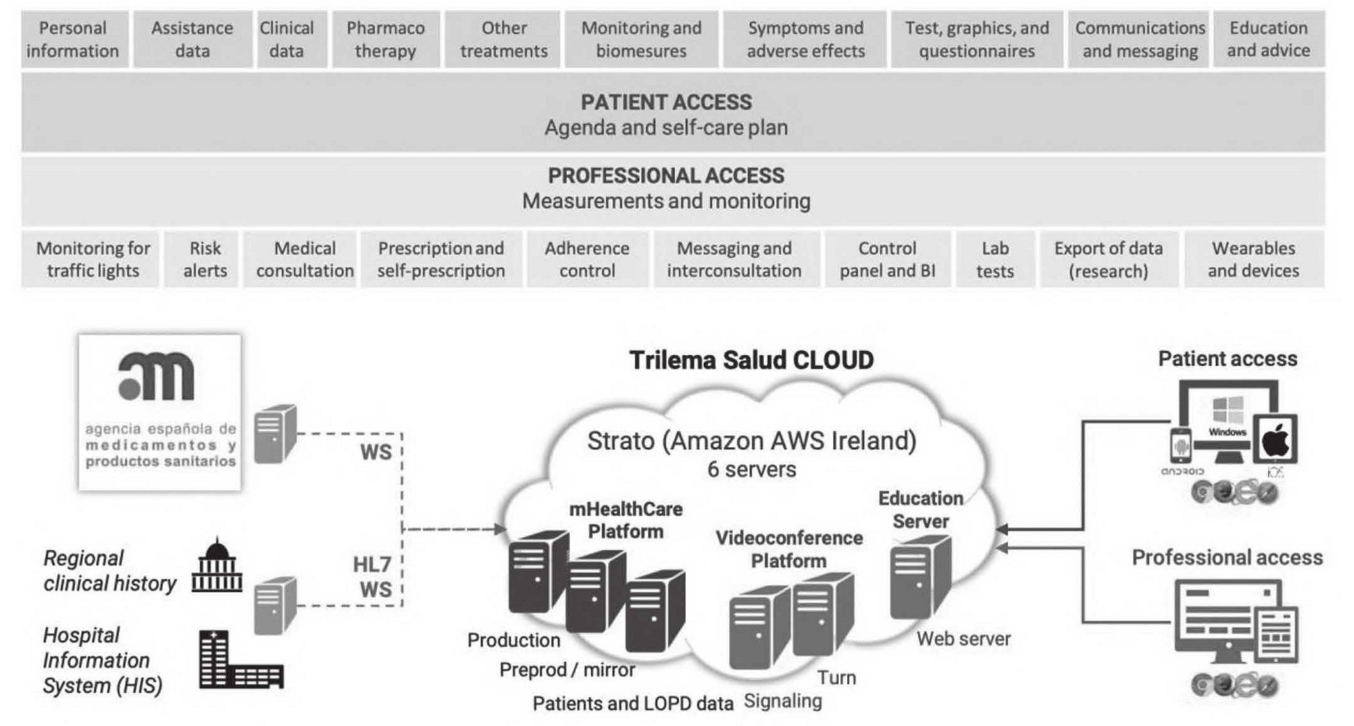
- **Patients**: 2 questions about the aspects to be improved in the current HIV-infected patients' journey and the strategies for their improvement.
- **Healthcare professionals:** 2 questions about the health outcomes benefits obtained from the use of mHealth tools and the role that HIV patients should adopt to achieve these improvements.

- **Patients and healthcare professionals:** 1 question about the characteristics they consider mHealth should have to achieve the improvements mentioned in the Metaplan.

- **Patients and healthcare professionals:** Visualization of the *EMMASalud MyPlan* platform and detection of improvements.

*Prioritization was carried out exclusively in the HCPs focus group. In the Metaplan, patients and HCPs had approximately 3 minutes to provide between 3-5 responses to each question individually. Answers to one of the questions were written down on a post-it in one color (light grey in the example), while the answers to the other question were written down on a post-it in a different color (dark grey in the example). Similar answers were grouped and shared with the group. In the prioritization, each HCP was asked to indicate the most important answer with a sticker (sticker with the number 1 in the example) and the next most important answer with another sticker (sticker with the number 2 in the example). The question that received more stickers was considered the most important (especially with more stickers with the number 1)

Supplementary Figure 2. *The EMMASalud MyPlan Functional Layer and Cloud Architecture. HIS, Hospital Information System; LOPD, the Spanish Organic Data Protection Law; WS, web server; HL7, High Level-7.*



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