ESMO GOOD SCIENCE BETTER MEDICINE BEST PRACTICE

ESMO REAL WORLD DATA AND DIGITAL ONCOLOGY

ORIGINAL ARTICLE

Development of digital self-management support for breast cancer survivors: ensuring evidence-based approaches and patient engagement from concept to implementation☆

M. A. Franzoi[1,2*], E. Martin[1], A. R. Ferreira[3,4], F. Jacq[3], E. Gillanders[1], A. Di Meglio[1,2] & I. Vaz-Luis[1,2,5]

[1]Cancer Survivorship Group, INSERM Unit 981—Molecular Predictors and New Targets in Oncology, Gustave Roussy, Villejuif; [2]L'IHU PRISM: "IHU PRISM National Precision Medicine Center in Oncology", Villejuif; [3]Resilience, Paris, France; [4]Catolica Medical School, Universidade Católica Portuguesa, Lisbon, Portugal; [5]Multidisciplinary Department for the Organisation of Patient Pathways (DIOPP), Gustave Roussy, Villejuif, France

Available online 26 August 2025

Background: This study aimed to develop digital self-management programs incorporating evidence-based behavioral interventions to address the physical and psychosocial challenges faced by breast cancer survivors (BCS).

Materials and methods: The development was guided by the Medical Research Council framework and involved five steps: (1) needs assessment and consultations with patients and providers (focus groups and surveys), (2) ranking of priority symptoms/conditions (evaluation of patient-reported outcomes within a large cohort), (3) identification of validated self-management programs (literature review), (4) prototype design, testing, and refinement (focus groups with patients for pilot testing), and (5) formal evaluation. This study focused on steps 1-4, including both quantitative and qualitative data collection.

Results: In steps 1-2, six priority symptoms/conditions were identified: emotional distress, fatigue, insomnia, musculoskeletal pain, physical inactivity, and high body mass index. In steps 3-4, three digital behavioral programs were developed and tested: physical activity, mindfulness/meditation, and yoga. These programs incorporated educational content, video and podcast exercises, weekly live sessions, and moderated chat groups. During prototype testing, focus groups with 27 patients highlighted high satisfaction with the programs, noting their potential to increase access to care, empower patients, and improve symptom management. Engagement challenges were identified, including digital literacy aspects, the need for flexibility for autonomous practice, and the need for tools to boost motivation. Programs were refined and are being tested in hybrid efficacy-implementation trials.

Conclusions: Digital self-management programs intended to improve symptom management and quality of life for BCS were developed. By integrating evidence-based content and early patient feedback, these programs have the potential to enhance supportive care access and empower patients. Ongoing trials will assess their clinical efficacy and implementation, with an emphasis on equitable access and engagement across diverse populations.

Key words: behavioral interventions, digital self-management support, digital health, quality of life, breast cancer survivorship, implementation science

INTRODUCTION

Survival rates after early breast cancer now exceeds 80% at 10 years.[1] Nevertheless, these patients face severe and prevalent physical, psychological, and social needs that are a combined byproduct of cancer and its treatments.[2-4] This represents up to 50% of patients living with at least one distressing long-term physical symptom,[2] 30% facing emotional distress,[5] and 20% struggling to rejoin the workplace.[6] In addition, ∼50% of the patients struggle to adhere to at least 5 years of endocrine therapy.[7]

Behavioral interventions, namely, physical activity, mind—body interventions, and cognitive behavioral therapies, are scientifically validated strategies that positively act in several burdensome concerns and symptoms commonly experienced by survivors of breast cancer such as fatigue, musculoskeletal pain, insomnia, emotional distress, hot

*Correspondence to: Dr Maria Alice Franzoi, Cancer Survivorship Group, Inserm Unit 981, Gustave Roussy, 114 Rue Edouard Vaillant, Villejuif 94800, France. Tel: +01-42-11-25170

E-mail: Mariaalice.borinelli-franzoi@gustaveroussy.fr (M. A. Franzoi).

☆Note: A partial description of the work described here was previously presented as an abstract (poster) at the 2024 Multinational Association for Supportive Care in Cancer Annual Meeting and the French National Association of Supportive Care (AFSOS) Annual Meeting.

flushes, and sexual dysfunction.[8] However, the overall uptake of behavioral interventions in routine practice is low and unequal, facing implementation challenges that range from low awareness and low rate of referrals from medical oncologists, to lack of available resources and standardized practices in oncology centers, lack of reimbursement policies, as well as barriers related to patient accessibility and engagement.[9-13]

Digital health strategies can be used to deliver patient self-management support including education and standardized behavioral interventions. This can be carried out either synchronously (guided, individual, or group-based) or asynchronously (self-guided). Prior randomized controlled trials demonstrated the efficacy of digital health behavioral interventions in reducing symptom burden such as sexual health,[14] fatigue,[15] insomnia,[16] fear of recurrence,[17] and anxiety,[18] improving health behaviors such as physical activity[19] and weight management,[20,21] and enhancing overall quality of life in patients with breast cancer.[22] However, these were fragmented interventions using different digital health platforms, not scalable or integrated into routine oncology care workflows, and currently not available in multiple languages.

In this setting, we aimed to co-design with a variety of stakeholders, digital self-management programs focused on behavioral interventions aggregated into one single digital health platform already integrated in routine oncology care workflows for remote symptom monitoring in France.[23,24] In this article, we describe the development process and implementation plan of these digital self-management programs.

MATERIALS AND METHODS

The development of the digitally delivered self-management behavioral interventions followed the Medical Research Council framework for co-designing and developing complex interventions, which includes the phases of development, feasibility/piloting, evaluation, and implementation.[25,26]

A five-step iterative process involving a wide range of stakeholders was established (Figure 1), consisting of the following: (1) needs assessment and consultation with patients and providers; (2) ranking of symptoms/conditions to be addressed; (3) identification of validated digitally delivered self-management programs; (4) prototype design, testing, and refinement; and (5) formal evaluation. This manuscript focuses on steps 1-4.

Step 1: needs assessment and consultation with patients and providers

To assess the need and acceptability of digital self-management tools for breast cancer survivors, we conducted both qualitative and quantitative studies. Qualitative research with 34 patients undergoing adjuvant endocrine therapy and 28 health care providers prescribing adjuvant endocrine therapy highlighted a strong need to improve access to and delivery of supportive care and behavioral interventions aimed at improving quality of life and managing symptoms. This study also highlighted the opportunity represented by digital health tools to address these concerns.[27,28] Additionally, a large national survey with 939 breast cancer survivors across France reaffirmed the high level of interest in and acceptability of personalized digital self-management support for symptom management.[28]

Step 2: ranking of symptoms/conditions to be tackled

Prior work by our group, which analyzed longitudinal patient-reported outcomes data from a large national prospective cohort study (CANTO NCT01993498), documented the prevalence, severity, and trajectories of post-treatment burden among breast cancer survivors.[2,4,29] These data were used to prioritize the symptoms and conditions that digital self-management behavioral interventions should target, ensuring that the most prevalent and impactful issues would be addressed.

In addition, an implementation study evaluating the supportive care needs and referrals within a breast cancer survivorship care pathway conducted by our group informed practical implementation needs regarding key aspects to be tackled by digital self-management support.[30] This included the need to improve accessibility to behavioral interventions for symptom management.

Step 3: identification of validated digitally delivered self-management programs

A comprehensive literature review was conducted to identify pharmacological and non-pharmacological interventions aimed at mitigating prevalent symptoms and concerns among breast cancer survivors.[8] This review focused on ranking the scientific evidence for non-pharmacological behavioral interventions. A detailed mapping of intervention content, duration, delivery method, and outcomes was carried out. Findings from this review,[8] as well as additional evidence[22,31] on digital health applications in breast cancer care, were used to select effective behavioral interventions suitable for digital delivery.

Step 4: prototype development, testing, and refinement

The technical development of the digital self-management programs was led by Resilience, a digital medicine company, with the ultimate goal of integrating these programs into a certified medical device, Resilience PRO. Resilience PRO enables remote symptom monitoring through electronic patient-reported outcomes (ePROs) and nurse navigation and is currently used in a large network of European hospitals with high levels of demonstrated engagement and implementation metrics.[32] In addition to the ePRO reporting and nurse navigation, the mobile application also has a library of curated educational content, with prior data demonstrating elevated levels of satisfaction and engagement among patients with breast cancer.[30,33]

The content of each digital behavioral self-management program was drafted by certified health care

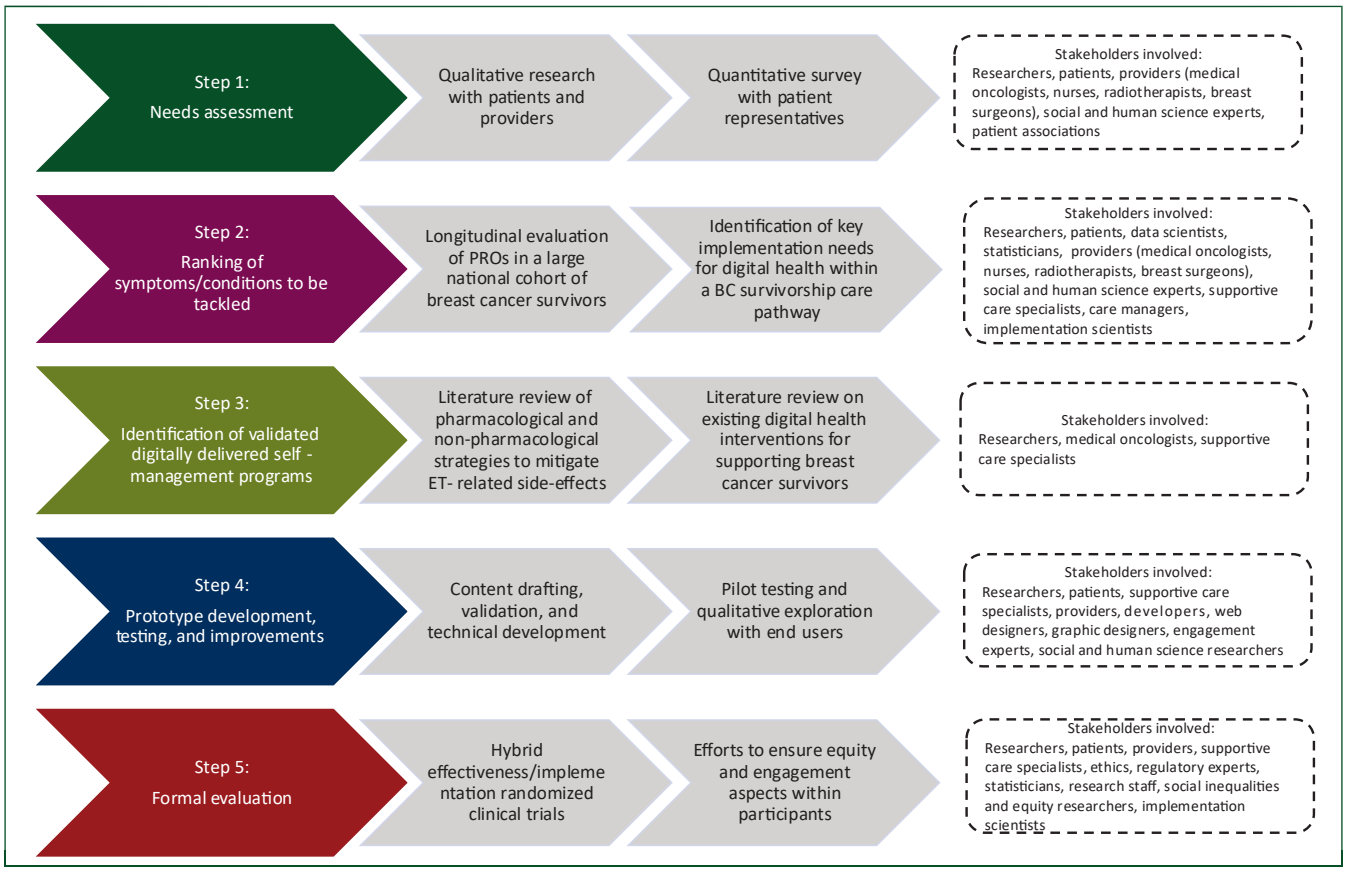

Figure 1. An iterative process for developing digital self-management behavioral interventions for BC survivors.
BC, breast cancer; ET, endocrine therapy; PROs, patient-reported outcomes.

professionals, guided by the findings of the literature review in step 3. A multidisciplinary breast cancer survivorship team consisting of medical oncologists, supportive care specialists, sociologists, social inequality researchers, and patient representatives[30] reviewed and provided feedback on the core content during the prototype development phase.

Pilot testing and qualitative evaluation. Focus groups were conducted with breast cancer survivors who tested the digital self-management programs. These focus groups aimed to gather patient feedback during the early development phase. The sessions assessed the programs' acceptability, barriers and facilitators for engagement, perceived utility, health impacts, and suggestions for improvement. Participants were recruited from the breast cancer clinic or via e-mail invitations to registered users in the Resilience database who had consented to receive e-mails. A formal qualitative study protocol was developed and approved by the institutional internal ethical review board (CSET no. 2021-33) to allow this investigation. All participants received an information sheet and provided oral informed consent. The qualitative analysis of the pilot testing phase was underpinned by an adapted model of social cognitive theory (SCT).[34] This framework emphasizes the interplay of personal, behavioral, and environmental factors. By applying SCT, we explored the patient journey and identified barriers and facilitators from the context of digital self-management support. Reflexive thematic analysis was conducted and involved six stages: gaining data familiarity, inductive coding, generating initial themes, refining those themes, defining them, and naming and reporting findings.[35] NVivo software (version 12.0) facilitated the organization of codes into sub-themes and overarching themes. EM carried out open coding of the transcripts, which were then categorized into broader categories to develop the central themes. The authors (MAF and EM) examined and refined these themes to ensure their accuracy and depth. To maintain participant confidentiality, pseudonyms were used, and personal information was anonymized. The COnsolidated criteria for REporting Qualitative research (COREQ) checklist was used for reporting the results.[36]

Step 5: formal evaluation

The final version of the self-management modules will be fully integrated into the Resilience mobile application and formally tested in hybrid effectiveness/implementation clinical trials evaluating its reach, effectiveness, adoption, implementation, and maintenance.[37,38]

RESULTS

Following step 1, and in response to positive feedback from both patients and health care providers regarding the use of digital health for supportive care during endocrine therapy, the multidisciplinary team decided to expand an existing digital companion. This companion, already integrated into a medical and scientific digital care program for remote symptom management in routine oncology care, was selected for enhancement. The goal was to incorporate digital self-management programs focused on evidence-based behavioral interventions tailored for the survivorship phase, addressing the ongoing needs of breast cancer survivors.

Following the analysis conducted in step 2[2,3,5,29] and the reviews in step 3,[8,22,31] six symptoms/conditions were prioritized for digital self-management behavioral interventions: emotional distress, fatigue, insomnia, musculoskeletal pain, physical inactivity, and high body mass index. Three digital behavioral programs were planned and developed to address these symptoms and conditions: (i) a physical activity program, (ii) a mindfulness meditation program, and (iii) a yoga program. These programs were selected for their potential to address multiple symptoms and concerns, while also being adaptable to a variety of tumor types beyond breast cancer. Additionally, specific cognitive behavioral therapies targeting anxiety and depression, fatigue, hot flashes, insomnia, sexual dysfunction, and fear of recurrence were identified as priorities for future development (Figure 2).

During step 4, the three programs (physical activity, meditation, and yoga) were developed in a digital format. The content included a combination of educational materials to raise awareness of expected health benefits related to the specific behavioral change, progressive readings and positive psychology elements, video and podcast exercises for independent practice, weekly live sessions for guided practice and community building, and a moderated online chat group to encourage positive messages. The meditation program lasted 6 weeks, the yoga program lasted 8 weeks, and the physical activity program lasted 12 weeks. Online live sessions were scheduled twice a week, providing two 1-h sessions of live practice per week for each program. The content and duration of the programs followed step 3 of the methodology, based on validated interventions for breast cancer survivors.[19,39,40]

To gather user feedback and involve patients in the development process, 27 cancer survivors participated in six virtual focus groups, where they tested different programs tailored to their symptoms: meditation for emotional distress or insomnia, yoga for insomnia or musculoskeletal pain, and physical activity for fatigue or musculoskeletal pain. Overall, feedback was positive, with all participants reporting a favorable experience with the programs, advocating for its implementation.

Key themes that emerged from the feedback

Facilitating access to supportive care. Patients emphasized how digital health platforms can democratize access to supportive care interventions, reducing time and travel constraints as well as being adaptive to work and family-related obligations. They also noted the potential to reach a larger number of patients and reduce financial burdens.

Patient empowerment. Patients appreciated how the programs enabled them to take a more active role in their care. They felt confident in their ability to make positive behavioral changes and sustain these improvements, with many expressing a desire to support others in their journey toward better health.

Perceived benefits. Participants reported significant improvements in emotional distress, musculoskeletal pain, insomnia, and fatigue, underscoring the positive impact of the interventions on their overall well-being.

A shared experience. Patients valued the live sessions and chat features as a means to connect with both participants and coaches, fostering a sense of community. However, participation in the chat varied, with some patients showing less interest in engaging with this feature.

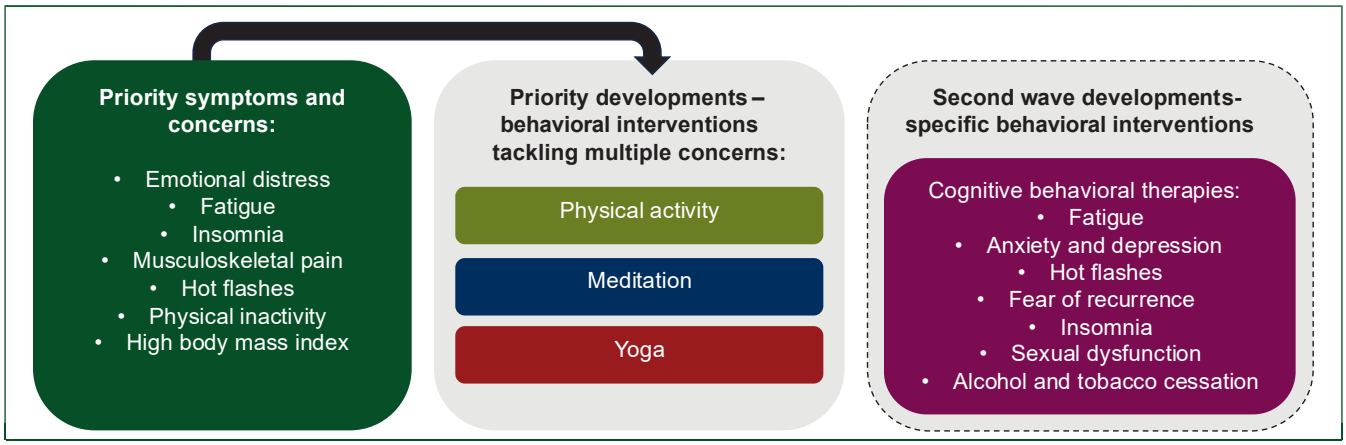

Figure 2. Symptoms and concerns prioritized and digital interventions developed.

Adaptations to enhance engagement. Patients emphasized the importance of adapting the programs to incorporate new functionalities and tools to maintain engagement both during and after the official program period. They suggested including follow-up sessions and opportunities for in-person meetings to further strengthen connections. Additionally, they stressed the need for simplified digital interfaces and the reduction of technical difficulties, as these could be significant barriers for engagement. While live sessions were seen as beneficial for building community, some patients found the fixed time slots challenging, leading to difficulties in following the sessions and scheduling conflicts. A few patients also expressed feelings of frustration and guilt for not being able to attend the live sessions regularly.

The focus group participants ranged in age from 38 to 60 years and all had an educational level beyond high school (27/27). Thirty-one percent (9/27) of participants resided outside urban centers (cities with fewer than 20 000 inhabitants). Eleven patients, all breast cancer survivors, tested the meditation program prototype, while seven patients, also all breast cancer survivors, tested the yoga prototype. The physical activity program was made available to patients with other tumor types, and among the 10 patients who provided feedback, 7 were breast cancer survivors. Illustrative patient quotes are provided in Table 1.

The results from the qualitative study were reviewed by the multidisciplinary team involved in the development of the programs and informed the final version of the programs. The following adaptations suggested by patients to enhance engagement were carried out: simplification of the multiple digital tools used into one single engaging mobile app interface, pre-recorded sessions instead of live sessions to allow for autonomous and flexible practice, and addition of engagement and motivational feedback loop mechanisms. A summary of the final programs' duration, content, and format is provided in Figure 3. The programs are being evaluated in ongoing effectiveness/implementation randomized clinical trials.

DISCUSSION

Randomized clinical trials have demonstrated that behavioral interventions can be effective in managing several symptoms and concerns experienced by breast cancer survivors, thereby improving their quality of life.[41-43] However, data also indicate that these interventions are not routinely integrated into clinical care pathways due to various barriers.[44] At the same time, research shows that patients may be particularly motivated to make behavioral changes following a cancer diagnosis, with a desire to adopt healthier habits.[45] Yet, achieving such changes can be challenging when these interventions are either unavailable or not proactively offered.[46] This study outlines the development of digital self-management programs aimed at improving symptom management and enhancing the quality of life for breast cancer survivors. While expanding the reach of behavioral interventions is critical to address the challenges faced by breast cancer survivors, it is equally important to ensure that these interventions are evidence based and incorporate patient input early in the development process to create effective and engaging solutions.

To this end, we adopted a rigorous approach, combining needs assessment, quantitative and qualitative research, as well as an extensive literature review to identify evidence-based components in the design of our symptom management programs. Additionally, recognizing the increasing importance of co-design and patient involvement in health care innovations, we conducted a qualitative study during the development phase to ensure that the perspectives of patients were incorporated into the development of the final product. Overall, feedback from participants was positive, with high perceived usefulness in managing survivorship concerns such as endocrine therapy side-effects and promising engagement levels. Commonly noted advantages included the practicality of the remote intervention, its potential to increase patient empowerment, and the reported improvements in daily life and symptom management.

A key feature of our programs was the inclusion of supervised coaching, which received high praise from participants, as well as live sessions aimed at fostering community engagement. While these features can indeed contribute significantly to engagement and retention,[31] they also present challenges for real-world implementation. Supervised coaching requires the availability of health care professionals, while live sessions necessitate administrative support for organizing group practices. These resources may not be readily available in many health care systems, particularly in resource-constrained settings or countries.[44,47-49] Furthermore, as noted by patients who pilot-tested our programs, the live session components may also hinder engagement due to the requirement for a fixed practice schedule, which compromises flexibility. As such, to enhance scalability across diverse health care environments and patient profiles, we adapted the programs to accommodate both supervised and autonomous self-management options. This adaptation includes autonomous engagement-enhancing features powered by artificial intelligence, such as encouraging messages, rewards for progress, and reminders for regular practice.

A randomized clinical trial is planned to assess the efficacy and implementation of these modules without the supervised coaching component and the live sessions, specifically among patients experiencing adverse effects from endocrine therapy (NCT06781996). As part of the trial, the patient activity in the mobile app will be tracked and a nurse navigator will be available to engage patients who are not participating actively in an autonomous way, helping direct them to additional solutions or to supervised practices if necessary. A comprehensive implementation analysis will also be conducted, yielding valuable insights into which patient profiles are most suited to autonomous interventions and which may benefit from more structured, guided support. Another ongoing randomized clinical trial

Table 1. Thematic analysis, illustrative patients' quotes, and insights from the focus groups during prototype testing phase

Emerging themes	Exemplifying quotes
Facilitating access to supportive care	
Meditation program	"What I really liked was that I could do it from home or from the place where I was. So, it didn't take away from my schedule, it didn't increase my fatigue level. It was a lot less fatigued, because I didn't have to go to a specific place to practice, I didn't have to get back in the car, I didn't have to come home late at night. Being at home, it was a little cocooning mode. I am at home, I take care of myself, and care comes to me, at home.""I was, in fact, quite surprised to see that we were able to meditate in Zoom, with the distance. I wasn't really convinced in the beginning, and in the end, it still worked well.""The program was very good, and I put it on my phone, so it's accessible right away, it's very good. In two minutes, we're in our meditation, and we don't have to deal with site searches, or things like that, that could be more problematic, and that could ultimately prevent practice."
Yoga program	"Despite the fact that it was a remote practice, the teacher still managed to correct our postures (and frankly, hats off to her) and to follow everyone really well.""It's also very interesting to do it remotely because we can't go out sometimes, we're busy with work, medical appointments. Plus, since it's an app, it's going to reach a larger number of patients, it's practical, for those who don't have the ability to go out or not the financial ability. Yoga it's not cheap, so this alternative it's very interesting.""The live video sessions are very convenient. I never had any resistance to attend these sessions, I never had any problem getting into them because it was simple. Right before I was making dinner, poof, the next thing I know I'm in the living room or on the patio doing the yoga session."
Physical activity program	"Honestly, I appreciated the practicality of the session duration to do at home: 15 to 30 minutes, which I could spread out over different times.""I've returned to work at 60%, so I'm optimizing my time. It's great to be able to do it at home and to have it adapted.""I really enjoyed it. It was very clear, and what's great is that we could do it on our own schedule, whenever we had the most time or felt up to it. Plus, we can go back if we didn't understand something, pause it, which is really helpful. No, the 12 weeks went by really quickly for me.""This very adaptable aspect really lifts a lot of things. It removes the sense of obligation, it takes away the pressure we might feel, for example, when we sign up for a club, like a yoga club or something similar, where we expect a certain level in the classes and, there's always a financial cost.""Yes, and even the fact that I can say, 'Okay, on Sunday, I'm more physically available, etc., to do my session,' I can do it at 10 p.m. if I need to, because I can't sleep, and there's no one there to tell me that it's not the right time to do it."
Perceived health benefits	
Meditation program	"With this program of six weeks, I found a real benefit. A lot less stress, anxiety, a lot less hamster wheel spinning in my head [...] A lot more composed, calm. And as a result, well, less pain. […] It's been an opportunity to reconcile with my body, it's been a really nice step, it allowed me to be more caring, more loving towards my body, with this body that's changed, that's gained 33 pounds.""It was very positive for me too, it made me go a long way in accepting the disease, and everything that happened because before I was caught in a kind of tsunami.""Anxiety, pain management, neuropathic pain. I can confirm that it's really a great tool to feel good.""I had a lot of insomnia, so I really felt a difference. And in terms of anxiety, actually, it's also repeating to myself: everything passes. There are meditations that help a lot to take a step back and live in the moment, and it helps to decrease my anxiety, so I really found benefits on that.""It has an impact on fatigue, I had a reoperation not long ago and I was very tired, and now, instead of taking a nap, I do a meditation. The long ones, the thirty minutes ones, and it's very very efficient to recover energy, I'm very surprised, each time."
Yoga program	"But it did me a lot of good, we didn't feel like we were working out and yet we felt that it was powerful, while respecting our weaknesses and mobilizing our strengths, with meditation, relaxation, breathing, there was a complete set. It was very good for me actually. (…) I really enjoyed it a lot and it relaxed me and made me feel good.""I really enjoyed to experience what it was going to do to my body after all this battery of treatments, it was kind of meeting a body that is a new body. (…) It also relieved my joints and muscles pain."
Physical activity Program	"I feel physically better when I move more, and I also feel better emotionally and psychologically.""Impact on muscle pain and upper body neuropathies: it helped me release the muscle tension around the nerves.""After cancer, we all go through a phase of depression. It comes and goes, and we don't really know why. When we do something for ourselves, like this physical activity program, we get back on track, leaving less room for those things to take hold.""Since starting the program, I've noticed it helps a lot, especially with joint pain, particularly in my wrists. In the mornings, when I got out of bed, I had trouble walking, but now it's much better.""Before, I didn't do any sports at all. It's true that this has done me good. And I'm not sure if it was a coincidence, but the first time I did a session in the morning, I didn't stop all day, I was like a whirlwind going full speed, and I felt like it gave me a boost having done that session.""Stretching and doing cardio makes me feel better, even mentally. I've gotten myself moving and activated my muscles. Having workout sessions at home when I'm relaxed helps me unwind.""I find that I'm less tired when I do all of this."
A shared experience	
Meditation program	"The teacher had this ability to play down the drama and then to make the subject really accessible to us. And above all, that whatever we did, it was not judged as bad.""The teacher had this kindness that I thought was extraordinary, there was no misstep. We were seen as people, actually.""She is a caring person, welcoming, and I believe that she knew how to make a place for each one of us.""Finding a group

Continued

Table 1. Continued

Emerging themes	Exemplifying quotes
	(…) being able to meet other people, with whom to share this experience, we knew that we were all somewhat connected by this vital experience that is the disease, but we understood each other, and we were able to exchange, and to see that we were connected, in search of more or less the same things.""There was really a team cohesion, a group cohesion, a lot of caring, support and thoughts for each other. (…) I'm really happy to have had the meetings with the group, because really, it was just what I needed at the moment." "I really appreciated these moments shared together. It also makes you feel less alone, you encounter the same things, you feel the same feelings.""I didn't use the chat too much, but it was nice to have it to communicate with the teacher, if ever. I didn't communicate too much with the other participants."
Yoga program	"What I liked was the teacher's approach, the fact that she was a former breast cancer patient, so she was fully aware of the difficulties that we can have in terms of movement limitations. And that she took this into account in the exercises that she proposed to us and that she really proposed a decomposition of the different movements and the different postures, steps by steps, so that we could do the sequence on our own in the end.""The teacher was really very gentle, educational. She really paid attention to each of us to adapt, if we had problems with our shoulders or pain. She was really attentive. And I think that she took a particular care to redo part of the videos, she didn't just capture the session, she edited (…). She did it very seriously, and with a lot of compassion.""And being in a group I felt good, in the group dynamic, without venting or anything. At least we all knew that we had weaknesses and that if we didn't succeed at least we didn't have to be looked at in the wrong way, like sometimes (…) we can be looked at by people because we don't have the strength in our arm for example. (…) I thought it was good because we knew that we all had more or less similar experiences. The same problems.""The group created a nice dynamic, we were always happy to connect."
Physical activity program	"I find the explanations in the sessions and live sessions very clear. They are very precise in their explanations. For me, it's the first time I've really understood things about breathing.""I found the coaches very human, really attentive, really great.""I find it very interesting. A few small things outside of the suggested sessions. It's really, really interesting to stay connected during the live sessions and in the chat.""I enjoy checking the progress of other patients, I like that. We can also share our experiences. I won't write much in the chat, but I will read and see what everyone shares.""The sense of community is always great. The only small thing is that, since I can't complete all the sessions, I feel a bit guilty seeing the enthusiasm of others. I think it's wonderful, but I also feel like I'm falling behind.""I think participation in the chat is personal to each individual. I only browse through the messages because sometimes I don't check every day, and there's no need to respond if it's 48 hours later."
Patient empowerment	
Meditation program	"Meditation had really seemed like an unattainable discipline to me. To me, you had to be a great Buddhist sage, with twenty years of Buddhism behind you, to be able to do that. And actually, through this program, I was able to realize that it was within my reach.""I have shifted my alarm clock earlier, so that I can do the meditation, and clearly, it starts my day. Before, I was much more latent, it was more difficult to get up, to put myself in action. And now, it's true that since the meditation, in the morning, on the other hand, I've got a really beautiful energy.""There were times I practiced less, and I saw that the side effects came back: headaches, a little more stressed and so I said to myself: no, I have to do it, practice more regularly."
Yoga program	"I think that having yoga sessions allows us to establish a kind of well-being dynamic that allows each patient to be an actor of his health. At least that's how I feel about it. (…) I've continued to practice in the morning when I get up, occasionally, and when I'm not feeling well.""I signed up for next year, to take classes. I know this is the activity I want to do next year."
Physical activity program	"Now I know I need to focus on consistency. I've noticed that on the weeks when I didn't do much, the pain was worse, so it's really important for me to be consistent. I try to take the stairs instead of the elevator—little things in daily life that will help me improve and get moving.""I think I will continue using this program after the 12 weeks. I've already talked about it with other patients.""My sister-in-law is a nurse in a nursing home. She has back pain and breathing problems, especially when she lifts patients. I showed her the specific exercises on my app. I am the one helping her now."
Adaptations to enhance engagement (digital literacy and technical aspects, motivation, and flexibility)	
Meditation program	"The things that were a little less pleasant, the irritants, it was really the technical part. We had to log in in a separated video tool, there were some difficulties to access the live sessions.""The possibility of having an in-person seminar at some point to get together that would be good. Why not with our teacher, that would be perfect. To finalize this program like that.""If a three-day face-to-face session, was proposed afterwards, focusing on meditation, well-being, and exchanges between patients, well, this could interest me.""I wish we still had a session after the program ended, once in a while, once a week, or once a fortnight, or once a month, to keep that group meditation.""It's a pity that there isn't an entry questionnaire and an exit questionnaire, to see if it had changed anything and boost engagement.""The fact that you need to connect in a fixed hour, it's not always easy to be able to be there at 6 pm when you work and have children."
Yoga program	"Sometimes the screen of a cell phone is not big enough to really see and look at the teacher's silhouette and postures. Sometimes the angles of vision are limited because you have to move the camera a little bit depending on whether you are standing or lying down. It may have been easier with a computer.""Having multiple digital platforms, one for content, another for live, another by email, was not optimal.""I just got

Continued

Table 1. Continued

Emerging themes	Exemplifying quotes
	frustrated when it stopped, we were in the middle of progress. We felt like we were stopping in the middle of the road, so we could see that she was making progress. (…) Four weeks was frustrating, I wouldn't have minded two more weeks so that we could really have all the tips in mind.""For me, the big drawback was really the daytime slot for the lives, between noon and two, it's true that it would have been much easier to be available in the evening slot."
Physical activity program	"Can we retrieve the videos on another device? On a computer or a television? Because the small screen is a bit complicated.""It's silly what I'm going to say… but when it's over, it feels like we're a bit left to our own. It's like when you finish your chemo and don't see the care team as much, except for scans and things like that. You need a little more support.""I couldn't participate in the live session because I was busy, and the same thing will happen next week. The ideal would be to have a recorded meeting in case you couldn't be available, so we can hear everything that was said afterward, which could help us.""I would suggest recording the live sessions so that we can watch them at other times. Sometimes, we don't remember everything. At the moment, I understood well, but when doing the exercises, I can't recall it.""The live sessions might be losing some momentum. I'm frustrated because I asked twice for the exercises from the live sessions which I missed, but I haven't received them.""For the live session timings, it depends on everyone's situation; it's difficult to find a time that works for everyone."

(NCT06505590) will evaluate the role of supervised versus unsupervised digital self-management support in the setting of cancer-related fatigue among multiple tumor types, also including breast cancer survivors, bringing valuable knowledge in this field. Prospective pilot cohort studies are also evaluating the role of these digital behavioral interventions as supportive tools to prevent quality-of-life deterioration and to assist in decentralizing the care of breast cancer survivors from the hospital to primary care infrastructures (NCT06479057). In addition, a totally autonomous, patient-led digital interface of the mobile application providing symptom monitoring, needs assessment, and the self-management behavioral programs will be tested to evaluate its efficacy and implementation among premenopausal patients under adjuvant endocrine therapy and ovarian function suppression in an international randomized clinical trial.[50,51]

It is important to recognize that, while digital health interventions have significant potential to equalize care, they often fail to engage a representative sample of patients, particularly across varying socioeconomic backgrounds and health literacy levels.[52-54] We acknowledge that, during the prototype testing phase in step 3, our sample of patients mainly consisted of individuals with higher educational levels and, ideally, a diverse population should be included during the co-design phase. To address this challenge, our ongoing trials investigating the effectiveness/implementation of the digital self-management support will proactively

Figure 3. Summary of key features of the digital self-management behavioral interventions developed.

incorporate equity-focused strategies. These strategies will include the following: (i) providing training for principal investigators and recruiters on implicit bias and cultural competency to ensure a more representative population is recruited; (ii) employing digital navigators to assist patients with varying levels of digital literacy in onboarding to the mobile app; and (iii) collecting and monitoring detailed demographic data on socioeconomic status and health literacy during the trial to allow prescriptive actions to be taken if the recruited sample becomes unrepresentative. Including a diverse population in a well-designed implementation study—collecting engagement metrics and assessing patients' preferences and barriers to use—will enable further refinement of the interventions to ensure their relevance and effectiveness in broader, real-world settings.

Another distinguishing feature of the tool developed in this study is the integration of a comprehensive portfolio of self-management programs within a single digital platform. This design minimizes the need for both health care providers and patients to manage multiple apps for different symptoms, as well as care managers and information technology departments needing to deal with multiple interoperability requirements, thereby improving user experience and simplifying the care pathway.[55] Moreover, the integration of this tool into a remote monitoring platform already used in routine care for symptom monitoring during active treatment[32] offers a unique advantage. By enabling seamless continuity of care, the platform will provide a digital companion for patients throughout their entire cancer journey—from diagnosis through survivorship care.

In conclusion, the digital self-management programs developed in this study offer a promising solution for improving quality of life and symptom management among breast cancer survivors. By focusing on evidence-based interventions, patient-centered co-design, and scalability, we believe these programs can play a pivotal role in expanding access to care, improving engagement, and ultimately enhancing the survivorship care experience. Further research and evaluation in randomized clinical trials, among a real-world, representative population, is planned to determine the clinical impact of this multimodal digital tool and the most effective implementation strategies among breast cancer survivors and beyond.

FUNDING

This work was supported by the French National Cancer Institute (Institut National du Cancer—INCA—RISP 2021-012) (no grant number) to IVL and by a Conquer Cancer—Breast Cancer Research Foundation Career Development Award for Diversity and Inclusion, supported by Breast Cancer Research Foundation (no grant number) to MAF.

DISCLOSURE

MAF: research funding: Resilience Care (institution), Gilead Sciences (institution); speaker honoraria: Novartis. ADM: consulting fees: Kephren, Medycis, EpiPhare, Techspert. IVL: speaker honoraria from Amgen, AstraZeneca, Pfizer/Edimark, Novartis, Sandoz (institutional); writing engagement from Pfizer/Edimark (institutional); research funding from Resilience Care (institutional); travelling: Novartis (institutional). ARF and FJ report personal salary from Resilience (personal). All other authors have declared no conflicts of interest.

DATA SHARING

The data that support the findings of this study are available from the corresponding author upon reasonable request.

DISCLAIMER

Any opinions, findings, and conclusions expressed in this material are those of the author(s) and do not necessarily reflect those of the American Society of Clinical Oncology or Conquer Cancer, or Breast Cancer Research Foundation. EM and MAF had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

REFERENCES

1. Arnold M, Morgan E, Rumgay H, et al. Current and future burden of breast cancer: global statistics for 2020 and 2040. *Breast*. 2022;66:15-23.
2. Ferreira AR, Di Meglio A, Pistilli B, et al. Differential impact of endocrine therapy and chemotherapy on quality of life of breast cancer survivors: a prospective patient-reported outcomes analysis. *Ann Oncol*. 2019;30:1784-1795.
3. Vaz-Luis I, Di Meglio A, Havas J, et al. Long-term longitudinal patterns of patient-reported fatigue after breast cancer: a group-based trajectory analysis. *J Clin Oncol*. 2022;40:2148-2162.
4. Di Meglio A, Havas J, Gbenou AS, et al. Dynamics of long-term patient-reported quality of life and health behaviors after adjuvant breast cancer chemotherapy. *J Clin Oncol*. 2022;40:3190-3204.
5. Charles C, Bardet A, Larive A, et al. Characterization of depressive symptoms trajectories after breast cancer diagnosis in women in France. *JAMA Netw Open*. 2022;5:e225118.
6. Dumas A, Vaz Luis I, Bovagnet T, et al. Impact of breast cancer treatment on employment: results of a multicenter prospective cohort study (CANTO). *J Clin Oncol*. 2020;38:734-743.
7. Pistilli B, Paci A, Ferreira AR, et al. Serum detection of nonadherence to adjuvant tamoxifen and breast cancer recurrence risk. *J Clin Oncol*. 2020;38:2762-2772.
8. Franzoi MA, Agostinetto E, Perachino M, et al. Evidence-based approaches for the management of side-effects of adjuvant endocrine therapy in patients with breast cancer. *Lancet Oncol*. 2021;22:e303-e313.
9. Adsul P, Schmitz K, Basen-Engquist KM, et al. Studying the implementation of exercise oncology interventions: a path forward. *Transl J Am Coll Sports Med*. 2022;7:1-8.
10. Garland SN, Trevino K, Liou KT, et al. Multi-stakeholder perspectives on managing insomnia in cancer survivors: recommendations to reduce barriers and translate patient-centered research into practice. *J Cancer Surviv*. 2021;15:951-960.
11. Demark-Wahnefried W, Schmitz KH, Alfano CM, et al. Weight management and physical activity throughout the cancer care continuum. *CA Cancer J Clin*. 2018;68:64-89.
12. Ehlers SL, Gudenkauf LM, Kacel EL, et al. Real-world implementation of best-evidence cancer distress management: truly comprehensive cancer care. *J Natl Compr Cancer Netw*. 2023;21:627-635.
13. Hack TF, Carlson L, Butler L, et al. Facilitating the implementation of empirically valid interventions in psychosocial oncology and supportive care. *Support Care Cancer*. 2011;19:1097-1105.

14. Hummel SB, van Lankveld JJ, Oldenburg HS, Hahn DE, Broomans E, Aaronson NK. Internet-based cognitive behavioral therapy for sexual dysfunctions in women treated for breast cancer: design of a multicenter, randomized controlled trial. *BMC Cancer*. 2015;15:321.
15. Abrahams HJG, Gielissen MFM, Donders RRT, et al. The efficacy of Internet-based cognitive behavioral therapy for severely fatigued survivors of breast cancer compared with care as usual: a randomized controlled trial. *Cancer*. 2017;123:3825-3834.
16. Zachariae R, Amidi A, Damholdt MF, et al. Internet-delivered cognitive-behavioral therapy for insomnia in breast cancer survivors: a randomized controlled trial. *J Natl Cancer Inst*. 2018;110:880-887.
17. Akechi T, Yamaguchi T, Uchida M, et al. Smartphone psychotherapy reduces fear of cancer recurrence among breast cancer survivors: a fully decentralized randomized controlled clinical trial (J-SUPPORT 1703 study). *J Clin Oncol*. 2023;41:1069-1078.
18. Zion SR, Taub CJ, Heathcote LC, et al. A cognitive behavioral digital therapeutic for anxiety and depression in patients with cancer: a decentralized randomized controlled trial. *J Clin Oncol*. 2023;41. 1507-1507.
19. Webb J, Fife-Schaw C, Ogden J. A randomised control trial and cost-consequence analysis to examine the effects of a print-based intervention supported by internet tools on the physical activity of UK cancer survivors. *Public Health*. 2019;171:106-115.
20. Santa-Maria CA, Coughlin JW, Sharma D, et al. The effects of a remote-based weight loss program on adipocytokines, metabolic markers, and telomere length in breast cancer survivors: the POWER-Remote trial. *Clin Cancer Res*. 2020;26:3024-3034.
21. Goodwin PJ, Segal RJ, Vallis M, et al. The LISA randomized trial of a weight loss intervention in postmenopausal breast cancer. *NPJ Breast Cancer*. 2020;6:6.
22. Singleton AC, Raeside R, Hyun KK, et al. Electronic health interventions for patients with breast cancer: systematic review and meta-analyses. *J Clin Oncol*. 2022;40:2257-2270.
23. Ferreira AR, Lemaire A, Rodriguez J, et al. Towards improvement of oncology care through digital technology: a snapshot of Resilience remote patient monitoring (RPM) system implementation across 19 hospitals in Europe. *J Clin Oncol*. 2023;41:1518.
24. Franzoi MAB, Di Palma M, Ribeiro JM, et al. The impact of self-reported social determinants of health (SDOH) on patient engagement and symptom burden across a remote patient monitoring (RPM) pathway in 42 European hospitals. *J Clin Oncol*. 2024;42:1506.
25. Shahsavari H, Matourypour P, Ghiyasvandian S, Nejad MRG. Medical Research Council framework for development and evaluation of complex interventions: a comprehensive guidance. *J Educ Health Promot*. 2020;9:88.
26. Skivington K, Matthews L, Simpson SA, et al. A new framework for developing and evaluating complex interventions: update of Medical Research Council guidance. *BMJ*. 2021;374:n2061.
27. Roche N, Le Provost JB, Borinelli-Franzoi MA, et al. Facing points of view: representations on adjuvant endocrine therapy of premenopausal patients after breast cancer and their healthcare providers in France. The FOR-AD study. *Eur J Oncol Nurs*. 2023;62:102259.
28. Rassy E, Benvenuti C, Akla S, et al. Breast cancer survivors' opinion on personalizing endocrine therapy and developing informative tools. *NPJ Breast Cancer*. 2024;10:48.
29. Franzoi MA, Di Meglio A, Michiels S, et al. Patient-reported quality of life 6 years after breast cancer. *JAMA Netw Open*. 2024;7:e240688.
30. Franzoi MAB, Degousee L, Martin E, et al. PROACT: implementing a PROACTive care pathway to empower and support breast cancer (BC) survivors. *J Clin Oncol*. 2022;40:221.
31. Chan RJ, Crichton M, Crawford-Williams F, et al. The efficacy, challenges, and facilitators of telemedicine in post-treatment cancer survivorship care: an overview of systematic reviews. *Ann Oncol*. 2021;32:1552-1570.
32. Franzoi MA, Ferreira AR, Lemaire A, et al. Implementation of a remote symptom monitoring pathway in oncology care: analysis of real-world experience across 33 cancer centres in France and Belgium. *Lancet Reg Health Eur*. 2024;44:101005.
33. Franzoi MA, Ferreira AR, d'Andon JF, et al. Abstract PO1-10-10: Leveraging technology to optimize symptom management and patient empowerment in routine breast cancer care: implementation of a remote patient monitoring (RPM) pathway across 24 hospitals in Europe. *Cancer Res*. 2024;84(suppl 9):PO1-10-10.
34. Schunk DH, DiBenedetto MK. Motivation and social cognitive theory. *Contemp Educ Psychol*. 2020;60:101832.
35. Braun V, Clarke V. Using thematic analysis in psychology. *Qual Res Psychol*. 2006;3:77-101.
36. Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *Int J Qual Health Care*. 2007;19:349-357.
37. Curran GM, Bauer M, Mittman B, Pyne JM, Stetler C. Effectiveness-implementation hybrid designs: combining elements of clinical effectiveness and implementation research to enhance public health impact. *Med Care*. 2012;50:217-226.
38. Gaglio B, Shoup JA, Glasgow RE. The RE-AIM framework: a systematic review of use over time. *Am J Public Health*. 2013;103:e38-e46.
39. Giridharan S, Soumian S, Ansari J. Yoga for cancer survivors (YOCAS): a systematic review of the YOCAS program's impact on physical and psychological well-being. *Cureus*. 2024;16:e71857.
40. Bower JE, Partridge AH, Wolff AC, et al. Targeting depressive symptoms in younger breast cancer survivors: the pathways to wellness randomized controlled trial of mindfulness meditation and survivorship education. *J Clin Oncol*. 2021;39:3473-3484.
41. Cramer H, Lauche R, Klose P, et al. Yoga for improving health-related quality of life, mental health and cancer-related symptoms in women diagnosed with breast cancer. *Cochrane Database Syst Rev*. 2017;1:CD010802.
42. Lahart IM, Metsios GS, Nevill AM, et al. Physical activity for women with breast cancer after adjuvant therapy. *Cochrane Database Syst Rev*. 2018;1:CD011292.
43. Schell LK, Monsef I, Wöckel A, Skoetz N. Mindfulness-based stress reduction for women diagnosed with breast cancer. *Cochrane Database Syst Rev*. 2019;3:CD011518.
44. Alfano CM, Oeffinger K, Sanft T, Tortorella B. Engaging TEAM medicine in patient care: redefining cancer survivorship from diagnosis. *Am Soc Clin Oncol Educ Book*. 2022;42:1-11.
45. Demark-Wahnefried W, Aziz NM, Rowland JH, Pinto BM. Riding the crest of the teachable moment: promoting long-term health after the diagnosis of cancer. *J Clin Oncol*. 2005;23:5814-5830.
46. Di Meglio A, Gbenou AS, Martin E, et al. Unhealthy behaviors after breast cancer: capitalizing on a teachable moment to promote lifestyle improvements. *Cancer*. 2021;127:2774-2787.
47. Atlas SJ, Haas JS, Perez GK, Park ER, Peppercorn JM. Engaging patients, oncologists, and primary care clinicians in the care of cancer survivors: a coordinated care model with system-level technology to move the outcomes needle. *JCO Oncol Pract*. 2025;21:123-127.
48. Brauer ER, Ganz PA. Moving the translational needle in breast cancer survivorship: connecting intervention research to clinical practice. *J Clin Oncol*. 2022;40:2069-2073.
49. Brauer ER, Long EF, Petersen L, Ganz PA. Current practice patterns and gaps in guideline-concordant breast cancer survivorship care. *J Cancer Surviv*. 2023;17(3):906-915.
50. Garcia M. Official signing of the European Project « PATH-FOR-YOUNG ». Breast International Group. 2024. Available at https://bigagainstbreastcancer.org/official-signing-path-for-young/. Accessed February 21, 2025.
51. EU Funding & Tenders Portal. Available at https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/projects-details/43108390/101156800/HORIZON?order=DESC&pageNumber=1&pageSize=50&sortBy=title&keywords=Path%20for%20young&isExactMatch=false. Accessed February 27, 2025.
52. Hernandez MF, Rodriguez F. Health techequity: opportunities for digital health innovations to improve equity and diversity in cardiovascular care. *Curr Cardiovasc Risk Rep*. 2023;17:1-20.
53. Isakadze N, Molello N, MacFarlane Z, et al. The virtual inclusive digital health intervention design to promote health equity (iDesign) framework for atrial fibrillation: co-design and development study. *JMIR Hum Factors*. 2022;9:e38048.
54. Richardson S, Lawrence K, Schoenthaler AM, Mann D. A framework for digital health equity. *NPJ Digit Med*. 2022;5:119.
55. Borges do Nascimento IJ, Abdulazeem H, Vasanthan LT, et al. Barriers and facilitators to utilizing digital health technologies by healthcare professionals. *NPJ Digit Med*. 2023;6:161.