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# Barriers to home-based exercise program adherence with chronic low back pain: Patient expectations regarding new technologies

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## ABSTRACT

*Objective:* To assess views of patients with chronic low back pain (cLBP) concerning barriers to home-based exercise program adherence and to record expectations regarding new technologies.

*Design:* Qualitative study based on semi-structured interviews.

*Participants:* A heterogeneous sample of 29 patients who performed a home-based exercise program for cLBP learned during supervised physiotherapy sessions in a tertiary care hospital.

*Interventions:* Patients were interviewed at home by the same trained interviewer. Interviews combined a funnel-shaped structure and an itinerary method.

*Results:* Barriers to adherence related to the exercise program (number, effectiveness, complexity and burden of exercises), the healthcare journey (breakdown between supervised sessions and home exercise, lack of follow-up and difficulties in contacting care providers), patient representations (illness and exercise perception, despondency, depression and lack of motivation), and the environment (attitudes of others, difficulties in planning exercise practice). Adherence could be enhanced by increasing the attractiveness of exercise programs, improving patient performance (following a model or providing feedback), and the feeling of being supported by care providers and other patients. Regarding new technologies, relatively younger patients favored visual and dynamic support that provided an enjoyable and challenging environment and feedback on their performance. Relatively older patients favored the possibility of being guided when doing exercises. Whatever the tool proposed, patients expected its use to be learned during a supervised session and performance regularly checked by care providers; they expected adherence to be discussed with care providers.

*Conclusions:* For patients with cLBP, adherence to home-based exercise programs could be facilitated by increasing the attractiveness of the programs, improving patient performance and favoring a feeling of being supported. New technologies meet these challenges and seem attractive to patients but are not a substitute for the human relationship between patients and care providers.

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### Keywords:

Adherence  
Home-based exercise  
Rehabilitation  
Low back pain  
Virtual reality

## 1. Background

Low back pain (LBP) is one of the leading causes of disability [1], is highly prevalent [2], and has major socioeconomic impact [3]. Among the treatments proposed for chronic LBP, exercise

therapy may be the most effective in decreasing pain and improving function [4]. Individually designed exercise programs appear to be effective in healthcare settings and are recommended to patients with LBP in addition to regular physical activity [4]. Programs that include stretching and strengthening exercises are learned during supervised sessions and followed by home-based sessions.

The reported adherence to home-based exercise is between 50 [5] and 70% [6]. Poor adherence can compromise treatment

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outcome and cause recurrence of symptoms, so its determinants must be better understood and strategies proposed to encourage long-term exercise practice. Factors that can impair adherence include patient-related factors (poor self-efficacy, fear of pain, inability to fit exercises into daily life [6–8]), physiotherapy program characteristics (absence of supervision during learning sessions, “one size fits all” program design, large number of exercises [6,7,9–11]) and care providers’ style (lack of monitoring or feedback [8,11]). Except for self-management techniques, no intervention has been found efficacious in enhancing the frequency of home exercising with LBP [9,12]. Refresher lessons, audiotapes and videotapes of exercises may improve patient performance [9]. Results for training diaries, telephone contact, brochures, email and website interventions in encouraging general physical activity were conflicting but have not been specifically studied in LBP [5,8,9,11–14].

New technologies based on virtual reality and/or information and communication technologies offer exciting perspectives for enhancing adherence to home-based exercise programs. Such technologies are interactive and playful; they can provide monitoring of patient performance and direct feedback and can include reminders and motivation strategies [15–18]. However, the extent to which this kind of technology fulfills expectations of patients with LBP to help them exercise at home is largely unknown.

Qualitative research may be the best way to understand patient needs and contexts [19]. A qualitative approach has been used to explore barriers to adherence to home exercising with LBP [20], but participants performed home exercises for only a short time and were all adherents. Moreover, interviews did not focus on strategies proposed by patients themselves to improve adherence, and their expectations regarding the use of new technologies were not recorded.

In a qualitative approach, we assessed the views of patients with chronic LBP concerning barriers to home-based exercise program adherence and solutions to increase adherence. We also recorded patient expectations regarding the use of new technologies to decrease the burden of home-based exercise programs.

## 2. Patients and methods

### 2.1. Qualitative interview study

A qualitative interview study of patients and healthcare providers was performed according to guidelines for inductive qualitative research [19,21,22]. Its reporting follows the Consolidated criteria for REporting Qualitative research (COREQ) criteria [23]. Semi-structured interviews were used to explore the barriers to home-based exercise program adherence with chronic LBP, propose acceptable strategies to promote it, and explore the expectations regarding the use of new technologies to decrease the burden of such programs. Individual behaviors (attitudes and practices), personal feelings and interpretations, social interactions and material backgrounds were examined throughout the patients’ therapeutic journey to allow for a deep understanding of patient expectations.

### 2.2. Sample

We used non-probability judgment sampling of patients, assuring both relevance to the subject and diversity of the members selected. A heterogeneous sample of 29 patients was selected from the files of physicians in Cochin hospital, identifying patients with chronic LBP for whom home-based daily exercises for at least 2 months were recommended. All patients learned their exercise program during supervised sessions in the physical therapy department, and they received a brochure of the

prescribed exercises. According to the medical situation and the patient’s socioprofessional status, patients followed an out- or inpatient rehabilitation program and could have received other treatment. The programs all included group cognitive behavioral interventions to manage fear-avoidance beliefs, and individual psychological management was proposed if necessary.

The diversity of the patient sample was ensured for age (20–40 years,  $n = 10$ ; 41–60 years,  $n = 11$ ; 61–85 years,  $n = 8$ ), gender (17 women), type of learning session (outpatient:  $n = 18$ ; inpatient:  $n = 11$ ), and level of adherence (14 adherent, 10 could have been adherent but abandoned the prescribed regimen, 5 not adherent).

### 2.3. Interviews

We studied the literature on the barriers and facilitators to adherence to home-based exercise programs, then created 2 focus groups conducted with care providers working in the physical therapy department of Cochin Hospital (8 physiotherapists, 1 physical coach, 1 occupational therapist, 1 psychologist, 2 physical medicine and rehabilitation physicians and 1 rheumatologist) to compile a semi-structured interview guide with open-ended questions (see appendix). Patients were to be interviewed in their home.

The interview protocol combined a “funnel-shaped” structure and an “itinerary method” [19,24]. The funnel-shaped structure was adopted to ensure that the interviews allowed for an inductive comprehension of the social reality underlying the adherence situation. The itinerary method was derived from anthropological data collection techniques and focused on objects, practices and the decision-making process. Applied to a therapeutic situation, this method allows the researcher to follow the course of the patient from the appearance of the pathologic condition, sometimes long before the physical therapy sessions, to the time of the interview, thus placing the problem of adherence in a broader context than the medical one. The postulate underlying this framework is that studying adherence to home-based exercise programs for patients with LBP cannot be limited to collecting barriers and expectations that patients might explicitly express: barriers and expectations must be identified throughout an analysis of the global social situation, identifying contradictions, ambivalence, implicit expectations, and unanswered needs. For the same reason, the use of new technologies to enhance adherence was mentioned only at the end of the interview. However, imagining a concrete tool that could help patients be adherent fleshed out the discussion and created new themes and questions.

The interview protocol was planned as a loose list of themes, the interviewer continually adjusting questions to the specific leads of the interview and pursuing unpredictable emergent data. The interview was designed to collect data on:

- the therapeutic journey from the initial health problem to the physical therapy supervised sessions (the global organization, relationship with care providers, satisfaction with the program, and number and type of prescribed exercises were evoked);
- the home-based exercise process (how patients fit exercises into daily life, preferred/disliked exercises, difficulties in following the prescribed regimen);
- strategies patients proposed to enhance adherence (supervision, feedback, reminders, playfulness, exercise practice with other patients or other family members);
- expectations regarding the use of new technologies (smart phone, tablets, computer, Internet, videogame, virtual reality).

Because patients were interviewed in their home, the interviewer could assess the home environment, the area devoted

to exercises, and the place held by new technologies in the home. Movies advertising interactive consoles (Kinect, Playstation, and Wii) were presented to patients to help them better understand the concept of virtual reality.

#### 2.4. Procedure

The interviews were conducted from June to December 2013. All patients but 3 who preferred public places were interviewed at home by the same trained interviewer (VD). The mean time for these interviews was 75 min (range: 45 min to 2 h).

#### 2.5. Analysis

The conversations were recorded digitally, transcribed literally, and analyzed by 5 different researchers (VD and CP independently analyzed all interviews and compared their results; EK and AK independently analyzed selected interviews that particularly developed the expectations regarding new technologies; IV was consulted to achieve consensus). An initial categorizing system was established on the basis of the interview guides. This first thematic index was modified, categories and subcategories were added as they emerged from the data analysis and researchers continually checked that they had a common understanding of the categories generated. Numerous free categories were developed, discussed, adjusted and grouped in an iterative and inductive process.

#### 2.6. Ethics statement

All patients gave their oral informed consent to participate in the study. The transcripts of the interviews were anonymous. The study protocol was approved by the ethics committee of the national institute for medical research in France (CEEI-IRB 13-110).

### 3. Results

#### 3.1. Characteristics of the sample

The characteristics of the patient sample are in the [Table 1](#). The 29 patients (12 men, mean age: 54 years [range: 24–85 years]) had a range of professional activities (full-time working: 15, part-time working: 3, sick leave: 1, retired: 7, unable to work: 3), sport habits (no sport: 12, sport  $\leq$  1 per week: 11, sport  $>$  1 per week: 6), and medical situations (disk impairment: 21, spinal stenosis: 2, scoliosis: 3, listhesis: 2). The mean duration of symptoms was  $4.9 \pm 3.8$  years. Patients practiced home-based exercises from 3 months to 5 years. Overall, 5 patients had never been adherent and 10 stopped exercising after several weeks.

#### 3.2. Barriers to adherence

##### 3.2.1. Barriers associated with the exercise program

**3.2.1.1. Number of exercises.** Older people and patients not used to practicing a regular physical activity considered that more than 4 exercises in their program was difficult, but patients used to training expected to have a high number of exercises to vary their practice. Patient 6: “We almost have 10 exercises. It’s too much. There should be a limit: 3 or 4 max.”

**3.2.1.2. The effectiveness of the program.** Exercises that caused or increased pain were usually stopped, whereas those that immediately relieved pain were followed. Patient 1: “I wasn’t really doing the stretching stuff anymore, because it wasn’t doing me any good.”

**3.2.1.3. The complexity of the program.** Several patients were not sure if they had the correct position or the correct motion and preferred to stop the exercise(s). Patient 10: “I think that every

**Table 1**  
Characteristics of the patient sample.

Patient number	Gender	Age	Adherence	Employment status	Sport habits
1	Man	37	Yes	Sick leave	No sport
2	Woman	55	Yes	Working	No sport
3	Woman	35	Yes	Working	Recreational practice
4	Man	24	Yes	Working	Regular practice
5	Man	56	Yes	Unable to work	Recreational practice
6	Woman	63	No (never did)	Retired	No sport
7	Woman	40	No (never did)	Working	Regular practice
8	Woman	68	Yes	Working	No sport
9	Woman	45	No (never did)	Working	Recreational practice
10	Man	62	No (stopped)	Working	Recreational practice
11	Man	40	Yes	Working	Recreational practice
12	Woman	85	Yes	Retired	Recreational practice
13	Woman	46	No (stopped)	Working	Recreational practice
14	Man	58	No (stopped)	Working	Regular practice
15	Woman	55	Yes	Unable to work	No sport
16	Woman	72	No (stopped)	Retired	No sport
17	Woman	64	No (never did)	Retired	No sport
18	Man	40	No (never did)	Working	No sport
19	Woman	43	No (stopped)	Unable to work	No sport
20	Woman	85	Yes	Retired	No sport
21	Man	55	Yes	Working	Recreational practice
22	Woman	37	No (stopped)	Working	Recreational practice
23	Man	61	Yes	Retired	Recreational practice
24	Woman	60	No (stopped)	Retired	No sport
25	Man	28	Yes	Working	Regular practice
26	Man	41	No (stopped)	Working	No sport
27	Woman	28	Yes	Working	Regular practice
28	Woman	42	No (stopped)	Working	Recreational practice
29	Man	37	No (stopped)	Working	Regular practice

time that we are supported or guided, like in physical therapy, like the osteopath. . . We can do things better. Because when you're alone you're scared! You're scared of getting hurt; you don't know what needs to be done. In the end, that's what made me quit doing the moves."

**3.2.1.4. The burden of exercising.** Exercises were considered repetitive and boring, which did not help with regular practice. Patient 11: "I have my rehabilitation sheets that I really struggle to follow every day, because it's so boring!"

### **3.2.2. Barriers associated with the healthcare journey**

**3.2.2.1. A breakdown between supervised group and home-based sessions.** Patients noticed a gap between intensive supervised programs with support by care providers and other patients and a home-based exercise program performed alone without any support, which could lead to a feeling of abandonment. Patient 29: "...because you're being taken care of in such a good way and after that, you're back into the wild on your own. . . Too violent!"

**3.2.2.2. A lack of follow-up.** Patients with LBP asked for more frequent meetings with physical therapists or physicians. They reported the need to be supported and to have close follow-up to maintain their motivation to exercise. Patient 29: "If I have an appointment every 2 months, maybe for a week you let go because well you know how it is, but then you have to start again because you're going to be followed." "If it's not 'carrot and stick', I don't move forward."

**3.2.2.3. Difficulties in contacting care providers.** Patients who stopped their program for health or personal reasons expressed the need to quickly contact a physical therapist or a physician to plan a refreshing of their exercise program. Patient 24: "It's like hell when you have an emergency. . . People who work in administration, they're not aware of our problems. You get rejected. . ." "Hmm, there's no [appointment time] available!"

### **3.2.3. Barriers associated with patient representations**

**3.2.3.1. Illness perception.** According to views of patients on causality of the disease (punishment, fatality, non-reversible damage to the body), they could be more or less adherent. Patient 28: "At some point, the two vertebrae may have to be sealed. But I don't know, I have no certainty when I tell myself." "If I do [the exercises], will I actually avoid aggravation? Maybe so. . . I don't know. I have no certainty on that."

**3.2.3.2. Exercise perception.** Fear of movement and false beliefs regarding exercises were associated with limited adherence. Patient 4: "[I quit practicing because] I didn't want to feel more pain, and also. . . there's a bit of apprehension that things would go again as it did before, I mean the slipped disc." However, other patients were convinced of the efficacy of exercises to prevent the resurgence of symptoms and disability or preferred exercises to other treatments (including surgery) and performed their program whatever the circumstances. Patient 6: "Maybe [I will] find a source of motivation that will make me say to myself 'Well, that's it, if you don't do them, you might end up in a wheelchair in six months or so'".

**3.2.3.3. Despondency.** The chronicity of symptoms and the uncertainty regarding recovery could induce despondency concerning the disease and its treatments. Patient 3: "It's like being fed up. I can't spend my whole life doing this all the time. . . When am I getting better?" This feeling could be worse for patients who experienced a resurgence of symptoms despite good adherence.

Patient 28: "I am sick of it, it's been years. . . I do every program, every rehab, all of them. In the end, no matter what I do, I'll still live with. It will stay no matter what."

**3.2.3.4. Depression.** Patients reported difficulties in practicing exercises when they felt depressed. Patient 3: "When I'm feeling down, I don't want to do it."

**3.2.3.5. Lack of motivation.** Most patients underlined the need for strong motivation to perform exercises, which was considered a personal coping strategy. Patient 23 "I think it's only a personal approach and also desire or faith. . . that will make you do it or not." Motivation was also increased by external factors, mainly humans. Patient 27 (about her coach): "His goal is to trigger an impulse."

### **3.2.4. Barriers associated with environmental factors**

**3.2.4.1. Attitudes of others.** The absence of listening and support had a negative impact on adherence to exercises. The burden of explaining the condition and treatments to others or to hide because of the fear of being stigmatized was reported. Patient 21: "People with backache, they really need to share and talk. And when they share with their relatives, their relatives wind up not hearing anymore."

**3.2.4.2. Difficulties to plan or organize exercise practice.** The lack of time was often a cause of non-adherence by young and working patients. Patient 18: "I would say my problem is to find out when to do it actually. Because in the morning, I have a hard time getting started, I need time to get up, take a shower [ . . . ] Getting up is difficult enough, and then at the end of the day, after work, I am too tired."

The lack of a place or equipment did not seem to be a problem. Patients found the place to do their exercises or adapted the content of the program. Patient 18: "It's true there's not much room, ok. . . but I still can put myself here or there in the entrance. It's one of those poorly designed apartments so things can be complicated. . . But no, I could put myself there or over there."

### **3.3. Strategies to enhance adherence from patients' perspectives**

The perfect solution for patients to enhance adherence would be to have a coach available at home on demand. Patient 13: "Ideally, I would have a personal trainer coming to my home!" Patient 29: "The idea of a personal trainer seems perfect, yes". However, this situation was not realistic for most patients. Other solutions to enhance adherence would be to replace human coaching by increasing the attractiveness of the exercise program, improving performance, and favoring the feeling of being supported by relatives.

#### **3.3.1. Increasing the attractiveness of exercise programs**

Young athletic patients desired evolving programs (new exercises, increased difficulty) to improve performance and increase the challenge. Patient 21: "Renewing the exercises, for me it's a good thing, because if you put a little bit of change, that makes it more enjoyable. . . From the moment you start a new exercise, it will stimulate you." Patient 25: "If there's no way to [surpass yourself], you get bored pretty quick."

Others proposed entertaining ways of doing exercises: a playlist of songs (Patient 22: "I guess there could be a song that would keep me going"); a TV program (Patient 29: "As you're watching TV, you can chat also, you're at ease. . . it keeps your mind going"); or incorporate exercises in a video game (Patient 26: "It needs to be fun. . . like an adventure or detective game. For people like me, it would work.").

Exercise programs were often considered time-consuming. Patients asked for exercises that could be performed anywhere, at anytime (walking in the street, sitting in bus, working) to avoid wasting time. Patient 7: "What would be nice is to have exercises you can do while sitting at the office, or doing something else, or vacuum cleaning..."

### 3.3.2. Improving patient performance

3.3.2.1. *Following a model.* This includes all methods where the patient can practice exercises following a model and therefore self-correct the position (without feedback). Patients cited dynamic visual solutions (movie or game) but considered an audiotape or static pictures (photographs, brochure) of little help. Patient 25: "With a CD, it would be difficult because there's no visual, and while exercising, you need to know how to set your body in the right position." Patient 2: "A video, that would be good really...that would be perfect...it's a stimulation straight from the rehabilitation department." "A real person practicing exercises! Imitate and follow!...it's better with images because you mimic."

3.3.2.2. *Providing feedback.* Patients expressed the need for feedback on their performance (correction, encouragement, congratulations). Solutions suggested were refreshing supervised sessions, telerehabilitation (an online physiotherapy session) or exergames (virtual reality). For exergames, patients proposed a virtual environment in which they could progress by exercising, with growing difficulty, and visual or sound signals to indicate failure and success. Patient 26: "Some sort of online class...a webcam...it could be nice!" Videogames were mainly considered by young people, whereas older patients found them "stupid and annoying" (Patient 23).

### 3.3.3. Favoring the feeling of being supported by care providers

Care providers were expected to modify some skills and attitudes during supervised sessions. More detailed explanations on the disease, the objectives of exercises, and the choice of exercises included in the program were cited as needed; the need for individualized advice to integrate exercises into daily life was also noted. Patient 21: "To be fit into daily life. I think that's what's missing...Or simply a website entitled 'Cochin Hospital's advice for your daily life'."

Easier access to care providers after the end of supervised sessions was strongly mentioned. Contact could be at a distance, by phone, for asking questions regarding exercises or face-to-face in refreshing sessions (on-site or by telerehabilitation). Patient 6: "It would be like skype, so I would see the contact person and the contact person would see me."

The need to have individualized objectives during the follow-up period with a patient-caregiver agreement (contract) was cited. The importance of being responsible for realizing the objectives was noted. A diary in which the patient noted the frequency and duration of the practice was cited as a simple solution. Patient 27: "To send a spreadsheet at the end of the week saying what I've done, by email or some stuff like that, that's something that could motivate me."

3.3.3.1. *By sport professionals.* Many patients would like to do exercises with a sport professional trained in management of LBP (Patient 6: "If we could have in- or out-hospital sport sessions provided by a professional really specialised in LBP...I would immediately say 'Oh yes! Yes!'"). They admitted not trusting every sport professional and wished they could be guided in their choice (Patient 7: "People who don't know me? What kind of exercise could they propose?").

3.3.3.2. *By other patients.* Patients expected more connections and dialog with other LBP patients to share information, experiences or advice and to support each other. Patient 7: "It's encouraging to share with people who have the same problem; we encourage each other to get better, to remind each other that the exercises need to be done, to get there, to stick with it. Because at some point 'See, I've not been practicing, see how I look now...You have to practice!'"

This connection could involve different tools: a forum or other social network (Patient 7: "Facebook can be helpful!") or the constitution of exercise groups (Patient 21: "Well, see this...If I say that, every 2 months, you go to [a] hospital where there's a room, with the same [people] coming and reaching out to each other, 'So, what have you been up to?' there's some sort of [incentive] effect between people. And that would provide moral support, you know, which is necessary. Because it's true that it's easy to lose courage").

### 3.4. Expectations regarding new technologies to enhance adherence

All patients who were interviewed had a TV, a DVD player and an Internet connection. Most had a smartphone and a digital tablet. The youngest had played videogames. Three different types of technological tools were distinguished: reminder tools, exchange tools and tools for improving performance.

#### 3.4.1. Reminder tools

Most patients were not very enthusiastic regarding the use of a simple anonymous reminder (short message service, email, watch). Patient 10: "...a short message on your phone?...No way! Not like that!"; Patient 16: "A short text, saying 'What about the exercises? Are you doing ok?'....Hell no, leave me alone!"

Reminders should be reinforced by a personalized challenge (Patient 14: "It can be a stimulation...Maybe it should be said somewhere 'There is an exercise to include' in a program with oral communication") or lead to an exchange with a professional (phone call, mail). Patient 21: "If this is a discussion, that's ok. If it's only a message automatically sent to everyone, there's no point doing it."

#### 3.4.2. Exchange tools

Patients were mainly favorable to social networks (Patient 25: "A forum...That's smart! Because it's true people lose courage..."), but only some were ready to share their own experiences (Patient 26: "When it comes to forums, my attitude is absolutely passive. I log on to find information, but I don't get involved"). They were afraid of the lack of confidentiality and consequences it could have (Patient 13: [about a forum] "It's supposed to be anonymous, but I don't trust it, no way. This is the only reason why I haven't registered, because I find [it] quite fascinating actually! But I'd rather not"). They expected the discussion forums to be led by professionals (Patient 24: "Answers would have...I mean questions would have to come from patients, but answers... Because we can relate to the question, and if the answer is given by a professional, there's no doubt [it's true]....")

#### 3.4.3. Tools for improving performance

Patients cited tools to help patients with exercises by following a model (movie of exercises or virtual coach rather than audiotape or static pictures) or providing feedback (telerehabilitation or exergames). Among consoles presented to patients, the Kinect (X-Box) was the most appreciated because it tracks full-body motions (and not just upper- or lower-limb movement like the Wii does). All patients expected to be immersed in a virtual environment, but they imagined a different interface. Some patients (older ones and women) were interested in following a virtual model (a coach or a

model such as a “ghost car”) (Patient 26: “There’s what’s called the ghost car actually. It shows what you did on the last lap, in transparent superposition, you can see the places you crashed also... it could be the same with posture, it would show what you did and what you should have done... That kind of tool could be alright for self-adjustment”), whereas others (young men) preferred an exergame with a real scenario (Patient 26: “...at some point you would go through tests or trials but with a real scenario to experience an adventure”). Whatever the interface, all patients wanted feedback on their performance (position, intensity, duration) (Patient 21: “The device is telling me ‘you’re pulling too much on your right’ or ‘lift your left leg up’... That would be awesome!” Patient 25 “And also, in some fitness games, it detects the tensions in the body, so you know if your position is right, if you’re not too low... It’s really not bad!”) and personalized and evolving objectives (Patient 21: “There might be [an incentive] effect and you start telling yourself ‘Last time I did 30 seconds, this time you try 40 seconds’”). Some suggested doing exergames online with other patients (Patient 21: “You know what would be stimulating, to be two or three doing it... like online gaming”).

#### 4. Discussion

This work gives an overview of barriers to home-based exercise program adherence for patients with LBP and reports for the first time solutions patients propose to enhance adherence, especially their expectations regarding the use of new technologies.

The difficulties patients encountered in exercising are mainly the same as for other treatments [25]. The main difference is the performance in doing exercise. Taking a pill requires no special competence, but performing injections or using walking sticks is more difficult and does not even compare to the complexity of learning an exercise program. During supervised sessions, the physical therapist should pay attention to the patient’s performance and appropriately adapt the type, duration and intensity of exercises. They should also consider patient preferences [11] regarding exercises. During follow-up, physicians should appreciate the need to refresh supervised sessions during regular medical visits, and healthcare structures should provide an easy way to contact care providers and have quick access to refreshed sessions.

Considering the increasing prevalence of musculoskeletal conditions [1] and the difficulties with access to care in certain countries (lack of structures, rural area), alternative methods are urgently needed to fulfill patient expectations. The ideal solution for patients would be to have a coach available on demand, what is not possible in most cases (because it is too expensive or because there is no offer). An alternative can be to practice exercises with sport professionals, but patients don’t trust them because of their lack of training in medical conditions. Adapted physical activity, which is relayed between the hospital and home, seems an acceptable solution and should be developed. Other solutions are call centres, telerehabilitation, or other systems based on new technologies that provide feedback on performance. In England, the effectiveness of a call centre managed by a physical therapist was tested for musculoskeletal diseases. It provided telephone assessment and advice, followed by face-to-face care if needed [26]. This intervention was as effective as usual care, provided faster access to treatment, and was cost-effective [27]. The effectiveness of telerehabilitation needs to be validated with LBP but showed interesting results in other musculoskeletal conditions [28]. New technologies such as virtual reality, which can track body movement and provide feedback, seem attractive to patients. Several systems were developed for LBP, but until now, their use was limited to rehabilitation centres because of their price or complexity [29,30].

We distinguished two ideal types of adherent patients: relatively older and conscientious women who really wanted to follow medical advice and athletic patients without family pressure who wanted to get back to the previous performance level. In contrast, the types of patients who tended to give up exercising were those who did not believe in the efficacy of exercises and who found them boring; depressed patients looking for human support; and active patients who cannot find time to take care of their health problems. Consequently, the strategies proposed to enhance adherence should be personalized. Convincing the first type of non-adherent patients to exercise regularly would be difficult, whereas the second type may need to have regular medical visits and physiotherapy sessions and develop contact with other patients (e.g., via social networking). The third type of non-adherent patients may expect personalized advice to include simple exercises in their daily life (at work, during transit, with family or colleagues).

With the explosion of technological tools, better understanding the expectations of patients regarding new technologies is needed to enhance adherence. All patients expected a visual and dynamic support reminder of how to perform the exercises, and most wanted feedback on their performance. The youngest patients wanted to have an enjoyable, extensive and challenging environment with the option to register their performance and modify their exercise program according to performance; the oldest patients were more interested in the possibility of being guided when doing exercises. Virtual reality meets those expectations. However, we found that the use of technological tools could not be isolated from the human relationship: the learning process and the adjustment of the different options (type of exercises, interface, sound) of the tool should be made by the caregiver whom the patient trusts and performance should be regularly checked by care providers and problems with adherence discussed with patients.

##### 4.1. Study limitations

Although we used non-probability judgment sampling of patients, assuring both relevance to the subject and diversity of the members selected, the characteristics of the patients interviewed may have induced bias in results and limit the external validity. Most patients were interviewed in a tertiary care hospital after failure of other treatment options; they had had disabling back pain for years, with serious psychological or socioprofessional consequences. Patients with less serious symptoms may need less human support and could be more interested in the use of new technologies to help them perform exercises. Our findings concern the French population. Although they may be transposed to other developed countries, they are probably not valid in other settings. The expectations of patients in different developed countries could differ. In the United States, the cost of healthcare may encourage the use of technological tools to enhance adherence; in Australia, the physical distance to medical structures may promote the development of telerehabilitation and web interventions.

#### 5. Conclusions

Adherence to a home-based exercise program for patients with LBP could be facilitated by increasing the attractiveness of exercise programs, improving patient performance and favoring the feeling of being supported. New technologies, particularly with virtual reality and information and communication technologies, meet these different challenges and seem attractive to patients. However, the use of technological tools must not be a substitute for the human relationship of the caregiver and patient.

## Author contributions

CP, VD, EK, AK, SP and IV contributed to conception and design of the semi-structured interview study, VD to data collection, CP, VD, EK, AK, SP and IV to data analysis, CP, VD, WM and SP to drafting the manuscript, EK and IV to critical review of the manuscript. All authors read and approved the final manuscript.

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## Disclosure of interest

The authors declare that they have no competing interests.

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## References

- [1] Vos T, Flaxman AD, Naghavi M, Lozano R, Michaud C, Ezzati M, et al. Years lived with disability (YLDs) for 1160 sequelae of 289 diseases and injuries 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet* 2012;380:2163–96.
- [2] van Oostrom SH, Monique Verschuren WM, de Vet HC, Picavet HS. Ten year course of low back pain in an adult population-based cohort – the Doetinchem cohort study. *Eur J Pain* 2011;15:993–8.
- [3] Coggon D, Ntani G, Palmer KT, Felli VE, Harari R, Barrero LH, et al. Disabling musculoskeletal pain in working populations: is it the job, the person, or the culture? *Pain* 2013;154:856–63.
- [4] Hayden JA, van Tulder MW, Malmivaara A, Koes BW. Exercise therapy for treatment of non-specific low back pain. *Cochrane Database Syst Rev* 2005; 3:CD000335.
- [5] Friedrich M, Cermak T, Maderbacher P. The effect of brochure use versus therapist teaching on patients performing therapeutic exercise and on changes in impairment status. *Phys Ther* 1996;76:1082–8.
- [6] Medina-Mirapeix F, Escobar-Reina P, Gascon-Canovas JJ, Montilla-Herrador J, Jimeno-Serrano FJ, Collins SM. Predictive factors of adherence to frequency and duration components in home exercise programs for neck and low back pain: an observational study. *BMC Musculoskelet Disord* 2009;10:155.
- [7] Beinart NA, Goodchild CE, Weinman JA, Ayis S, Godfrey EL. Individual and intervention-related factors associated with adherence to home exercise in chronic low back pain: a systematic review. *Spine J* 2013;13:1940–50.
- [8] Slade SC, Patel S, Underwood M, Keating JL. What are patient beliefs and perceptions about exercise for non-specific chronic low back pain? A systematic review of qualitative studies. *Clin J Pain* 2014;30:995–1005.
- [9] Jordan JL, Holden MA, Mason EE, Foster NE. Interventions to improve adherence to exercise for chronic musculoskeletal pain in adults. *Cochrane Database Syst Rev* 2010;1:CD005956.
- [10] Henry KD, Rosemond C, Eckert LB. Effect of number of home exercises on compliance and performance in adults over 65 years of age. *Phys Ther* 1999;79:270–7.
- [11] Slade SC, Molloy E, Keating JL. People with non-specific chronic low back pain who have participated in exercise programs have preferences about exercise: a qualitative study. *Aust J Physiother* 2009;55:115–21.
- [12] McLean SM, Burton M, Bradley L, Littlewood C. Interventions for enhancing adherence with physiotherapy: a systematic review. *Man Ther* 2010;15:514–21.
- [13] Moseley GL. Do training diaries affect and reflect adherence to home programs? *Arthritis Rheum* 2006;55:662–4.
- [14] Ferney SL, Marshall AL. Website physical activity interventions: preferences of potential users. *Health Educ Res* 2006;21:560–6.
- [15] Sveistrup H, McComas J, Thornton M, Marshall S, Finestone H, McCormick A, et al. Experimental studies of virtual reality-delivered compared to conventional exercise programs for rehabilitation. *Cyberpsychol Behav* 2003;6:245–9.
- [16] Burdea GC. Virtual rehabilitation – benefits and challenges. *Methods Inf Med* 2003;42:519–23.
- [17] Irvine AB, Russell H, Manocchia M, Mino DE, Cox Glassen T, Morgan R, et al. Mobile-web app to self-manage low back pain: randomized controlled trial. *J Med Internet Res* 2015;17:e1.
- [18] Kim S, Min SWK, Kim JH, Lee BH. The effects of VR-based Wii Fit yoga on physical function in middle-aged female LBP patients. *J Phys Ther Sci* 2014; 26:549–52.
- [19] Alami S, Desjeux D, Mousaoui I. *Méthodes qualitatives*. PUF, editor; 2009.
- [20] Escobar-Reina P, Medina-Mirapeix F, Gascon-Canovas JJ, Montilla-Herrador J, Jimeno-Serrano FJ, de Oliveira Sousa SL, et al. How do care-provider and home exercise program characteristics affect patient adherence in chronic neck and back pain: a qualitative study. *BMC Health Serv Res* 2010;10:60.
- [21] Glaser BG, Strauss AL. *The discovery of grounded theory. Strategies for qualitative research*. Chicago: Adline, editor; 1967.
- [22] Strauss AL, Corbin J. *Basics of qualitative research: grounded theory procedures and techniques*; 1990.
- [23] 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;19:349–57.
- [24] Desjeux D, Zheng L. *The itinerary method*; 2002, <http://www.argonautes.fr/sections.php?op=viewarticle&artid=422>.
- [25] Tran VT, Barnes C, Montori VM, Falissard B, Ravaud P. Taxonomy of the burden of treatment: a multi-country web-based qualitative study of patients with chronic conditions. *BMC Med* 2015;115:13.
- [26] Salisbury C, Foster N, Hopper C, Bishop A, Hollinghurst S, Coast J, et al. A pragmatic randomised controlled trial of the effectiveness and cost-effectiveness of 'PhysioDirect' telephone assessment and advice services for physiotherapy. *Health Technol Assess* 2013;17:1–157.
- [27] Hollinghurst S, Coast J, Busby J, Bishop A, Foster N, Franchini A, et al. A pragmatic randomised controlled trial of 'PhysioDirect' telephone assessment and advice services for patients with musculoskeletal problems: economic evaluation. *BMJ Open* 2013;3:e003406.
- [28] Moffet H, Tousignant M, Nadeau S, Merette C, Boissy P, Corriveau H, et al. In-home telerehabilitation compared with face-to-face rehabilitation after total knee arthroplasty: a noninferiority randomized controlled trial. *J Bone Joint Surg Am* 2015;97:1129–41.
- [29] Brodbeck D, Degen M, Stanimirov M, Kool J, Scheermesser M, Oesch P, et al. Augmented feedback system to support physical therapy of non-specific low back pain. *Biomed Eng Syst Technol* 2010;52:381–93.
- [30] Trost Z, Zielke M, Guck A, Nowlin L, Zakhidov D, France CR, et al. The promise and challenge of virtual gaming technologies for chronic pain: the case of graded exposure for low back pain. *Pain Manag* 2015;5:197–206.