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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

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 técnica de farmacia). Los pacientes consideraron que debían mejorarse los siguientes aspectos en su ruta asistencial: información insuficiente (n = 5),

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.



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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.

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 present 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 comorbidities⁷. In addition, some of them have a high prevalence of comorbidities and polypharmacy⁸. 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,

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.

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.

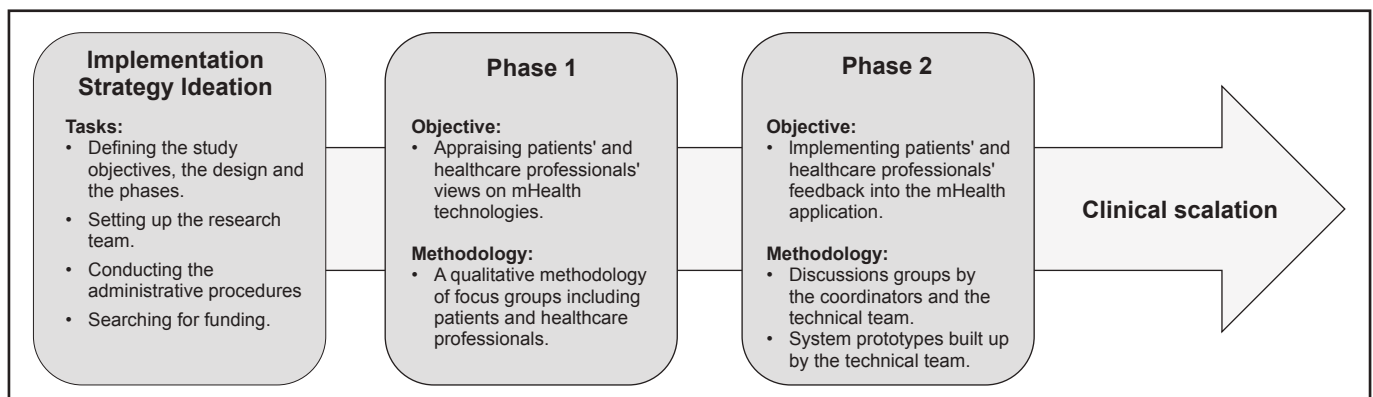
Methods

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 groups¹² (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: <ul style="list-style-type: none"> 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, <i>n</i> = 7 (77.8%) | | |
| Improved disease control, <i>n</i> = 5 (55.5%) | | |
| Improved patients' adherence to therapy, <i>n</i> = 5 (55.5%) | | |
| Improved comorbidities' control, <i>n</i> = 3 (33.3%) | | |
| Increased patient awareness of their pathology (expert patient), <i>n</i> = 3 (33.3%) | | |
| Prioritization | | |
| <ul style="list-style-type: none"> • Quality of life • Disease control | | |
| Role that PLWH should adopt to achieve these objectives (most frequent answers) | | |
| Increased patients' engagement, <i>n</i> = 6 (66.7%) | | |
| Increased patients' confidence in the professionals who attend them, <i>n</i> = 4 (44.4%) | | |
| Increased clinical follow-up, <i>n</i> = 3 (33.3%) | | |
| Improved communication between patients and HCPs, <i>n</i> = 2 (22.2%) | | |
| Healthier lifestyle habits, <i>n</i> = 2 (22.2%) | | |
| Prioritization | | |
| <ul style="list-style-type: none"> • 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 phar-

macy 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 provi-

ded 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 Google¹³ and Apple¹⁴ 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 socio-demographic 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.

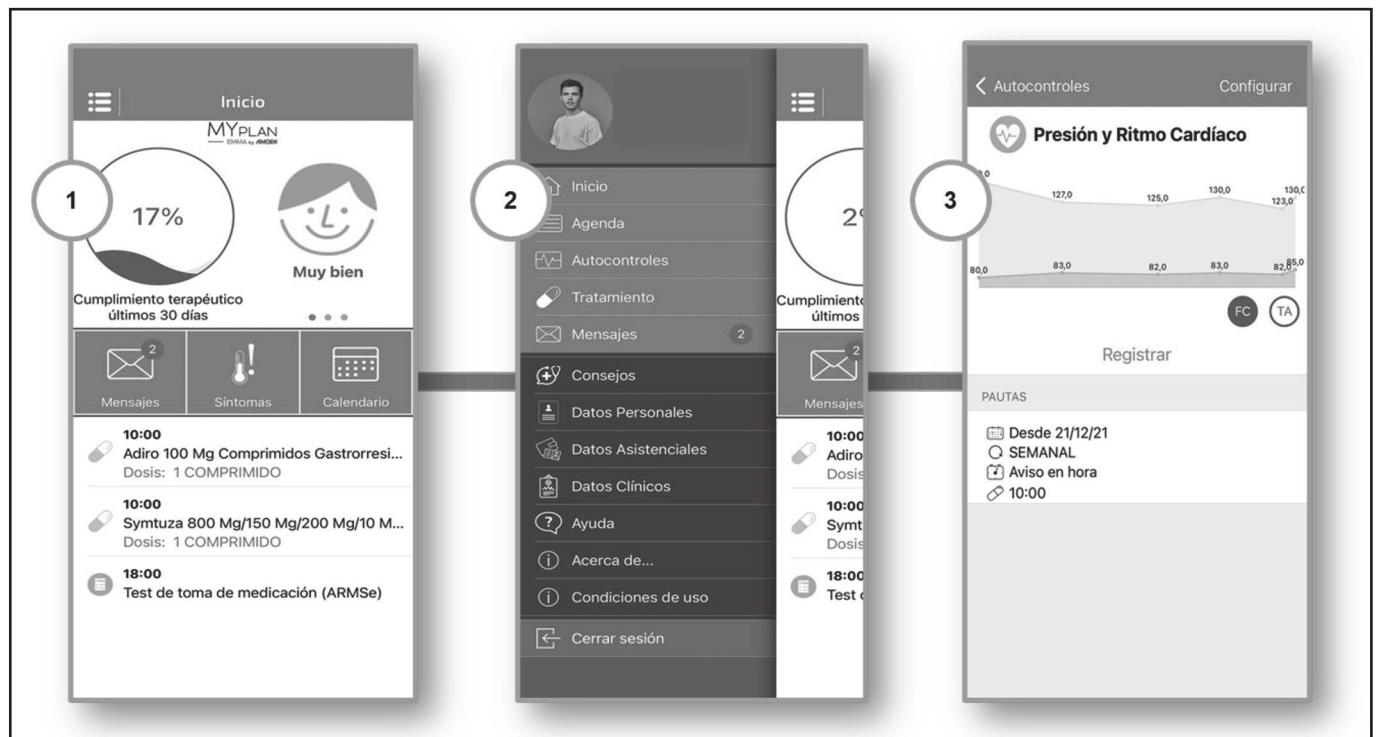


Table 2. EMMASalud patient and professional profile modules, components, and clinical use

| 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: <ol style="list-style-type: none"> 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 clinician 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: <ol style="list-style-type: none"> 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 | <ol style="list-style-type: none"> 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 | <ol style="list-style-type: none"> 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 | <ol style="list-style-type: none"> 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 | <ol style="list-style-type: none"> 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 | <p>All the data recorded in the Patient-Centered Module can be tracked graphically in tables and diagrams. Timeframes filters can be used.</p> <p>Traffic lights and alerts on the main page help the clinician to prioritize their intervention. The app allows to trace the following aspects:</p> <ol style="list-style-type: none"> 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 | <ol style="list-style-type: none"> 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 settings²⁶. Our study has contributed to develop an interdisciplinary technology-based behavioral app for PLVH 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 States¹⁵, young PLVH 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 monitoring¹⁶.

Patients and HCPs in the study agreed on important aspects. However, they focused on different aspects of mHealth tools for PLVH. 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 PLVH anonymity and more flexibility in scheduling appointments¹⁷. 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 func-

ionalities. 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 PLVH in real-world conditions and compared with routine care. With the implementation in clinical practice, we expected an improvement in the PLVH' 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 settings²⁰⁻²³. Adherence to ART is crucial in HIV management to avoid drug resistance, disease progression, and complications²⁴. In line with this, different interventions show that digital health help PLVH comply with ART²⁵⁻²⁷. 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. PLVH 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 PLVH'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 PLVH treated in Spain are men, what makes this sample a good representation of the end-users of the mHealth in our center³⁰.

In conclusion, improving patients' quality of life, therapeutic adherence, or disease control are key objectives for the optimization of PLVH' journey. We are currently implementing our technology-based behavioral app EMMASalud MyPlan into our clinical protocols to establish a new PLVH' 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.

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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

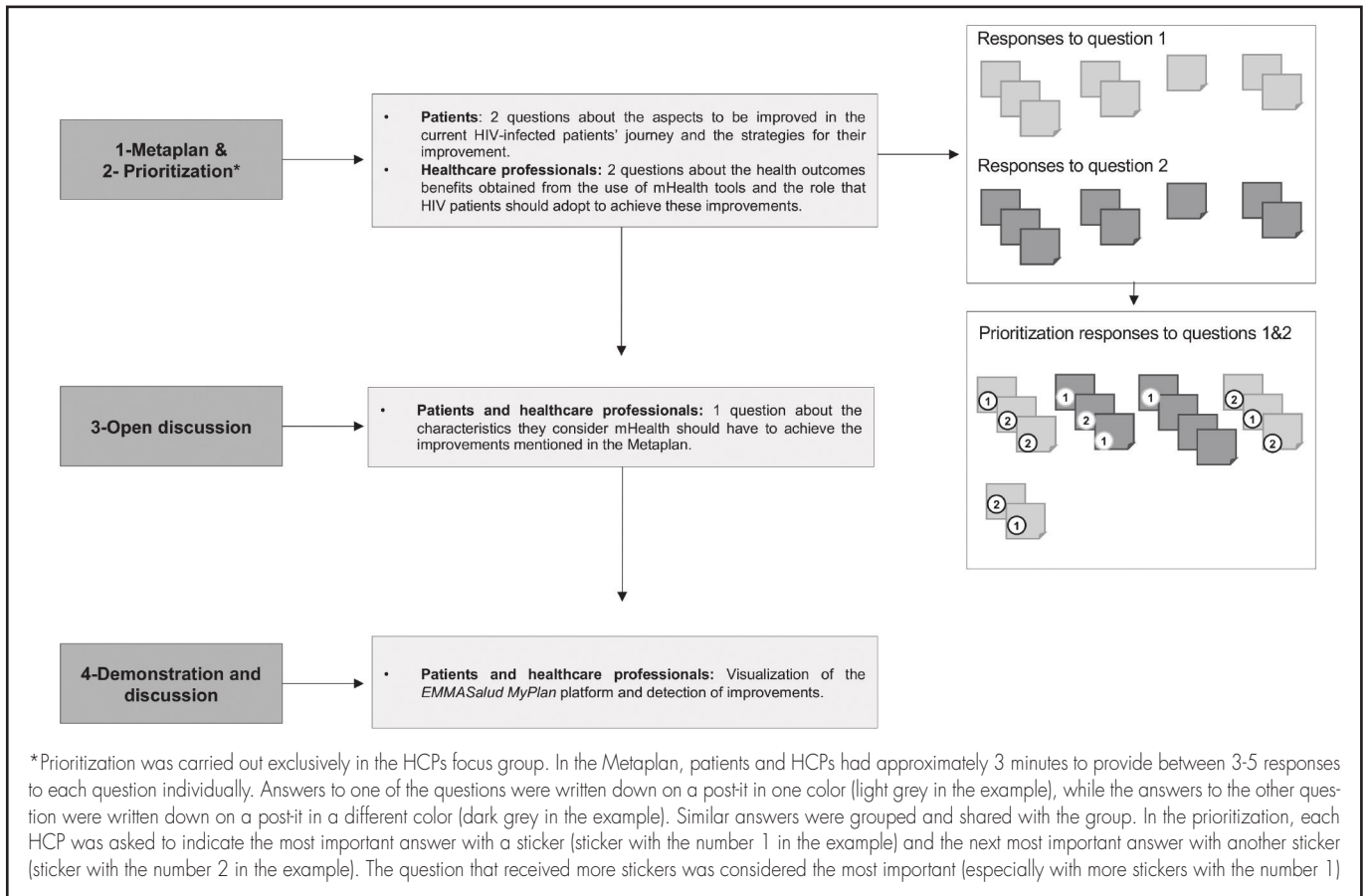
| Domain | Items | HCPs' Focus Group | Patients' Focus Group |
|--|---|---|---|
| Domain 1: Research team and reflexivity | | | |
| Relationship with participants | | | |
| 7- Participant knowledge of the interviewer | What did the participants know about the researcher? e.g., personal goals, reasons 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

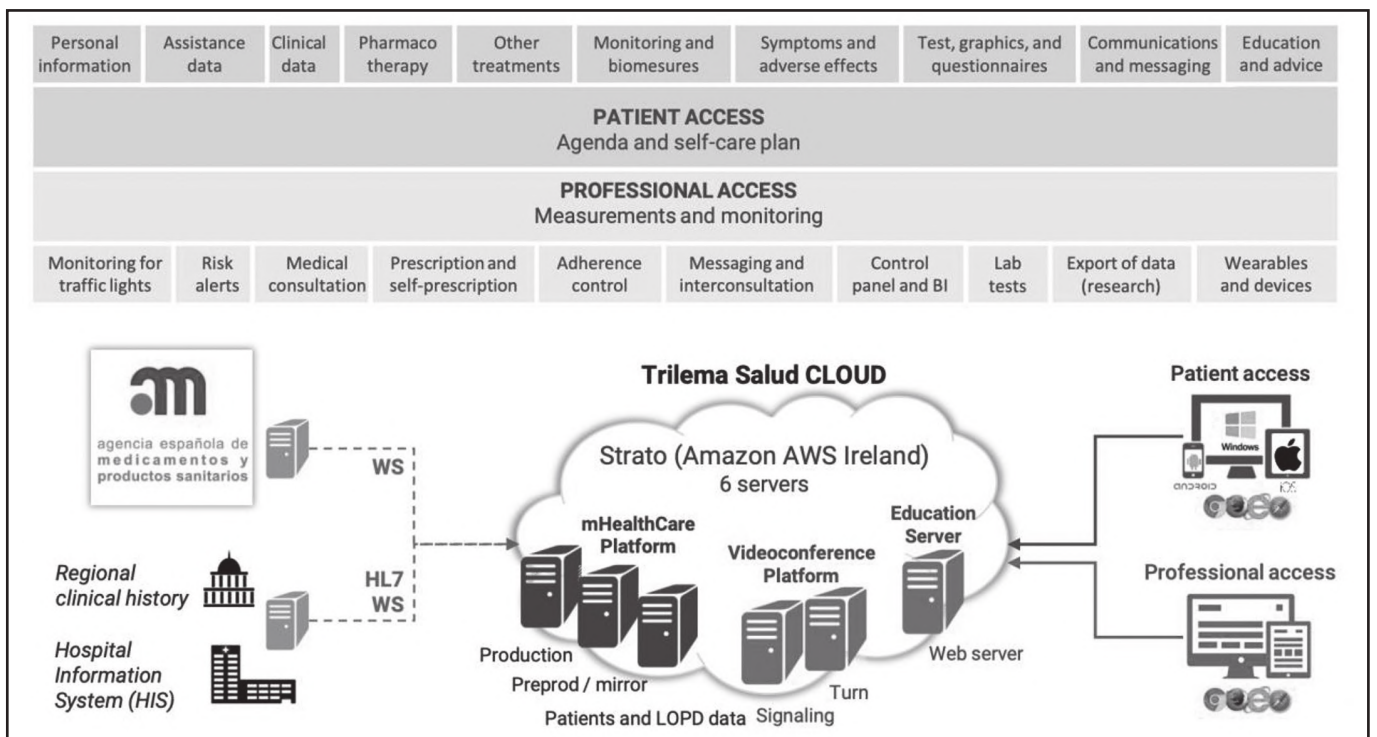
| Domain | Items | HCPs' Focus Group | Patients' Focus Group |
|--|---|---|---|
| Domain 2: study design | | | |
| Data collection | | | |
| 17- Interview guide | Were questions, prompts, guides provided by the authors? Was it pilot-tested? | The initial approach was a structured guide based on open-ended 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



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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