

EVOLUTIONARY STEPS IN THE IMPLEMENTATION OF A PREHABILITATION SERVICE: FROM KNOWLEDGE GENERATION TO CLINICAL PRACTICE

PASSOS EVOLUTIVOS NA IMPLEMENTAÇÃO DE UM SERVIÇO DE PRÉ-HABILITAÇÃO: DA CRIAÇÃO DO CONHECIMENTO À PRÁTICA CLÍNICA

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INTRODUÇÃO

A população cirúrgica está cada vez mais envelhecida, com necessidades médicas complexas (incluindo o descondicionamento físico resultante do estilo de vida sedentário)¹. Este panorama vem colocar um importante desafio à equipa perioperatória, na medida em que se antecipa um aumento significativo das taxas de morbimortalidade pós-operatória. A baixa condição física e capacidade funcional reduz a capacidade de tolerar, mental e fisicamente, a hospitalização e a cirurgia, comprometendo a recuperação funcional pós-operatória e podendo levar ao desenvolvimento de complicações pós-operatórias e morte².

A pré-habilitação multimodal surgiu nos últimos anos como uma intervenção inovadora que visa a otimização da resiliência fisiológica e psicológica para tolerar o impacto da cirurgia. Envolve um programa abrangente, preventivo, de curto prazo e centrado no doente, com duração de cerca de quatro semanas, desenvolvido para melhorar a capacidade aeróbia, o estado nutricional e psicológico do doente, e para otimizar as multimorbidades existentes^{3,4}. O seu objetivo final é aumentar a capacidade funcional

INTRODUCTION

The surgical population is becoming increasingly older, with complex medical needs (including deconditioning from sedentary lifestyles)¹. This phenomenon represents a challenge for the perioperative team, because it leads to a significant increase in surgery-related morbidity and mortality rates. Poor physical condition and functional status reduces the ability to cope, mentally and physically, with hospitalization and surgery and may compromise postoperative functional recovery, potentially leading to postoperative complications and death².

Multimodal prehabilitation has emerged in recent years as an innovative intervention that focuses on optimizing physiological and psychological resilience to withstand the upcoming stress of surgery. It involves a comprehensive, preventive, short-term, patient-centred programme lasting around four weeks designed to improve the patient's aerobic capacity, nutritional balance, and psychological status, and to optimize existing multimorbidities^{3,4}. Its ultimate aim is to enhance the patient's functional capacity in order to



do doente, com o intuito de minimizar a morbidade pós-operatória e de garantir uma recuperação mais rápida.

Vários estudos têm vindo a demonstrar que a pré-habilitação é uma estratégia segura e eficaz para prevenir complicações pós-operatórias e reduzir o tempo de hospitalização em diferentes populações cirúrgicas⁵⁻⁸. No entanto, apesar dos benefícios esperados, das recomendações emergentes de vários especialistas e do seu potencial na redução dos custos associados, a pré-habilitação encontra-se ainda subutilizada na prática clínica e a sua implementação impõe alguns desafios consideráveis para a maioria dos hospitais. Torna-se assim fundamental realizar uma avaliação abrangente do processo de implementação dos programas, com a finalidade de identificar os fatores essenciais para o seu sucesso e gerar recomendações para que a utilização deste tipo de serviços possa ser generalizada.

Neste artigo, descrevemos a nossa experiência na implementação de um programa de pré-habilitação multimodal como um serviço regular no *Hospital Clínic de Barcelona* (HCB). O projeto começou no contexto de um ensaio clínico randomizado (RCT) realizado entre 2013 e 2016, que mostrou a eficácia e o potencial na redução de custos da pré-habilitação. Seguiu-se o desenvolvimento do presente programa multimodal, que foi adaptado ao longo do tempo de acordo com os recursos disponíveis e o *feedback* fornecido pelos médicos e doentes. Ao longo dos anos, identificamos os fatores necessários para ampliar (scale-up) o serviço de pré-habilitação. Entendemos que para uma implementação bem-sucedida e alargada dos programas de pré-habilitação, são necessárias mais evidências sobre a sua eficácia em cenários mais próximos do mundo real, o programa deve ser padronizado e modularizado, e as plataformas digitais e dispositivos portáteis deverão ser exploradas para melhorar o acesso ao programa e garantir o empoderamento do doente na gestão do seu próprio processo de tratamento.

minimize postoperative morbidity and accelerate recovery.

Several studies assessing prehabilitation have shown it to be an effective and highly advantageous strategy to prevent postoperative complications and reduce hospital length of stay in different populations⁵⁻⁸. However, despite the expected benefit, emerging recommendations from experts, and its cost-saving potential, the implementation of prehabilitation programmes in clinical practice is a major unmet need and an ongoing challenge for most hospitals. A comprehensive assessment of the implementation process is critical to identify the factors that can ensure success, and to generate recommendations for service transferability.

In this paper, we report our experience in implementing a multimodal prehabilitation programme as a mainstream service at the Hospital Clínic de Barcelona (HCB). The project started with a randomised clinical trial (RCT) carried out between 2013 and 2016, which showed the efficacy and cost-saving potential of prehabilitation. This was followed by the present multimodal programme, which has been adapted over time in accordance with the available resources and the feedback received from clinicians and patients. Over the years, we have identified the factors needed to scale-up the prehabilitation service. For successful, large scale implementation of a prehabilitation service more evidence of the effectiveness of such a programme in real-world scenarios is needed, the service needs to be standardised and modularised, and digital platforms and portable devices are required to improve patient access and empower self-management.



KNOWLEDGE GENERATION

The Barcelona preHAB group at HCB conducted a three-year blinded RCT (2013-2016) to assess the efficacy of prehabilitation in high-risk patients undergoing major digestive surgery. Although prehabilitation appears to be positive in all patients, in this study we specifically decided to include only patients at high risk for postoperative complications. The main inclusion criteria were age over 70 years and/or American Society of Anesthesiologists (ASA) class III/IV. Patients considered too fit (Duke Activity Status Index [DASI] ≥ 46) were specifically excluded. In this study⁵, the prehabilitation programme revolved around three main elements: (i) a motivational interview, (ii) a hospital-based high-intensity endurance exercise training program, and (iii) promotion of physical activity. After completing a programme lasting around 6 weeks, prehabilitation was shown to be a protective factor for both postoperative complications (RR 0.5, 95% CI [0.3-0.8]; p-value=0.001) and the risk of presenting more than one complication (RR 0.6, 95% CI [0.3-1.1]; p=0.001). The study also showed that prehabilitation reduced intensive care unit length of stay (3[2] vs. 12[20] days for the intervention and control group, respectively; p=0.046). The mean cost of the prehabilitation program was €389 per patient. The cost-consequences analysis showed the intervention may result in health value-generation, since prehabilitation add cost to healthcare, but those seem to be offset by a reduction in postoperative complications and shorter hospital stay (€812 [95% CI -878 – 2,642; p=0.365]). Additionally, the prehabilitation-induced benefits in aerobic capacity and physical activity showed sustainability at 3 and 6 months after surgery, respectively.

PILOT PREHAB UNIT

These promising results encouraged us to create the Prehab Unit at HCB in April 2016. The HCB

is a university hospital for adults in Catalonia with about 700 beds. It serves as a community hospital, and is the main public health provider in its district in Barcelona, with a population of 540,000 inhabitants. It also serves as a “high-complexity” tertiary hospital, developing lines of action for patients not only in Catalonia but also in Spain and worldwide.

Over the past decade, it has become increasingly obvious that nutritional support and psychological wellbeing could be key factors in improving both adherence to the prehabilitation programme and response to the physical training⁹. This led to a shift from unimodal to multimodal prehabilitation, and prompted us to incorporate these elements in our intensive multidisciplinary outpatient programme. At the start of the pilot project, the hospital had no multidisciplinary preoperative clinic or active training programme for patients awaiting surgery (except for research purposes). We identified several highly motivated clinicians with the skills to work within different aspects of the perioperative pathway, until then, working such as specialist “silos”. Therefore, we approached our hospital management to request the creation of a unit where these specialists could work together in order to offer an integrated care programme for high-risk patients scheduled for major surgery. We all know that optimum management involves a multidisciplinary team, a multimodal approach to continuum of care, and collaborative behavioural (lifestyle) change. It was clear to us that integrating certain specialists within a specific unit would minimize both personnel costs and use of material resources. The decision to implement the programme was taken internally, with some external support from a research grant. In this initial phase, we used our hospital’s outpatient facilities in the afternoons, when they are usually empty.

For the first year, the main goal of the Unit was to demonstrate the feasibility of a prehabilitation programme in a real world scenario, and to identify the actionable prehabilitation factors that would



further enhance the service workflow. The service initially focused on candidates for major abdominal or cardiovascular surgery. However, over time it has been expanded to include others types of surgery.

Since our capacity was very limited, we prioritized patients with poor baseline functional status (less fit), being the ones likely to benefit the most from prehabilitation¹⁰. The criteria used to enrol patients in the service were similar to those used in the RCT⁵: i) scheduled for major digestive, cardiac, thoracic, gynaecologic or urologic surgery; ii) high-risk for postoperative complications, defined by age >70 and/or ASA class III-IV, and/or patients suffering from severe deconditioning caused by cancer and undergoing highly aggressive procedures (i.e., esophagectomy, gastrectomy, cystectomy or oncologic gynaecologic surgery); and iii) a preoperative schedule that would allow for at least 4 weeks of prehabilitation without delaying the surgical schedule. The programme adhered to the Enhanced Recovery After Surgery standard of care recommendations.

At the moment of contemplation of surgery and, as soon as the anaesthesiologist had identified the case as a candidate for the programme in their routine preoperative assessment, the patient was referred to the Unit. On the first day, patients underwent holistic characterization to introduce them to the team and the programme, identify their clinical requirements and comorbidities, assess their nutritional and psychological status, and to assess their baseline aerobic capacity and history of daily life activities in order to personalise the volume of training/physical activity, identify any factors that would affect their access (social, logistics, etc..) and adherence (behavioural profile) to the physical activity schedule (Figure 1). The aim was to address any problems that could undermine the success of the programme.

At this time, due to the absence of specific facilities for supervised training, the programme only included home-based exercise training and promotion of physical activity that started with a

patient-physiotherapist interview. The main aim of this motivational interview was to involve the patient in the design of the physical activity plan while reinforcing their motivation and commitment to behavioural change to achieve the objectives of the programme. Replacing sedentary time with physical activity by increasing the amount of movement performed on a daily basis in short sessions is a well-known strategy for improving health, especially in previously inactive individuals¹¹. Specifically, the physical activity programme consisted of increasing the patient's daily step count measured on a pedometer and/or optimising walking intensity measured on the modified Borg scale¹². International recommendations for step-based physical activity were used as a theoretical framework to establish the objectives¹³. In addition to the aerobic exercises, patients were required to complete at least two resistance training sessions per week.

The exercises prescribed required only basic fitness equipment. Patients were encouraged to attend a public/shared fitness facility, if available. A weekly follow-up visit was performed in the unit to redefine the physical activity objectives. During this visit, patients participated in a 1-h group fitness class led by an instructor, and any significant changes in symptoms were noted (e.g., excessive shortness of breath, chest pain, etc.).

Based on their initial evaluation, patients received recommendations for a healthy balanced diet or a diet adapted to their digestive symptoms, as appropriate. The daily amount of protein intake capable of producing a positive nitrogen balance in these patients is estimated to be close to 2 gr·kg⁻¹·day⁻¹¹⁴. This protein intake (1.5-2 gr·kg⁻¹·day⁻¹) was assured in patients with adequate kidney function, and was distributed in three main daily meals by means of food enrichment and/or nutritional supplements such as whey protein powder or casein. Sufficient caloric supply was assured to guarantee proper protein utilization. Patients with iron deficiency anaemia received intravenous iron, and those at





FIGURE 1 – Holistic assessment on admission to the program. 6MWT Six-minute walking test. CSHA Canadian Study of Health and Aging. MUST Malnutrition Universal Screening Tool. HAD Hospital Anxiety and Depression

high risk for malnutrition (Malnutrition Universal Screening Tool ≥ 2)¹⁵ were treated by a qualified dietician.

All patients were invited to attend weekly mindfulness group sessions. This intervention was particularly recommended in patients showing signs of anxiety or depression (defined as a Hospital Anxiety and Depression scale [HADS] score > 8)¹⁶. The sessions (90 minutes each) included breathing and relaxation exercises led by a psychiatrist or psychologist expert in Mindfulness-Based Stress Reduction (MBSR). The aim was to reduce the patient's levels of stress, anxiety, and depression.

Patients were provided with a pedometer to encourage them to achieve the daily step target and to provide feedback to the physiotherapist. They were also asked to self-report their physical activity, nutritional supplement intake and their mindfulness

sessions, if prescribed, in a small notebook with prehabilitation-related information that was given to them on admission to the programme.

OPENING THE GYM, REDEFINING THE PROGRAMME

In 2017, a year after the Prehabilitation Unit had been opened, we were able to increase and adapt the infrastructure. Additional physiotherapy equipment allowed us to consolidate a supervised training programme in this second period. Physical exercise training is the main driver to improve aerobic fitness. The prehabilitation programmes reported in the literature so far have been heterogeneous; in fact, there are no clear guidelines for designing a preoperative exercise intervention to optimise



aerobic capacity that has shown improvement after both supervised and unsupervised training¹⁷. However, when time is short, as is often the case in prehabilitation, it is reasonable to assume that well-structured, supervised high-intensity training would be more effective than moderate-intensity exercise training or an unsupervised home-based exercise programme¹⁸. Therefore, we included supervised exercise training sessions in our programme.

Because of the limited capacity of our training facilities, we offer two main multimodal prehabilitation programmes: a physical activity-based prehabilitation programme; and exercise training plus promotion of physical activity. The latter is mainly prescribed in patients with comorbidities that affect their physical fitness and/or those scheduled for highly aggressive surgery. The supervised exercise training sessions consist of high-intensity

endurance training performed on a stationary cycle-ergometer (*Technogym® Excite Bike; Cesena; Italy*) and muscle strength training (*Technogym® Plurima Multistation Wall; Cesena; Italy*). Patients receive 2 to 3 sessions per week. Work-rate progress during the program is tailored on an individual basis, according to patients' tolerance with the final aim of maximizing the training effect.

The other main components of the programme (nutritional and psychological support) are incorporated and adapted to the exercise programme modality. Individual visits and group sessions for nutrition education, stress-reduction training, and behaviour-change support are prescribed according to the patient's needs (Figure 2).

After the initial assessment and once the plan of the intervention has been designed by the team, mild-to-moderate complex patients are assigned a

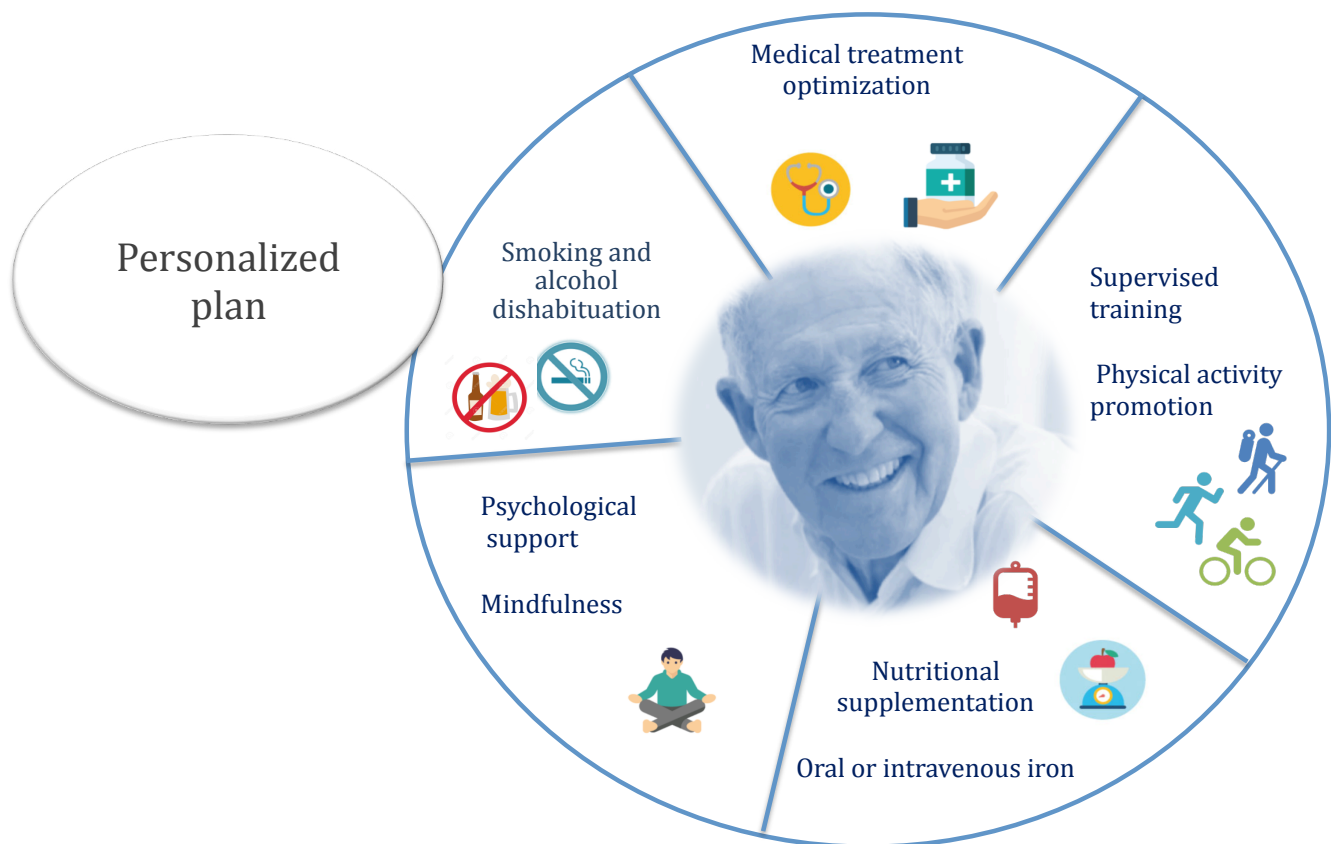


FIGURE 2 – Personalized prehabilitation intervention.



health professional, often a physiotherapist, who fulfilled three roles: i) to act as a case manager and to liaise with the other professionals involved in the intervention; ii) to reinforce the patient's adherence to the programme and commitment to self-management; and iii) to perform remote evaluation of the progress. The prehabilitation programme is partly supported with a mobile app co-developed by the team that monitors the patient's daily step count, sends motivational messages, and provides access to educational material. Complex and multimorbid patients, however, need closer, more structured monitoring by prehabilitation team members, and their progress is checked in a face to face interview every week.

Patients are instructed to follow their programme until the day of their surgery. The duration of prehabilitation is mainly determined by the wait time until surgery. At the end of the programme, before surgery, we perform a reassessment of the patient's functional, nutritional and psychological status in order to monitor the effects of our intervention. At the same time, patients are asked to complete a satisfaction survey to evaluate their experience of the care provided (including quality and satisfaction). All clinical data are uploaded to the Hospital's database, and we also use Research Electronic Data Capture (REDCap®) to routinely collect all patient data.

We have defined some key performance indicators for the purpose of performing a long-term evaluation of the structure, processes and outcomes of the prehabilitation programme in clinical practice. These include: coverage of the service (i.e., patients included in the programme/ total target patients), drop-out rate, adherence rate, health outcomes (development of 30-day postoperative complications and intensive care unit and hospital length of stay), and 30-day use of healthcare resources (surgical re-intervention, hospital readmission, and emergency room visits). The analysis of all these data will provide valuable information about the safety, quality and

effectiveness of the intervention, and will show the changes and improvements needed in overall care before the service achieves full maturity.

MAIN CHALLENGES DURING IMPLEMENTATION OF THE PROGRAMME

This pioneering project has showed the feasibility and potential of a mainstream prehabilitation service for high risk patient scheduled for different types of major surgical procedures at HCB. We learnt that there was a clear need for capacity building to meet demand. We estimate that about 1,200 patients per year are candidates for prehabilitation in our hospital; however, we are currently only able to include about 150-200 patients. Two years ago, the team explored the possibility of using Design Thinking to improve the service workflow and facilitate large scale implementation¹⁹. Design Thinking is a creative, solution-based process for designing new products that can also be used in other contexts, such as business, social services, and more recently, to redefine clinical processes in healthcare²⁰. The Design Thinking workshops include all stakeholders, namely, healthcare workers and managers, designers, health-technology agents, business school representatives and policy makers. Given the multifaceted challenges involved in implementing prehabilitation programmes, different aspects were identified as core traits to ensure consistency during implementation.

Implementing a prehabilitation unit requires a *multidisciplinary team, proper facilities and adequate equipment*. Members of the multidisciplinary team must meet in person in a particular place, at a particular time. It is important to secure the support of the hospital management before embarking on the implementation process. Prehabilitation requires a collaborative effort. The prehabilitation team should be made up of different specialists, including anaesthesiologists, rehabilitation physicians, physiotherapists, dietitians, psychologists and



nurses. Effective leadership and establishment of key roles are crucial for the success of any project. The surgeon, as the patient's referring clinician, plays a pivotal role in prescribing and encouraging patients to adhere to prehabilitation. Early identification and referral of these patients to the prehabilitation unit is only possible when surgeons, anaesthesiologist and primary care clinicians work together. Partial transfer of the programme to the community through either home-based or health club-based activities may help extend the programme to all surgical candidates without overloading hospital facilities.

Implementing a prehabilitation programme involves several logistic challenges. *Modularity, flexibility and personalization* are the cornerstones of the service, and will determine whether the programme is successful and can be transferred to other hospitals. Prehabilitation is highly patient-centred, meaning that the approach to each individual depends on their baseline characteristics, goals and preferences. One intervention does not fit all; training plans are not closed. The patient may go from one plan to another depending on their evolution and/or availability. Certain patients can also combine different options. The aim should be to facilitate adherence to the programme and maximize the positive effects of prehabilitation.

Unlike some other therapeutic interventions, *patient cooperation* is crucial in prehabilitation programmes. Compliance can significantly influence the effectiveness of the programme. Surgical patients are presumably more adherent than, for example, patients with chronic lung disease, of whom less than 2% of eligible cases take part in rehabilitation programmes²¹. The impact of the recent diagnosis and the implications of major surgery generate a certain momentum that may play a key role in adherence. The preoperative period has been described as a window of opportunity, a "teachable moment", when patients faced with a potentially life-threatening event may be persuaded to adopt lifestyle changes that will improve their

postoperative outcome. In our experience, although patients are initially enthusiastic about taking part in a prehabilitation programme, the drop-out rate is high. This is why the factors that determine patient adherence and response must be identified in order to redefine the service and optimize outcomes.

In our experience, older and/or more deconditioned patients are more adherent to the programme – probably because they are more aware of the increased risk of surgery. Nevertheless, the need for a caregiver and transportation difficulties make it difficult for them to attend their prehabilitation appointments. McGill et al. identified these as the major barriers to participation in the programme, while there was no strong correlation between baseline characteristics, such as physical activity level, anxiety, and depression, and programme completion²². Continuous monitoring of satisfaction levels and acting on feedback from patients and professionals is highly recommended. Focus groups can help guide the implementation process.

Although the ideal *programme length* has not been established, an intervention lasting three to four weeks has been found to be sufficient to increase functional capacity²³. However, patients who are malnourished, sarcopenic, old, or frail might need longer. It is reasonable to assume that the earlier the patient is evaluated, the more successful the outcome will be. The duration of the prehabilitation programme is highly dependent on the wait time for surgery, which is in turn largely dependent on organizational aspects of the healthcare system and the type of surgical intervention. Recent data in patients undergoing non-metastatic colorectal cancer resection surgery suggest that treatment delays >4 weeks are not associated with worse oncologic outcomes²⁴. Therefore, delaying surgery to optimize the health status of certain patients can be considered without compromising survival. Patients in need of neoadjuvant chemotherapy and/or radiotherapy would also benefit from prehabilitation either during neoadjuvant therapy



or while waiting for surgery. In non-cancer patients, the duration of prehabilitation can be extended if necessary. Thus, the intensity and duration of the intervention should be based on clinical needs, and should be tailored to goals and outcomes rather than fixed time periods.

Digital tools for supporting patient empowerment for self-management with off-line follow-up and efficient interactions between patients and clinicians appears to be a key requirement for generalization of the service. Even simple programmes performed outside the hospital setting are capable of improving aerobic capacity by increasing daily physical activity. However, successful implementation relies to a large extent on the patient's motivation. Strategies that include personal coaching based on monitoring and reporting progress and activity may encourage behavioural change and achieve results. Information and communication technologies can enable integrated healthcare by encouraging patients to engage with programmes. The immaturity of the technology that can be used to support programme management may be an important barrier. However,

the “social distancing” imposed by the current SARS-CoV-2 pandemic has triggered an important adaptive response, such as telemedicine platforms, and this may soon encourage healthcare providers to transfer their services to the community, a step that may goad technology companies into moving from product- to service-centred design and the creation of sustainable business models.

In the absence of research that addresses specific issues related to the implementation of prehabilitation services, this review provides practical recommendations based on evidence, experience and common sense. It may open new perspectives in different areas during the implementation period. Multidiscipline integration appears to be the cornerstone for continuum of care. Standardization and modularization of the service, and the use of digital platforms and portable devices to increase accessibility for patients should also be taken into consideration. There is a clear need for ongoing assessment and further studies to improve the establishment of prehabilitation programmes in clinical practice.

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