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Improving cancer preventive behaviours in cancer patients and their families in a prehabilitation/rehabilitation cancer surgery context

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Abstract

Background: A cancer diagnosis offers a potential opportunity for health behaviour change through prehabilitation, with interventions comprising physical activity, weight/diet and psychological support. However, current prehabilitation interventions lack systematic family integration and consistent application of behaviour change techniques. This thesis aims to explore how prehabilitation interventions for cancer surgery patients may be optimised and how family members can be engaged in behaviour change.

Methodology: The thesis included five studies, beginning with a systematic review of behaviour change techniques (BCTs) in prehabilitation for colorectal and ovarian cancer patients (Study 1). Semi-structured interviews with health care professionals and service providers (n=5) (Study 2). Patient-family dyads interviews (n=6 dyads, n=2 individual interviews) (Study 3). Findings from Studies 1-3 were synthesised using the COM-B model and Family Systems Theory to develop an optimised family-inclusive intervention (Study 4). A multi-stakeholder focus group (n=3) evaluated the proposed intervention and its acceptability (Study 5).

Main Findings: Study 1 found that BCTs were present in all 16 reviewed interventions but were inconsistently implemented; effective studies used more BCTs overall, self-monitoring was linked to better adherence, and social support was entirely absent across all interventions. Study 2 found that healthcare professionals recognised family members' value but faced implementation barriers, including time constraints, scheduling conflicts, and staffing pressures, and advocated for earlier patient referral to maximise the prehabilitation window. Study 3 found that patients valued technology-enhanced delivery, identified significant gaps in nutritional support, as family members wanted systematic inclusion, but felt their own needs were overlooked. Study 4 developed an optimised intervention comprising technology-enhanced delivery, comprehensive nutritional support, and flexible family inclusion pathways. Study 5 found stakeholders supported the intervention, while highlighting the need for automated exercise progression and simplified terminology.

Conclusions: This thesis demonstrates the potential for optimising prehabilitation through systematic family integration, technology-enhanced delivery, and comprehensive nutritional support. The absence of social support BCTs in current interventions represents a significant gap, given evidence that family involvement enhances adherence. However, findings must be interpreted cautiously, given sample limitations and the predominance of engaged

participants with functional family relationships. Future research should test effectiveness through trials comparing family-inclusive versus standard approaches, examine implementation across diverse healthcare settings, and ensure that technology solutions do not exacerbate health inequalities. This work contributes to recognition that effective prehabilitation must address the relational context in which health behaviours occur.

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Author's declaration

I declare that, except where explicit reference is made to the contribution of others, this thesis is the result of my own work and has not been submitted for any other degree at the University of Glasgow or any other institution.

I acknowledge the use of Claude 4.1 (Anthropic, https://claude.ai/new) as a tool to proofread the final version of this work and help with clarity, in moments where I struggled to articulate my thoughts adequately.

Study 1 – BCT coding

Alia von Seherr-Thoß provided support as a secondary coder on the BCT coding for study 1.

Abbreviations

LOS - Length of hospital stay

Prehab - Prehabilitation

Rehab - Rehabilitation

HCP – Healthcare professionals

SP – Service providers

CR – Cancer patient

FM – Family member

CFIR – Consolidated Framework for Implementation Research

MMAT – Mixed Methods Appraisal Tool

BCW - Behaviour Change Wheel

Chapter 1. Understanding cancer: a public health perspective

1.1. Thesis purpose and overview

This thesis examines how a prehabilitation intervention for cancer surgery patients can be optimised, with a secondary focus on how to include family members in the behaviour change process. Through four interconnected studies, this thesis addresses critical gaps in the current prehabilitation practice, such as the absence of systematic family involvement, inadequate application of behavioural change techniques, and implementation barriers which limit effectiveness in healthcare settings.

Prehabilitation, which is a multimodal intervention delivered during the preoperative period to enhance functional capacity and reduce surgical complications, has demonstrated benefit to cancer surgery patients (Gillis et al., 2014; Minnella et al., 2017; Waterland et al., 2021; Miralpeix et al., 2022; Molenaar et al., 2023; Sebio-Garcia et al., 2024). Prehabilitation focuses on influencing modifiable risk factors through physical activity, psychological wellbeing and/or nutritional support, with the aim to optimise patients' physical and psychological condition during the preoperative period (Carli et al., 2018). There are unimodal approaches focusing on, for example, physical activity, psychological support, nutrition, smoking cessation or sun exposure, or multimodal interventions which consist of a combination of components. There is potential for broader family health benefits when relatives of cancer patients are engaged in preventative health behaviours (Humpel et al., 2007; Mazanec et al., 2015). However, current approaches predominantly focus on individual patients, overlooking the influence of family members in supporting behaviour change. For the purpose of this thesis, prehabilitation will be viewed as a multimodal intervention consisting of physical activity, nutritional, and psychological support, with its main aim to elicit long-lasting cancer preventative behaviour change. This differs from traditional definitions, which predominantly focus on the functional and physiological capacity of patients.

This thesis specifically focuses on colorectal cancer (CRC) and ovarian cancer patients due to their usual requirement of major abdominal surgery as part of their oncological treatment plan, which makes this disease population likely to benefit from prehabilitation interventions (Rodriguez-Bigas et al., 2003; Pomel et al., 2007; Barberan-Garcia et al., 2017). CRC, the fourth most frequently reported cancer in the Scottish population (Public Health Scotland,

2024), led to the selection of this patient group for prehabilitation at a hospital in Scotland. Ovarian cancer patients were included as both cancer types often fall under major abdominal surgeries for cancer care. Another aspect is the well-established surgical approaches for both cancer types, which often offer surgery as a treatment with curative intent for early-stage disease. Postoperative morbidities are observed for both cancer type and although there has been a decrease over the years, prehabilitation may offer another care element to further reduce postoperative complications (Heikkinen et al., 2024; Lesi et al, 2024; Levett & Grocott, 2025). This provides a clear treatment pathway which allows for prehabilitation to be systematically integrated and focuses on optimal recovery and long-term survival.

The thesis consists of four interconnected studies which build upon each other:

- Systematic review (Study 1) identifying behaviour change techniques (BCTs) in current prehabilitation interventions
- Qualitative interviews with healthcare professionals and service providers (Study 2) exploring implementation barriers and opportunities within the current prehabilitation intervention at a hospital in Scotland
- Qualitative interviews with cancer patients and family members (Study 3), examining lived experiences with the prehabilitation intervention, identify unmet needs and preferences for an optimised intervention design
- Development of an optimised prehabilitation intervention (Study 4) based on findings in Studies 1-3
- Focus group (Study 5), which explores stakeholder input and their acceptability of the proposed optimised prehabilitation intervention

These studies collectively inform the development of an optimised, evidence-based, family-inclusive prehabilitation intervention, which is grounded in behaviour change theory and designed to be implemented within the healthcare context. Optimisation in the context of the thesis means improvement of the uptake, adherence, as well as implementation of long-lasting health behaviour change within prehabilitation for cancer surgery patients.

1.2. What is cancer?

Cancer is a disease characterised by the uncontrolled growth and division of abnormal cells that have the potential to invade surrounding tissues and spread to other parts of the body (National Cancer Institute, 2021). Unlike normal cells that follow orderly patterns of growth, division, and death, cancer cells bypass the body's natural regulatory mechanisms, continuing to grow and divide when they should not. This fundamental disruption of the cell process forms the basis of cancer pathology. At its core, cancer develops when genetic material within cells becomes damaged or altered, producing mutations that affect the normal process of cell growth and division. These mutations may occur spontaneously during cell replication or may be caused by environmental factors. While the body typically identifies and repairs such genetic errors or eliminates cells with irreparable damage, cancer occurs when these protective mechanisms malfunction, allowing abnormal cells to survive and replicate unrestrained (Cancer Research UK, 2023).

Cancer can develop in almost any organ or tissue of the body, with more than 200 different types of cancer (Cancer Research UK, 2023), each with distinct characteristics and challenges. Common sites include the lungs, breast, prostate, colon, rectum, and skin, though cancer can originate in any cell type. An important distinction exists between benign and malignant tumours. Benign tumours remain localised, meaning they do not spread to other tissues, and are rarely life-threatening, unless they press on vital structures (Cooper, 2000). In contrast, malignant tumours, which are understood as cancer, can spread to surrounding tissues and to other body sites through a process called metastasis, often making treatment more challenging and outcomes less favourable (Liu et al., 2021).

1.3. Cancer as a public health challenge

Cancer remains one of the most significant public health challenges we face today, affecting not just individuals but also their families and the healthcare systems at large. According to the World Health Organisation, cancer is a leading cause of death worldwide, accounting for nearly 10 million deaths annually (WHO, 2025). The global cancer burden continues to grow, exerting physical, emotional, and financial strain on individuals, families, communities, and healthcare systems. In economic terms, the cost of cancer is expected to add £14.4 billion annually (Belloni, 2024).

In the UK specifically, cancer accounts for approximately 165,000 deaths each year, with the NHS managing over 300,000 new cancer diagnoses annually (Cancer Research UK, 2025). According to data from Public Health Scotland (2024), there were 36,036 new cancers registered in Scotland in 2022.

Cancer's impact as a public health challenge is further amplified by persistent health inequalities across the cancer continuum (Cancer Research UK, 2020; Scott & Hoskin, 2024). Disparities in cancer incidence, mortality, and survival rates are evident across socioeconomic, racial, ethnic, and geographic factors (Rachet et al., 2010; Cancer Research UK, 2020; Warnock, 2025). These inequalities stem from complex interactions between social determinants of health, including access to high-quality healthcare services and racial discrimination (Martins et al., 2022; The King’s Fund, 2023), but also socioeconomic status and cultural factors affecting health behaviours. For example, individuals from lower socioeconomic backgrounds often face delayed diagnosis and fewer supportive care resources (Guadamuz et al., 2023). Similarly, rural populations may encounter geographic barriers to cancer screening and treatment facilities, resulting in more advanced disease at diagnosis and poorer outcomes (Murage et al., 2018).

Addressing cancer as a public health challenge requires comprehensive strategies that span the entire cancer continuum, from prevention and early detection to treatment and end-of-life care. Public health approaches emphasise population-level interventions, health promotion, and system-level changes to reduce cancer burden. The NHS Long Term Plan (2019) has specifically identified cancer as a clinical priority, setting ambitious goals for improving cancer outcomes through earlier diagnosis, personalised care, and enhanced recovery pathways. The plan explicitly acknowledges the importance of prehabilitation and rehabilitation, establishing it as a key component of comprehensive cancer care. Within this strategic government plan by the Department of Health and Social Care, prehabilitation represents an emerging strategy to improve cancer outcomes by optimising patient health and resilience before treatment begins. The COVID-19 pandemic has further highlighted the importance of prehabilitation, as cancer diagnosis and treatment pathways faced unprecedented disruption (Lambert et al., 2021; Tay, 2024). Extended waiting times between diagnosis and treatment created both challenges and opportunities, emphasising the potential value of structured prehabilitation interventions to mitigate the impact of delays on patient outcomes (Damjanovic, 2021).

1.4. What is prehabilitation?

The 2020 published guidance by the UK Cancer charity, Macmillan, "*Principles and Guidance for Prehabilitation within the Management and Support of People with Cancer Guide",* in collaboration with the Royal College of Anaesthetists, the National Institute for Health Research Cancer and Nutritional Collaboration, offers structured guidance for the standardisation of prehabilitation interventions. It suggests a tri-modal intervention approach, including weight management through nutritional guidance and physical activity, and psychological support to help address behaviours associated with cancer risk (Macmillan et al., 2020). These not only include occurrence of the disease but also impact surgical procedures as part of the care plan, as well as reoccurrences. Therefore, prehabilitation aims to improve patients' general health and wellbeing prior to major surgery for cancer treatment by addressing key modifiable risk factors. By intervening in the preoperative period, the patients may benefit from short- and long-term health benefits such as improved immune system functions before surgery, shorter hospital stays and a possibility for lasting health behaviour change (West et al. 2021; Cambriel et al., 2025; Levett & Grocott, 2025)

1.5. Modifiable and non-modifiable risk factors

Understanding cancer risk factors is essential for developing effective prevention strategies and identifying individuals who might benefit most from targeted interventions such as prehabilitation (Bojesen et al., 2022). Cancer risk factors can be broadly categorised as non-modifiable and modifiable. Understanding the interaction between modifiable and non-modifiable risk factors provides important context for cancer prevention and highlights the potential value of prehabilitation (Zhang et al., 2024; Marino et al., 2024). While non-modifiable factors cannot be changed, their presence can identify individuals who might benefit most from early detection methods as well as targeted pre-treatment interventions due to correlations with other health issues that might impact their treatment; whereas modifiable risk factors are amenable to change and can be directly addressed in interventions (Wang et al., 2019).

1.5.1. Non-modifiable risk factors

Advanced age remains the most significant risk factor for most cancers. Approximately 60% of cancer cases occur in people aged 65 or older, reflecting the accumulation of genetic

damage over time and age-related changes in immune function and cellular repair mechanisms (Gudkov, 2020).

Another factor is biological sex, as certain cancers affect one sex disproportionately due to anatomical and hormonal differences. Ovarian cancer affects only those with female sexual organs, while men have higher rates of colorectal cancer compared to women (White et al., 2018). Whereas inherited genetic mutations account for approximately 5-10% of all cancers (National Cancer Institute, 2024), notable examples include BRCA1 and BRCA2 mutations, which significantly increase ovarian and breast cancer risk, and Lynch syndrome, which elevates colorectal cancer risk (Hall et al., 2016).

1.5.2. Modifiable risk factors

The most prominent cancer-causing habit is tobacco use in various forms, including cigarettes, cigars, pipes and smokeless tobacco, such as chewing tobacco or tobacco pouches (World Cancer Research Fund UK, 2024). Tobacco smoke contains over 7,000 chemicals, with at least 70 known carcinogens, and both active as well as second-hand exposure has shown to increase cancer risk and is associated with up to 16 different cancer types (American Cancer Society, 2024). The strongest associated cancers are lung and head and neck cancer; however, it is also linked to CRC (Cancer Research UK, 2024). Studies have shown that though smoking cessation provides immediate and long-term health benefits, some elevated risk is presumed to persist for years (Reitsma et al., 2020). Within prehabilitation, smoking cessation stands as its own and somewhat separate intervention, additionally offered to those consuming nicotine and tobacco. Therefore, it is not a core component of the tri-modular prehabilitation intervention addressed in this thesis.

A further modifiable risk factor, and one of the three main components of prehabilitation, is nutrition, as certain dietary patterns significantly influence cancer risk, such as high consumption of processed meats and red meat, which is associated with increased colorectal cancer risk (World Health Organisation, 2015; Ungvari et al., 2025). Whereas diets rich in fruits, vegetables, whole grains, and fibre can be protective against several cancer types (Maximova et al., 2020; World Cancer Research Fund, 2024). For ovarian cancer, while dietary links are less established, maintaining a healthy weight through balanced nutrition may reduce risk (Crane et al. 2013; Liu et al., 2015). The consumption of alcohol, classified

as a Group 1 carcinogen by the International Agency for Research on Cancer, also increases the risk of several cancers, including colorectal cancer (Secretan et al., 2009).

Another habit which influences cancer risk is regular physical activity, another core component of prehabilitation, as it improves immune function, reduces inflammation, enhances hormonal regulation, and aids in weight management (Friedenreich et al., 2020; Khair et al., 2023). Excess body weight is associated with increased risk for at least 13 cancer types, including colorectal and possibly ovarian cancer (Lauby-Secretan et al., 2016). Adipose tissue produces excess oestrogen and inflammatory cytokines, creating an environment conducive to cancer development (Iyengar et al., 2016; Avgerinos et al., 2018).

There are various environmental factors that contribute to cancer risk, including the ultraviolet radiation from sunlight, radon gas, air pollution, and occupational exposures to carcinogens such as industrial chemicals or asbestos (Armstrong & Kricker 2001; Prüss-Ustün et al., 2016). While some exposures are difficult for individuals to control, awareness and mitigation strategies can reduce risk (Espina et al., 2013).

Finally, certain infectious agents also contribute to cancer development, such as the human papillomavirus, which is associated with cervical cancer, while hepatitis B and C viruses increase liver cancer risk (Bosch et al., 2002; Plummer et al., 2016). Vaccinations against these agents, as well as infection prevention, are important cancer prevention strategies (Basu & Mittal, 2013).

1.6. Connection between prevention and prehabilitation

There is a conceptual link between cancer prevention principles and prehabilitation approaches, as both emphasise modifiable health behaviours and risk reduction (Brown et al., 2018; Driessens et al., 2024). However, they target different points in the cancer continuum; prevention focuses on reducing cancer incidence in healthy populations, while prehabilitation aims to optimise outcomes for those already diagnosed with cancer.

Many of the same health behaviours that reduce cancer risk, such as physical activity, nutrition, stress management, and smoking cessation, form the concept of prehabilitation interventions (Parkin et al., 2011; Burnett et al., 2024). This alignment creates opportunities for public health messaging that promotes consistent health behaviours across the cancer continuum. Importantly, this overlap creates a unique opportunity for involving family

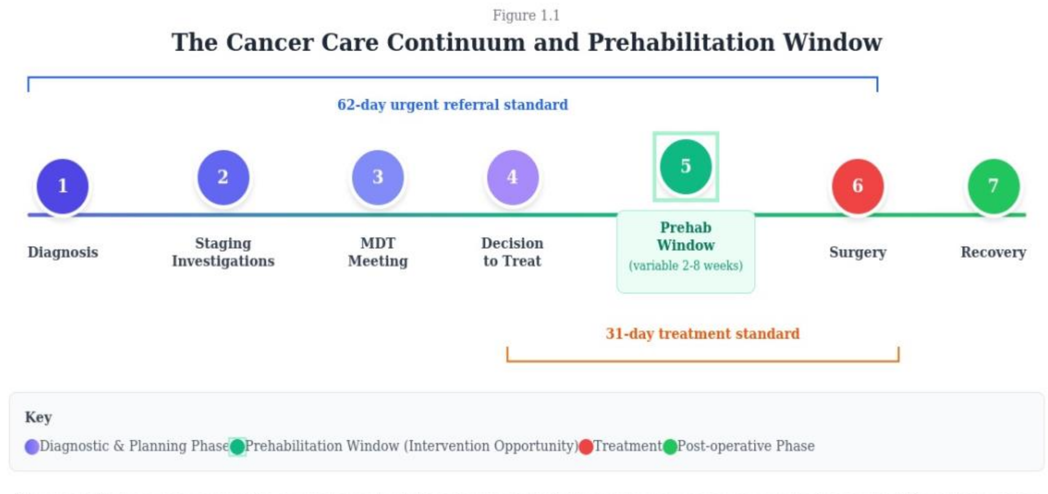
members of cancer patients in prehabilitation (Mazanec et al. 2015). Family members often actively engage in these behaviours, alongside patients, participating in physical activity together or exerting a strong influence over household dietary choices, and may consequently adopt healthier behaviours themselves, potentially reducing their own cancer risk (Ezendam et al., 2019; Secinti et al., 2021). This possibility for a collateral health benefit remains largely unexplored in prehabilitation research.

1.7. The diagnostic-to-treatment window

A critical phase in the cancer continuum is the window between diagnosis and the initiation of treatment, as it is the primary timeframe during which prehabilitation interventions are delivered (Stout et al., 2021). Though traditionally viewed as a planning period for medical issues and procedures, this period represents a valuable opportunity for intervention from a prevention and health psychology perspective (Silver, 2014). During this time, patients typically experience heightened psychological distress while simultaneously making important treatment decisions and preparing physically and mentally for upcoming treatment (Andersen et al., 2023).

Within the NHS, the diagnosis-to-treatment window is governed by specific cancer waiting time standards. The most relevant for prehabilitation is the 62-day urgent referral standard, which specifies that treatment should begin within 62 days of an urgent GP referral for suspected cancer; and the 31-day treatment standard, which requires treatment to commence within 31 days of a decision to treat, both shown in Figure 1 (Cancer Research UK, 2023; Johnson, 2024). These standards are particularly relevant as prehabilitation should be delivered between the decision to treat and the treatment commencing. While the 62-day pathway provides the overall timeframe, much of this period is guided by diagnostic procedures, staging investigations, and multidisciplinary team meetings, which leaves a shorter window to initiate, as well as less capacity for the healthcare team to facilitate prehabilitation interventions. While providing a predictable framework within which structured interventions can be systematically integrated into the treatment pathway, the short timeframe may urge an approach that can deliver prehabilitation rapidly.

Figure 1.: The cancer care continuum and prehabilitation window



The diagnosis-to-treatment window varies in duration depending on cancer type, healthcare system factors, and individual circumstances. For colorectal cancer, this period may extend to several weeks as patients undergo staging procedures and prepare for surgery (Curtis et al., 2018). For ovarian cancer, particularly in advanced cases, the interval may be shorter due to the often urgent nature of treatment needs (Dhanis et al., 2022).

A Canadian survey of 17,809 cancer patients found that while most felt their diagnosis was communicated sensitively, over half of those with emotional concerns were not referred to support services (Coronado et al., 2017). Patients who engage in prehabilitation often report improved psychological wellbeing simply from feeling they are taking positive action during an otherwise disempowering time (Powell et al., 2023). Understanding the psychological complexity of this period provides important context for developing prehabilitation interventions that address both physical and emotional needs (Popescu et al., 2025).

This time window presents an opportunity for prehabilitation interventions to serve multiple functions in preparing patients for cancer treatment. Focusing on optimising physical health before the treatment begins, such as building strength and cardiorespiratory fitness, may enhance treatment tolerance and recovery (Coderre et al., 2022). Nutritional deficiencies, which might otherwise compromise treatment effectiveness or exacerbate side effects, may also be addressed (Gillis et al., 2018). Prehabilitation provides psychological support to

reduce distress and improve coping mechanisms during an emotionally challenging time (Grimmett et al., 2022). Through structured interventions, patients receive education about their condition and upcoming treatment, allowing them to develop realistic expectations and better navigate their care journey. Additionally, well-designed prehabilitation approaches address patients' understanding of their health to ensure patients are truly informed and are able to participate effectively in shared decision-making about their care. These interventions enhance self-efficacy and empower patients to take an active role in their treatment and recovery (Wynter-Blyth et al., 2017; Marinelli et al., 2020).

1.8. Treatment and beyond

Following the diagnosis-to-treatment window, patients enter the treatment phase, which may include surgery, chemotherapy, radiation therapy, immunotherapy, or combinations of these modalities (NHS, 2025). The specific approaches depend on cancer type, stage, molecular characteristics, and patient factors (Cancer Research UK, 2023). For colorectal cancer, treatment typically includes surgical resection, often with adjuvant chemotherapy for higher-stage disease (NICE, 2020). Ovarian cancer treatment frequently involves cytoreductive surgery and platinum-based chemotherapy (Miralpeix, 2022).

After completing primary treatment, patients transition to survivorship or, in cases of advanced disease, to ongoing disease management (Department of Health, Macmillan Cancer Support and NHS Improvement, 2010). Survivorship brings its own challenges, including fear of recurrence, managing treatment side effects, returning to work and social roles, and adapting to a new normal (Foster & Fenlon, 2011; van der Smissen et al., 2025). Public health approaches to survivorship focus on surveillance for recurrence, monitoring for late effects of treatment, addressing psychosocial needs, and promoting healthy behaviours to reduce the risk of secondary cancers and comorbid conditions (NHS England, 2019).

1.9. Theoretical behaviour change models in prehabilitation

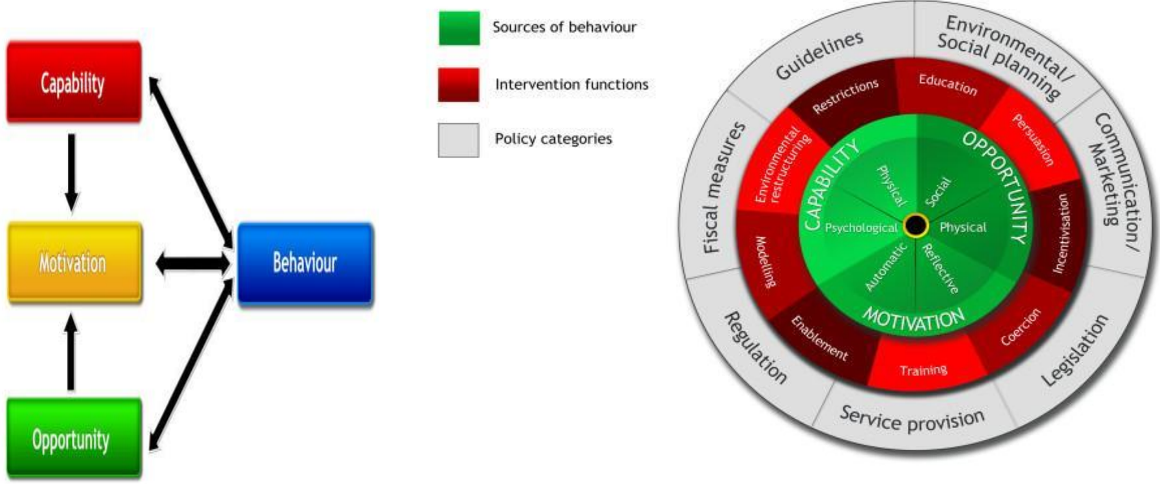
The application of behaviour change models provides valuable theoretical guidance for prehabilitation interventions. This thesis primarily employs the COM-B model as it's a useful organising framework for behaviour change, though several other theoretical models may also be relevant to prehabilitation. The COM-B model from the Behaviour Change Wheel framework (Michie et al., 2011) is particularly relevant to understanding and supporting cancer prehabilitation. It was selected as the primary model in this thesis due to its

comprehensiveness; it synthesises insights from multiple behaviour change theories into one, whilst being directly linked to intervention design through the Behaviour Change Wheel (BCW). The BCWs' use in prehabilitation intervention has been recommended by the guidelines published in the Macmillan (2020) report to create more coherent prehabilitation interventions.

1.9.1. The COM-B model

The model offers a comprehensive framework for understanding behaviour change in the context of cancer prehabilitation. Developed by Michie and colleagues (2011), this model proposes that behaviour (B) occurs as a result of the interaction between three components: capability (C), opportunity (O), and motivation (M) (Figure 1.1). When applied to cancer prehabilitation, this framework provides a systematic approach to identifying barriers and enablers to patient engagement.

Figure 1.1.: The Behaviour Change Wheel, including the Com-B Model (centre), from Michie et al., 2011



The capability component of the model is broken down into two segments, physical and psychological. In the prehabilitation context, physical capability encompasses the physical strength, stamina, and skills needed to perform recommended exercises or nutritional

changes. For many cancer patients, physical capability may be compromised by their disease or comorbidities, necessitating tailored approaches. Psychological capability refers to the knowledge, understanding, and cognitive skills required to engage with prehabilitation activities. This includes understanding the rationale behind prehabilitation, remembering exercise techniques, and comprehending nutritional guidance.

Opportunity within the COM-B model is divided into physical and social dimensions. Physical opportunity includes access to prehabilitation facilities, time to participate, and resources required for engagement. For cancer patients awaiting treatment, physical opportunities may be constrained by geographical distance from services, financial limitations, or competing demands like work or caring responsibilities. Social opportunity encompasses the cultural norms, social cues, and interpersonal influences that facilitate or hinder prehabilitation participation. Support from family members, encouragement from healthcare professionals and service providers, and interaction with peers undergoing similar experiences can significantly influence engagement.

Motivation, the third component, consists of both reflective and automatic processes. Reflective motivation involves conscious decision-making, plans, and evaluations about engaging in prehabilitation. This includes beliefs about the consequences of prehabilitation, intentions to participate, and personal identity as someone who takes active steps to improve health outcomes. Automatic motivation encompasses emotional responses, habits, and impulses related to prehabilitation activities. Fear about cancer progression during the waiting period may motivate some patients to engage actively with prehabilitation, while anxiety about trying new activities might inhibit others.

The COM-B model's value for prehabilitation lies in its ability to identify specific barriers to behaviour change and match these with appropriate intervention functions and policy categories from the wider Behaviour Change Wheel (Fracis-Coad et al, 2021; van der Velde et al., 2023). For instance, if physical opportunity is constrained by transportation barriers, environmental restructuring through tele-health options might be implemented (Moyen et al., 2025).

This systematic approach to behaviour change allows prehabilitation interventions to move beyond one-size-fits-all approaches toward targeted interventions that address the specific capability, opportunity, and motivation barriers experienced by individual patients or patient

groups. The diagnosis-to-treatment window represents a unique behavioural context with specific challenges and enablers that the COM-B model can help address.

The diagnosis-to-treatment window represents a potentially "teachable moment" when individuals may be particularly motivated to adopt health-promoting behaviours. Prehabilitation may capitalise on this motivation to initiate behaviour changes that could continue throughout treatment and into survivorship, potentially reducing the risk of cancer recurrence and improving overall health outcomes. By conceptualising prehabilitation as an extension of prevention principles applied during the diagnostic-to-treatment window, public health practitioners and health psychologists can develop integrated approaches that support individuals across the entire cancer continuum, from health promotion through treatment and beyond.

Theoretical frameworks provide not only explanatory models for understanding patient engagement with prehabilitation but also practical guidance for intervention design, implementation, and evaluation.

1.9.2. Family Systems Theory

While the COM-B Model provides understanding for individual behaviour change, Family Systems Theory (Bowen, 1978) offers insight into the relational contexts in which health behaviours occur. This theory is important for this thesis as it provides the theoretical foundation for family-inclusive prehabilitation approaches. Family Systems Theory suggests that families function as interconnected systems where changes in one member inevitably affect others, and that family relationships and dynamics significantly influence health behaviours.

The core principles relevant to prehabilitation are interdependence, which explains that family members do not function as independent units but rather as parts of an interconnected system where each member's experiences, emotions, and behaviours influence and are influenced by others. In the context of cancer diagnosis and treatment, this means that a patient's prehabilitation engagement occurs within a family system experiencing collective stress and adjustment.

Family Systems Theory’s principle of circular causality replaces linear cause-and-effect thinking to recognise reciprocal influence patterns. For example, a patient's anxiety about

surgery may increase family members' worry, which in turn may heighten the patient's anxiety, creating feedback loops that may affect prehabilitation engagement. Homeostasis and adaptability are characterised by both stability-seeking (homeostasis) and adaptability, meaning that interventions must work with rather than against existing family patterns while facilitating necessary adaptations to new health challenges. Multigenerational patterns, according to Family Systems Theory, are family members' responses to illness which are shaped by patterns transmitted across generations, including how previous generations coped with illness, attitudes toward healthcare, and communication styles around health concerns.

In the context of cancer prehabilitation, Family Systems Theory may help explain why family members often assume responsibilities for supporting patients' diet, exercise, and emotional wellbeing, as well as how family communication patterns affect information processing and decision-making. This thesis is, to the best of the authors' knowledge, the first to systematically integrate Family Systems Theory with the COM-B model in prehabilitation research, recognising that capability, opportunity, and motivation are not solely individual characteristics but are shaped by family system dynamics. For example, a patient's opportunity to exercise may depend on a partner's willingness to adjust schedules or participate in activities together.

1.10. Chapter conclusion

This chapter has established the foundational context for this thesis. A patient's diagnosis-to-treatment window, governed by NHS waiting time standards, offers an opportunity for prehabilitation interventions to optimise patients' physical and psychological condition before surgery (Levett et al., 2025).

Prehabilitation has demonstrated benefits for surgical outcomes, yet significant gaps remain in how interventions are designed and delivered (Davis et al., 2022; Kann et al., 2025). Current approaches remain predominantly individual-focused, despite evidence that health behaviours are embedded in relational contexts (Berman et al., 1994; Weiss-Laxer et al., 2020; Voorn et al., 2023). The modifiable risk factors addressed through prehabilitation, such as physical activity, nutrition, and psychological wellbeing, are not only influenced by individual capability and motivation, but by family dynamics, social support, and interpersonal relationships (McLeroy et al., 1988; Watts et al., 2024).

The frameworks introduced in this chapter, such as the COM-B model for understanding behaviour change and Family Systems Theory for understanding relational dynamics, provide the foundation for the studies in this thesis (Bowen, 1978; Michie et al., 2011). Within the context of this thesis, these theoretical frameworks are used to systematically analyse the findings and conceptualise how prehabilitation interventions can be enhanced in existing healthcare systems through evidence-based behaviour change techniques and family integration.

Chapter 2 will examine the need for prehabilitation in cancer surgery patients, reviewing the evidence for its individual components (physical activity, nutrition, psychological support) and the rationale for multimodal approaches. It will also explore the connection between cancer prevention and prehabilitation, highlighting the potential for broader health benefits when family members are engaged in the behaviour change process.

Chapter 2. The need for prehabilitation in cancer surgery patients

Cancer has become increasingly prevalent worldwide, with 36,036 new cases registered in Scotland in 2022 alone (PHS, 2024). Hereditary cancers only account for 5-10% of these cases, leaving 90-95% attributable to environmental exposure and behavioural factors. Modifiable risk factors, particularly excess body fat, have been causally linked to thirteen cancer types, including colorectal (CRC), liver, pancreatic, and postmenopausal breast cancer (Lauby-Secretan et al., 2016). Leading a healthy lifestyle with sufficient physical activity and a well-balanced diet can reduce the risk of cancer; however, implementing a cancer-preventive lifestyle is challenging. In Scotland, two-thirds of adults (66%) are living with overweight, which includes 32% classified as obese (The Scottish Government, 2025), and many do not meet the advised hours of physical activity (PA) nor the recommended dietary targets (The Scottish Government, 2021; NHS, 2022).

A cancer diagnosis with surgery as curative treatment or part of a treatment plan in conjunction with chemotherapy, radiotherapy and/or immunotherapy might present an opportunity for a "teachable moment" promoting health behaviour change (Flocke et al., 2014). To ensure appropriate care is available to those affected by the disease, pathways need to be put in place to support patient engagement in physical activity and healthy eating, in addition to offering psychological support. A personalised prehabilitation care plan might offer a feasible pathway to engage patients in preventive behaviour change from the point of diagnosis to rehabilitation in order to support the psychological, dietary and physical health of the patient throughout their cancer continuum.

2.1. The impact of prehabilitation on the individual and the health care system

Prehabilitation intervention aims to identify and improve disease-related malnutrition, cachexia and sarcopenia, perioperative outcomes, and increase health-related quality of life through personalised, patient-centred care plans (Ismail et al., 2018; Macmillan, 2020). Malnutrition is a deficiency in energy, protein, or micronutrients that compromises physiological function and is amendable through nutritional interventions (Cederholm et al., 2019). Sarcopenia, however, is the progressive loss of skeletal muscle mass and strength, which can be addressed through protein-intensive nutritional interventions and resistance exercise (Crus-Jentoft et al., 2019). These mechanisms stand in contrast to cachexia, which is

a metabolic syndrome characterised by inflammation-driven muscle wasting which resists conventional nutritional support (Fearon et al., 2011). These conditions frequently co-occur in cancer patients and independently predict adverse surgical outcomes (Reisinger et al., 2015). Previous prehabilitation research has demonstrated a positive effect on perioperative and postoperative outcomes, leading to shortened hospitalisation, as well as a reduction in reoccurrences and overall improved health-related quality of life of the patient (Silver and Baima, 2013; Li et al., 2013; Barberan-Garcia et al., 2018; West et al., 2021).

A randomised controlled trial by Gillis and colleagues (2014) compared pathways for colorectal surgery patients. The prehabilitation group started four weeks prior to surgery and continued eight weeks post-operatively, compared to the rehabilitation group, which started the eight-week intervention straight after surgery. Both arms comprised home-based aerobic and resistance exercises, nutritional support and stress-releasing exercises, which were measured through weekly telephone calls and patient diaries. The prehabilitation group performed better than the rehabilitation group in the 6-minute walk test; leading up to surgery, the prehabilitation group improved by a mean average of 25.2 meters while the rehabilitation arm declined by 16.4 metres (mean difference 41.7m, 95% CI 19.8 to 63.5, P<0.001). In either group, 50% were found to be an average of 20 metres below baseline four weeks after surgery; eight weeks past surgery, the prehabilitation group proved to be above baseline with 23.4 metres improvements, whereas the rehabilitation group were still 21.8 metres behind and did not return to their baseline recording (P=0.020).

Focusing specifically on high-risk patients (age >70 years and/or ASA III/IV, which indicates severe disease), Barberan-Garcia et al. (2018) conducted a randomised controlled trial for patients undergoing elective major abdominal surgery. The intervention consisted of personalised prehabilitation including motivational interviewing, high-intensity endurance training, and promotion of physical activity over an average of six weeks. Results demonstrated that prehabilitation reduced postoperative complications by 51% (31% vs 62% in the control group, P = 0.001), with particularly notable reductions in cardiovascular complications (2% vs 13%, P=0.033). ICU length of stay showed a trend towards reduction in those patients who participated in prehabilitation (mean 4 vs 1 day, P=0.078), which reached statistical significance in a sensitivity analysis of ICU-admitted patients (mean 12 vs 3 days; p=0.046). The study attributed these clinical improvements to enhanced aerobic capacity, with the intervention group showing a statistically significant 135% improvement in

endurance time (P<0.001). Building on these findings further, a recent systematic review and meta-analysis by D'Amico and colleagues (2025) synthesised evidence from 29 randomised controlled trials involving 3,508 patients. The study found that home-based prehabilitation significantly reduced postoperative complications (38.4% vs 43.3% in controls, risk ratio 0.84, P=0.02) with a median adherence rate of 82%. Benefits were particularly pronounced with multimodal interventions and those lasting longer than two weeks. A recent systematic review by Daniels and colleagues (2020) of 30 studies of prehabilitation in older adults with abdominal cancer identified ten nutrition-based and multimodal prehabilitation interventions that reduced complication rates. Seven studies also reported a reduction in length of hospital stay (LOS) following multimodal, exercise, and nutrition interventions**.** This reduction in hospital stay was also demonstrated by D'Amico et al. (2025), who found an average reduction of 0.3 days across 18 studies. This reduction in LOS may be attributed to several interconnected physiological mechanisms. Surgery creates a significant inflammatory response and increases oxygen demand by 40% above baseline, placing substantial stress on the cardiorespiratory system (Older et al., 1993). Prehabilitation increases oxygen delivery capacity through enhanced cardiac output and oxygen extraction at the tissue level, allowing patients to better withstand this increased metabolic demand (Sherrington et al., 2022; Rose et al., 2022). Additionally, improved muscular strength and endurance from prehabilitation directly facilitate earlier post-surgical mobilisation (Tazreean et al., 2022). Early ambulation is a key predictor of reduced hospital stay, as each additional day of immobility can significantly extend LOS (Brown et al., 2009). By enhancing preoperative functional capacity, prehabilitation creates a higher baseline from which patients decline during the immediate post-surgical period, allowing them to reach critical functional thresholds for discharge more quickly (Scheede-Bergdahl and Carli, 2019; Gillis et al., 2022). The nutritional optimisation component addresses sarcopenia and micronutrient deficiencies that directly affect wound healing and recovery trajectories, providing necessary substrates for tissue repair while supporting immune function and reducing infection risk, a major cause of prolonged hospitalisation (Demling, 2009; Weimann et al., 2021; CDC, 2026). Despite predominantly positive findings, Daniels et al (2020) noted limitations related to the methodological quality of included studies. Similar to Hijazi and colleagues (2017), considerable heterogeneity of interventions in terms of composition, duration, mode of administration, compliance, and outcome measures was reported. The 2020 publication "Prehabilitation for Patients with Cancer" guide offers structural guidance for standardisation

of prehabilitation interventions. It suggests a multimodal prehabilitation intervention including weight management and nutritional guidance, physical activity, and psychological help; and that behavioural components have shown promising impacts on patient-centred care and service provider outcomes (Macmillan et al.,2020).

2.2. Psychological factors making patients receptive to change

A cancer diagnosis often triggers a complex psychological response that heightens receptivity to health behaviour interventions. The concept of the teachable moment describes how, for example, a cancer diagnosis can prompt cognitive and emotional responses that create an opportunity for behaviour change (Karvinen et al., 2015; Puleo et al., 2022). Patients frequently experience a heightened sense of vulnerability where their sense of health security is fundamentally disrupted (Wolyniec et al., 2022; Shen et al., 2024). This disruption creates cognitive dissonance between current lifestyle behaviours and desired health outcomes, potentially motivating patients to resolve this inconsistency through behaviour change (Tollosa et al., 2020).

Cancer diagnosis also commonly elicits a re-evaluation of personal priorities and values, with many cancer patients reporting reassessment of what is important in their lives (Dhanis, et al., 2022; Carreno et al., 2023). Newly diagnosed cancer patients report an increased sense of personal mortality that prompts them to place greater importance on health behaviours (Carreno and Eisenbeck, 2022; Arnaboldi et al., 2024). This existential awareness can serve as a powerful motivator for behaviour change, as patients seek to regain a sense of control amid the uncertainty of their diagnosis.

Additionally, the shift in self-identity that accompanies a cancer diagnosis, transitioning from a healthy individual to a cancer patient, creates psychological space for adopting new health behaviours that align with recovery and survivorship identities (Denmark-Wahnefried et al., 2005; Park et al., 2009). This identity reconstruction process may provide an opening for healthcare professionals to introduce behaviour change interventions that support this identity transition.

2.2.1. Increased motivation to change during a cancer diagnosis

The research literature supports the concept of a heightened motivational state following cancer diagnosis, with this period often characterised as a “teachable moment” for health

behaviour change (McBride and Ostroff, 2003; McBride et al., 2003). Research has documented elevated readiness to change health behaviours in cancer patients, with studies showing that patients report being in action or preparation stages for behaviour change shortly after diagnosis (Denmark-Wahnefried et al., 2000; Pinto et al., 2002). However, such intentions do not always translate into action, and some population-based studies have found limited evidence of spontaneous health behaviour changes following cancer diagnosis, highlighting a potential intention-behaviour gap in this population (Boereboom et al., 2016). There is evidence that patients are more likely to adopt positive health behaviour change when interventions are integrated early into the cancer care continuum (Denmark-Wahnefried et al., 2005; Rabin,2009). This suggests that the motivational aspects for behaviour change might be greater during the initial phases of the cancer journey, and the teachable moment has the most effect in the period immediately following diagnosis (Gritz et al., 2006; Puleo et al., 2022).

Systematic reviews have demonstrated that cancer survivors are capable of making multiple health behaviour changes simultaneously when interventions successfully target combinations of diet, physical activity, smoking cessation, and alcohol consumption (Amireault et al., 2016). Some evidence indicates that cancer diagnosis may prompt behaviour change attempts among not only patients but also family members, suggesting a broader motivational impact compared to other health-related diseases (Schnoll et al., 2013).

2.2.2. Duration of the "window" for intervention

While evidence supports heightened motivation following cancer diagnosis, the precise duration of this receptive window remains poorly characterised in the literature. Cross-sectional evidence suggests that proximity to cancer diagnosis may be associated with better adherence to certain health behaviours, particularly dietary modifications and smoking cessation, though the relationship with physical activity appears more complex and may be influenced by symptom burden (Bluethmann et al., 2015). However, longitudinal studies tracking motivational readiness from diagnosis through treatment to survivorship are lacking, preventing definitive conclusions about how this receptivity changes over time.

For patients whose treatment pathway includes surgery, the preoperative period may represent an intensified teachable moment where the concrete goal of surgical preparation

enhances engagement with lifestyle recommendations (Schulz et al., 2021). Understanding these temporal dynamics can inform strategic timing of intervention components within prehabilitation interventions to optimise patient engagement.

2.3. Body composition and nutritional status in prehabilitation

Obesity and overweight are the second-highest preventative risk factors for cancer, linked to 13 types of the disease (Lauby-Secretan et al., 2016), including endometrial, ovarian, and colorectal cancer (Steel et al., 2017). Although clear links between obesity and cancer have emerged in the literature, the exact mechanism by which obesity affects the cause of cancer is less understood. High adiposity is related to hormonal imbalances, insulin resistance, and inflammation, which have been implicated in the pathogenesis of cancer (Donohoe et al., 2011). Mullen and colleagues (2008) undertook a study of 2258 cancer abdominal surgery patients and found no difference in length of operation times nor an increased LOS after surgery of those with a higher BMI compared to those with a lower BMI. There was no evidence to support that a BMI >30 kg/m^2 was linked to higher death rates or increased complications during surgery; however, an association between obesity and wound complications were reported. An increased risk of postoperative mortality was linked to patients with a BMI of <18 kg/m2, classified as underweight. Similarly, Amri et al. (2013) reported BMI as a predictor of laparoscopic and open procedure complications, with an increase in wound infection per increase of BMI category; additionally, slow healing processes were reported. These findings suggest obesity may impact the risk of disease; however, the impact on perioperative outcomes has not been fully corroborated. It is important to note that BMI is a limited proxy for body fatness, particularly in cancer patients and older adults, as it does not distinguish between fat mass and muscle mass (Park et al., 2018; Gonzalez et al., 2014). The relationship between body composition and cancer is complex, depending on adiposity, muscle mass, and muscle function. Patients with a high BMI may have preserved muscle mass, which can act as a barrier against the physiological stress of surgery and treatment (Prado et al., 2008). Whereas low muscle mass and poor function, which is classified as sarcopenia, in the presence of obesity, may negatively impact treatment side effects and surgical complications (Baracos & Arribas, 2018; Wang et al., 2022). These variations in body composition may explain some of the discrepancies observed in studies examining BMI and perioperative outcomes.

Although there are no reported effects of weight loss after diagnosis on malignancy, there are associated factors for perioperative outcomes. Perceived quality of life has been reported to be lower in those with high BMI, and weight loss to increase quality of life for those overweight or obese prior to surgical treatment (Kushner and Foster, 2000; McCarroll et al., 2014). Malnutrition, often described as an imbalance of nutritional intake compared to requirement, leading to alterations in metabolism, overall function impairment and loss of body mass such as fat, muscle, bone density and visceral mass, has been reported to most frequently occur in cancer patients, compared to other patient groups (Bozzetti et al. 2009). Compared to the overall population, individuals with cancer are at higher risk of malnutrition and may experience appetite loss triggered by altered appetite signals and physical hindrances, such as pain or malabsorption of nutrients due to diarrhoea, vomiting, and intestinal obstructions (Ryan et al. 2016). An observational study by Muscaritoli and colleagues (2017) reviewed the prevalence of malnutrition in cancer patients at their first encounter with oncology care, reporting that out of 1,952 patients, 51% were nutritionally impaired, 9% overtly malnourished, and 43% presented a high risk for malnutrition.

There is sufficient epidemiological evidence suggesting a relationship between malnutrition and perioperative outcomes, such as the heightened risk of infection and increased LOS (Mosquera et al., 2016; Correia et al., 2003). Garth and colleagues (2010) reported that LOS associated with preoperative malnutrition might not prove causality. However, it further supports previous research associating LOS with other comorbidities and an increase in hospital costs. Past research also suggests preoperational malnutrition to be an associated factor in 30-day mortality (Hede et al., 2015; Kaegi-Braun et al., 2021). Identifying patients at risk of malnutrition and providing accurate nutritional support may decrease LOS and improve postoperative mortality. Similar to obesity and overweight, malnutrition and underweight relate to poorer health-related quality of life of cancer patients.

The need for nutritional support pre-surgery has been widely discussed; however, poor nutrition remains under-screened, underdiagnosed, and undertreated (Williams et al., 2019). Nutritional support in the prehabilitation context should be patient-specific and adjusted according to body composition and age, identifying malnutrition risks, cachexia, and sarcopenia.

Nutritional interventions within prehabilitation address surgical risk through several targeted pathways. Protein supplementation directly supports preserving lean body mass, which rapidly breaks down during the post-surgical period (Gillis et al., 2016). Adequate protein reserves allow for sufficient amino acid availability for wound healing, immune function, and maintenance of vital organ systems during recovery (Wooten et al., 2021). Micronutrient optimisation addresses subclinical deficiencies that might otherwise compromise recovery. Nutrients such as zinc, vitamin C, and vitamin D play critical roles in wound healing and immune function (Seth et al., 2024). Correcting these deficiencies preoperatively ensures optimal substrate availability for recovery processes, particularly in patients who might have compromised intake due to cancer-related appetite changes or malabsorption.

Modulation of the gut microbiome through nutritional interventions represents another pathway by which prehabilitation reduces surgical risk (Stavrou & Kotzampassi, 2017). Prebiotic and probiotic strategies can enhance gut barrier function, reducing the risk of bacterial translocation following surgical stress. This mechanism is particularly relevant for colorectal surgery patients, where alterations in gut flora directly impact anastomotic healing and infection risk (Pitsillides et al., 2021; Chen et al., 2025). Notably, alterations in gut microbiome composition have been proposed as one mechanism through which prehabilitation may increase muscle mass by reducing chronic inflammation and anabolic resistance (Giron et al., 2022; Li et al., 2024). For patients with obesity, targeted nutritional interventions during the preoperative phase can reduce visceral adiposity, which is metabolically active and contributes to systemic inflammation (Griffin et al. 2021); even modest reductions in visceral fat can improve surgical exposure, reduce technical difficulty, and decrease surgical stress, particularly in minimally invasive procedures.

2.4. Physical activity and exercise in prehabilitation

Physical inactivity is linked to an increased risk of cancer and poorer cancer treatment outcomes, including curative cancer surgery (Rogers et al., 2008). Research suggests the inclusion of physical activity in prehabilitation, with substantial epidemiological evidence to support its impact on pre, peri and postoperative factors (Meyerhardt et al., 2006) and as preparation for the physical and psychological trauma cancer surgery may inflict on patients. However, past systematic reviews have criticised the heterogeneity of physical activity interventions, which have lacked consistency in activity type and duration (Wu et al., 2016).

Sarcopenia and cachexia are prevalent in colorectal and gynaecological cancer patient groups, and both conditions are worsened by anabolic resistance, which is the ability of muscles to synthesise protein in response to nutrition and exercise (Vergara-Fernandez et al., 2020; Burd et al., 2013). This is why preoperative resistance training, with the aim to increase muscle mass, is emphasised in prehabilitation interventions (Laza-Cagigas et al., 2023). The combination of nutritional guidance and physical activity creates a stronger stimulus which promotes muscle protein synthesis, preserving functional capacity before surgery (Burd et al., 2009). One systematic review (Wu et al., 2016) reported that physical activity pre- and post-diagnosis affected mortality in CRC patients, and inverse associations were found between CRC survivors who presented with high levels of physical activity compared to those with lower levels of physical activity or inactivity. Physical activity may also improve cardiorespiratory fitness as part of prehabilitation, which helps to reduce pulmonary complications of post-surgery (Fernandes et al., 2019). Predominantly measured through Vo2 peak (the maximum amount of oxygen the body can use during exercise), cardiorespiratory fitness shows low numbers of return to preoperative function when prehabilitation is not offered before major abdominal surgery (Waterland et al., 2021), leading to increased post-operative complications and mortality in abdominal cancer surgery patients (West et al., 2015; Rose et al., 2022). Recent evidence from a randomised controlled trial by Moug et al. (2020) of rectal cancer patients undergoing neoadjuvant chemoradiotherapy demonstrated that a telephone-guided walking intervention increased muscle mass in 65% of intervention participants, compared to 67% of controls who experienced muscle loss. This finding is clinically significant given that sarcopenia is associated with higher rates of major complications, increased hospital stay and reduced long-term survival in colorectal cancer patients (He et al., 2023).

The relationship between improved physical fitness and reduced complications operates through multiple physiological systems. Enhanced cardiorespiratory fitness improves oxygen delivery to tissues during the hypermetabolic state following surgery (Rose, 2022). This increased oxygen availability helps maintain adequate tissue perfusion during periods of surgical stress, reducing ischemic damage and supporting cellular metabolism during recovery. At the pulmonary level, prehabilitation improves respiratory muscle strength and lung volumes (Mans et al., 2015). These improvements directly decrease the risk of post-operative pulmonary complications, which is a leading cause of morbidity after major abdominal surgery. Enhanced respiratory function allows for more effective clearance of

secretions, reducing atelectasis and pneumonia risk, while improved diaphragmatic function prevents respiratory compromise even with pain-limited breathing patterns.

Skeletal muscle adaptations from exercise-based prehabilitation extend beyond simple strength improvements. Exercise induces mitochondrial biogenesis and enhances metabolic flexibility, allowing tissues to better utilise available substrates during the catabolic post-surgical state (Hood, 2009; Tetlow & Whittle, 2025). These adaptations help preserve muscle mass during periods of reduced mobility and nutritional intake, maintaining functional capacity throughout recovery (Perry & Hawley, 2018). Regular exercise during prehabilitation also modulates the inflammatory response to surgical trauma. Physical activity has been shown to reduce baseline inflammatory markers and improve the resolution of acute inflammatory responses (Flynn et al., 2007). This anti-inflammatory effect helps prevent excessive systemic inflammation following surgery, which can lead to complications like multi-organ dysfunction and delayed recovery (Magni et al., 2025). The integration of physical activity with nutritional support offers the potential effects of both interventions. Exercise enhances nutrient delivery to tissues through improved circulation, while proper nutrition provides the substrates necessary for exercise-induced adaptations (Shanmugasundaram Prema et al., 2025). This interaction underlines the possible importance of multimodal approaches, which address complementary physiological mechanisms.

2.5. Psychological support in prehabilitation

A cancer diagnosis has a drastic impact on a patient's mental health (Stark et al., 2002; Kelleher et al., 2021). Psychological distress, such as anxiety and depression, is common in cancer patients and has been linked to poorer health-related quality of life (Arndt et al., 2004; Grassi et al., 2023). Providing psychological support along with physical activity and weight management was found to improve wound healing and overall mortality for people with CRC, although no improvement in surgical outcomes was documented when psychological support was offered alone (Haase et al., 2005; Walburn et al., 2009; Gouin et al., 2011). Similarly, a systematic review by Tsimopoulou and colleagues (2015) reported no effect on surgical outcomes; however, a positive effect on the patient's immune function and an impact on psychological outcomes such as quality of life and somatic symptoms were reported. Furthermore, offering psychological support at the beginning of the patient's cancer continuum may strengthen their psychological resilience, increase physical activity and

nutrition adherence, and lead to an overall improved recovery experience (Foster et al., 2016).

2.6. Behaviour change in prehabilitation

Grimmett and colleagues (2021) recently suggested that previous prehabilitation interventions lacked sufficient application of behaviour change frameworks and theory. The Behaviour Change Wheel offers an established framework (Michie et al., 2011) consisting of three layers; the core consists of the COM-B model, proposing behaviour change is facilitated by one or more of the following: capability, opportunity and motivation. The second layer of the Behaviour Change Wheel includes nine intervention functions: training, coercion, enablement, modelling, incentivisation, environmental restructuring, persuasion, restrictions, and education. The top layer consists of policy categories that could be addressed to enhance the chance of behaviour change, including environmental/ social planning guidelines, communication marketing, fiscal measures, regulation, legislation and service provision. These factors need to be considered when establishing a prehabilitation intervention.

When applying the COM-B model specifically to cancer surgery patients, certain elements appear particularly relevant to the prehabilitation context. Physical capability is often compromised in cancer patients due to the disease itself, comorbidities, or age-related factors. Psychological capability, including the knowledge and skills to engage in rehabilitation activities, may be limited if patients have not previously engaged in structured physical activity or nutritional planning. Patients may also lack reflective motivation when overwhelmed by their diagnosis, whilst automatic motivation may be hindered by established habits that are difficult to modify during a stressful period. Physical opportunity can be constrained by treatment schedules, fatigue, and physical limitations, whilst social opportunity may be affected by cultural norms around 'resting' after diagnosis rather than increasing activity levels.

Current prehabilitation interventions often address physical capability through personalised exercise interventions, and psychological capability through educational materials about nutrition and physical activity. However, many interventions may inadequately address automatic motivation by failing to establish techniques that help form new habits or break existing ones. Similarly, social opportunities are frequently overlooked, with limited attention

given to how family dynamics, social support networks, and cultural backgrounds influence adherence to prehabilitation recommendations. Reflective motivation may be partially addressed through information about benefits, but without adequate attention to patients' beliefs, values, and aspirations regarding their cancer continuum.

The intervention functions from the Behaviour Change Wheel could be more thoroughly implemented in prehabilitation interventions. Education could extend beyond simple information provision to include tailored communication about how prehabilitation specifically affects surgical outcomes relevant to the individual patient's procedure. Training could involve not just prescribing exercises but ensuring patients have practised them under supervision to build confidence. Environmental restructuring might involve helping patients modify their home environment to facilitate exercise and proper nutrition. Enablement could include addressing psychological barriers like fear or anxiety through integration with psychological support components. Modelling might involve connecting patients with peers who have successfully completed prehabilitation intervention to share experiences and strategies.

For example, a comprehensive prehabilitation intervention might include an initial assessment of not only physical status but also behavioural determinants across all COM-B domains. This might reveal that whilst a patient understands the importance of physical activity (psychological capability), they lack confidence in performing exercises correctly (psychological capability) and have limited space at home (physical opportunity). The intervention could then incorporate supervised exercise sessions (training), home environment assessment (environmental restructuring), and connection with a peer supporter (modelling) to address these specific barriers.

This more nuanced application of the Behaviour Change Wheel to prehabilitation would enable interventions to move beyond standardised approaches to truly personalised behavioural support that addresses the unique constellation of barriers and facilitators experienced by each cancer surgery patient. By systematically addressing all relevant COM-B elements through appropriate intervention functions, prehabilitation interventions could potentially achieve greater adherence and effectiveness.

2.7. Inclusion of family members in the intervention process

There is sufficient evidence to suggest that family health behaviours are a risk factor for cancer (Yaghoobi et al., 2010; Fuchs et al., 1994). Primary cancer prevention, such as advocating for a healthy diet, smoking cessation, and reduction of alcohol consumption, doesn't directly target those at greater risk of cancer, presenting a missed opportunity to engage multi-generational family members, who would benefit from cancer-related lifestyle changes. A cancer diagnosis is viewed as a shared, family experience, confronting family members' perceived risk and vulnerability to the disease. Predominantly, research has focused on family members providing support, and there has been limited research on incorporating interventions for preventive behaviour change in family members alongside the cancer patient (St George et al., 2020).

Understanding the impact of cancer on family members provides important context for family-based prehabilitation interventions. Grunfeld and colleagues (2004) conducted a landmark longitudinal study of 89 family caregivers of women with advanced breast cancer, which examined the psychosocial, occupational and economic impact of caring for a person with cancer. Findings of the study indicated that caregivers were significantly more anxious and therefore more depressed as their perceived burden increased, and patients' functional status declined. Over three-quarters of caregivers who were employed reported missing work due to caregiving responsibilities. These findings underline the need for strategies that support caregivers while also addressing their own health needs (Grunfeld et al., 2004).

Social support, particularly from family caregivers, is recognised as a positive determinant of physical activity participation in cancer patients, with family members serving as role models and motivators for behaviour change (Sun et al., 2019). Interpersonal connections, such as spousal encouragement to engage in physical activity, may be a fundamental factor for successful prehabilitation adherence (Watts et al., 2024). Indeed, family support has been identified as a predictor of exercise adherence after cancer treatment (Ormel et al., 2018). Exercise prehabilitation has been shown to be highly acceptable to the core stakeholders of prehabilitation, which are comprised of patients, family members, and health professionals (Smyth et al., 2024).

Family inclusion in prehabilitation may create shared accountability, which extends from the clinical environment into the home setting. Patients whose family members participate in the prehabilitation process might maintain better nutritional status during treatment, with implications for wound healing and recovery trajectories (Marshall et al., 2020). The psychological benefits of family inclusion may directly impact physiological recovery pathways (Gouin et al., 2011). Shared participation in prehabilitation could create collective motivation, where patients experience reduced anxiety and improved coping when facing challenges alongside family members. This reduced psychological distress might correlate with improved immune function and inflammatory profiles that support surgical recovery. Therefore, a more actively engaged family unit during the prehabilitation process may improve adherence, enhance functional outcomes, and reduce complication rates post-surgery.

Beyond providing support, a cancer diagnosis may also present an opportunity for a teachable moment for family members themselves. It is suggested that heightened cancer awareness, emotional closeness to someone diagnosed with cancer, and anxiety about one's own personal vulnerability can be a catalyst for family and friends to change their own health-related behaviours (Frazelle & Friend, 2016; McBride et al., 2017). Therefore, the cancer experience may represent a window of opportunity, not only for the cancer patient, but also for family members, during which health professionals and service providers can facilitate behaviour change and adoption of healthy lifestyles (Mazanec et al., 2015). Evidence from a cross-sectional study by Humpel and colleagues (2007), which compared cancer survivors with their family and friends attending a cancer fundraising event, supports this receptivity among family members. Within the cancer survivor cohort, 31.3% reported an increase in physical activity, 50% of smokers quit, and 59 to 72% reported dietary improvements within one month of diagnosis. Their family and friends also made positive changes, as 24.3% reported improved physical activity, and the majority reported dietary changes. Although cancer survivors made significantly more changes than their family and friends, these findings suggest that a cancer diagnosis may act as a teachable moment to elicit health behaviour change for the entire family unit.

Research demonstrates that partners are a significant influence on each other's individual health, and similarities in health behaviours increase over time in couples (Meyler et al., 2007). Spouses of patients with several illnesses are at increased risk of the same diseases

due to oftentimes mirrored health behaviours. Therefore, when one partner adopts healthier behaviours, the other is more likely to make a positive health behaviour change (Jackson et al., 2015). This suggests that engaging family members in prehabilitation may increase intervention adherence through a shared household environment, which includes availability and accessibility of similar foods and exercise equipment and routines (Hippisley-Cox et al., 2002; Seabra et al., 2008). Interventions that utilise this eagerness to behaviour change have the potential to promote primary cancer prevention for family members, whilst also enforcing secondary prevention for those diagnosed with cancer (Milton et al., 2022).

Evidence for the effectiveness of dyadic approaches in cancer populations is emerging. The DUET (Daughters, dUdes, mothErs, and others Together) study is a randomised controlled trial testing a web-based lifestyle intervention for cancer survivors and their chosen partners (Demark-Wahnefried et al., 2023). The rationale for this dyadic approach was that scalable, effective interventions are needed to address poor diet, insufficient physical activity, and obesity amongst rising numbers of cancer survivors, and that interventions targeting survivors and their friends and family may promote both tertiary and primary prevention. The study enrolled 56 dyads comprising cancer survivors and chosen partners, including spouses, children, other family members, friends, and neighbours, all with overweight/obesity, sedentary behaviour, and suboptimal diets. The results of this study demonstrated that the intervention was feasible and resulted in significant weight loss among cancer survivors and their chosen partners. Dyad weight loss averaged 2.8 kg in the intervention arm compared to 1.1 kg in the waitlist control ($p = 0.044$). Waist circumference also reduced to a greater degree in the intervention arm (-3.3 cm) compared to the waitlist control (-2.6cm), though this difference did not reach statistical significance ($p=0.128$). Caloric intake among survivors in the intervention arm decreased by approximately 134 kcal/day compared to 144 kcal/day in the waitlist group ($p=0.027$). Self-reported moderate-to-vigorous physical activity increased by approximately 50 min/week in the intervention arm, versus 12 min/week in the waitlisted group, though this difference also did not reach statistical significance ($p=0.099$). Furthermore, the study suggested that the relationship established between the cancer patient and their partner was important for influencing effects on body weight ($p = 0.009$), waist circumference ($p = 0.023$), diet quality ($p = 0.009$), and physical activity ($p < 0.001$). These findings provide support for dyadic-based lifestyle interventions in cancer populations.

The inclusion of family members could be conceptualised through several theoretical lenses. Families can be viewed as interconnected units where health behaviours are reciprocally influenced, suggesting that sustainable behaviour change is more likely when interventions target the family system rather than individuals in isolation. Cancer patients exist within social contexts where the family represents an important support system. Family involvement can address psychological needs, such as autonomy and confidence, through encouragement and shared learning, all within the context of meaningful relationships. Family approaches to health challenges, where problems are perceived as shared rather than individual concerns, may be particularly relevant for cancer prehabilitation. This collective approach to health management might produce improved outcomes across various health contexts and appears especially relevant for cancer patients navigating complex prehabilitation interventions.

Previous research suggests that family members are receptive to education about behaviour change for cancer prevention. Kristeller et al. (1996) found that relatives of cancer patients were highly receptive to discussing behavioural risk factors. However, spontaneous behaviour change among relatives was low, suggesting that receptiveness alone is insufficient and that a structured intervention might be needed. The similarities between tertiary and primary prevention may offer sufficient parallels for a family-based prehabilitation intervention, including active participation of family members. Breitkopf and colleagues (2014) investigated the willingness to participate in a family-based prevention intervention through a mixed-method approach. The sample included 23 families and a total of 73 participants, with 21 participants affected by CRC. Receptiveness to family-based interventions was high, with 91% of patients willing to participate. Perceived barriers were geographic dispersion, varying education levels, generational differences, and scheduling conflicts. Despite the recorded barriers, motivational aspects of the self-efficacy of family members' inclusion need to be addressed. Evidence suggests that at least 80% of family members with two or more relatives with colorectal or pancreatic cancer are receptive to taking part in a lifestyle cancer risk reduction intervention, even a decade after their relatives have been diagnosed (Howell et al., 2013). This high level of receptivity, combined with the demonstrated effectiveness of dyadic interventions such as DUET, supports the feasibility of family-based prehabilitation approaches.

Family-based interventions could be integrated within existing prehabilitation frameworks through several approaches. Family members might serve as supportive coaches, providing

structured support for adherence to prescribed activities. Alternatively, family members could actively engage in the same prehabilitation activities as patients, creating opportunities for mutual encouragement and shared experiences. A systematic review by Arden-Close & McGrath (2017) on dyadic interventions indicates that the majority of the fourteen reviewed interventions (74%) instructed an interaction between dyad members using cross-over techniques or joint intervention techniques, rather than merely having the partner present without explicit interaction. This suggests that active engagement between family members and patients may be the preferred approach in dyadic interventions. Interventions might also address family-level barriers to patient adherence, such as food purchasing patterns and family activity routines that may otherwise undermine individual patient efforts. These approaches provide a foundation for expanding prehabilitation from an individual-focused intervention to a family-centred approach that may enhance effectiveness while simultaneously addressing cancer prevention opportunities for family members.

2.8. Chapter summary

Prehabilitation interventions are beneficial for patients and service providers alike. Improving surgical outcomes and providing the opportunity to deliver out-of-hospital care to those with cancer from the point of diagnosis, offering support and guidance prior, during and post-treatment. The evidence reviewed in this chapter highlights the potential to significantly improve prehabilitation interventions through a more comprehensive approach to both intervention design and participant inclusion. This thesis aims to explore two primary avenues for advancing prehabilitation: firstly, how prehabilitation interventions for cancer patients may be improved through more sophisticated application of theoretical frameworks and evidence-based components; and secondly, how family members can be further engaged in the behaviour change process to enhance both patient and family outcomes. The literature suggests that future prehabilitation interventions should be based on tri-modal interventions, including PA, nutritional guidance, and psychological support, with each component tailored to address specific physiological and psychological mechanisms that influence surgical outcomes. As the research indicates, these interventions must be grounded in behavioural frameworks and theories, like the COM-B model and Behaviour Change Wheel, to promote sustained preventive behaviour. A more systematic application of these frameworks would address the current limitations in prehabilitation interventions by targeting the specific capability, opportunity, and motivation barriers that cancer surgery patients face.

The inclusion of family members represents a particularly promising direction for enhancing prehabilitation effectiveness. The shared nature of the cancer experience creates an opportunity to engage family members not merely as supporters, but as active participants in behaviour change. This approach has the potential to improve patient adherence whilst simultaneously addressing cancer prevention in family members who may be at elevated risk. The evidence from Breitkopf and colleagues (2014) demonstrates high receptiveness to family-based intervention, suggesting feasibility despite identified barriers such as geographic dispersion and scheduling conflicts. To develop more effective family-based prehabilitation interventions, qualitative data will be collected to ensure patients', their family members', healthcare professionals and service providers' views are included. This participatory approach aligns with the thesis's aim to explore practical and acceptable ways to engage family members in the prehabilitation process, addressing both the relational dynamics and logistical challenges involved. By addressing these aims, this research seeks to transform prehabilitation from an individual-focused, sometimes fragmented intervention into a theoretically grounded, family-centred approach that maximises both perioperative outcomes and long-term preventive behaviour change across the family unit.

2.9. Thesis aim and research questions

2.9.1. Aim of thesis

The aim of this thesis is to use a qualitative approach to explore how to optimise prehabilitation interventions for cancer surgery patients, and how family members can be included. To achieve this, four studies will be described, which all build on one another, to create an overall understanding of how long-lasting behaviour change in the cancer prehabilitation/rehabilitation context can be achieved, whilst also encouraging family members to engage in preventative behaviours. The research questions are detailed below:

Research Question 1: What behaviour change techniques are employed in prehabilitation interventions for colorectal and ovarian cancer surgery, and which techniques are associated with intervention effectiveness? (Study 1)

Research Question 2: How can the existing patient-focused prehabilitation/rehabilitation for cancer surgery intervention be optimised to support cancer preventive behaviour change in

cancer patients and their family members? A healthcare professionals' and service providers' perspective (Study 2)

Research Question 3: How can the existing patient-focused prehabilitation/rehabilitation for cancer surgery intervention be optimised to support cancer preventive behaviour change in cancer patients and their family members? A cancer patient and family members' perspective (Study 3)

Research Question 4: How can evidence from healthcare professionals and service providers, patients and family members be synthesised to develop an optimised family-inclusive prehabilitation intervention? (Study 4)

Research Question 5: Is the optimised family inclusive prehabilitation/rehabilitation for cancer surgery intervention acceptable to cancer patients, family members, and service providers? (Study 5)

2.9.2. Overview of thesis

In this section, I present an overview of the thesis.

Chapters 1 and 2 establish the foundation and rationale for this thesis, providing a comprehensive introduction to prehabilitation interventions and their implementation. These chapters explore the multimodular components of prehabilitation interventions, examining how physical activity, nutritional, and psychological support come together to prepare patients before surgery. The review of the existing literature suggests two significant gaps in current prehabilitation interventions: the limited inclusion of family members within the interventions and the sparse use of theoretical frameworks in intervention designs.

Chapter 3 presents Study 1, a systematic review of the existing literature on prehabilitation for CRC and ovarian cancer surgery patients, examining both quantitative and qualitative evidence. The review identified and analysed behaviour change techniques employed in 16 interventions. While BCTs were presented across all reviewed studies, they were inconsistently reported and lacked explicit theoretical underpinning. Self-monitoring (BCT 12) emerged as a technique associated with higher adherence rates. Most significantly, the

review identified a complete absence of social support BCTs across all interventions, despite evidence that social support facilitates health behaviour change. This gap provided the rationale for exploring family inclusion in the subsequent studies.

Chapter 4 presents Study 2, a qualitative interview study with healthcare professionals and service providers (n=5) working within a prehabilitation service for CRC and ovarian cancer surgery. Using thematic analysis, the study explored healthcare professionals' perspectives on how prehabilitation could be optimised and how family members might be better included. Findings revealed that while healthcare professionals and service providers recognised the value of family inclusion for information retention and motivation, significant structural barriers, including time constraints between diagnosis and surgery, scheduling conflicts, and limited staffing, prevented systematic family inclusion with existing services.

Chapter 5 presents Study 3, a qualitative interview study with cancer patients who had attended prehabilitation and their family members (n=14, comprising 6 dyads and 2 individual patients). The study explored patients' and family perspectives on the current prehabilitation intervention and how it could be improved. Thematic analysis, with subsequent mapping to the COM-B model, identified that those patients who received it valued technology-enhanced exercise delivery, but that patients and family members saw a need for improvement for nutritional guidance. Family members expressed a desire for systematic inclusion in the prehabilitation process and highlighted that their own support and information needs were often overlooked by healthcare professionals.

Chapter 6 presents Study 4, the development of an optimised family-inclusive prehabilitation intervention. Using the 6SQuID framework, findings from studies 1-3 were synthesised and integrated with theoretical frameworks, the COM-B Model and Family Systems Theory, to design an intervention addressing the gaps identified in earlier studies. The optimised intervention comprises technology-enhanced delivery with healthcare professional and service provider monitoring, comprehensive nutritional support including practical recipe-based guidance, and flexible family inclusion pathways that accommodate varying preferences and circumstances.

Chapter 7 presents Study 5, a focus group evaluation of the proposed intervention with a cancer patient, family member, and service provider (n=3). Participants reviewed the intervention components and provided feedback on improvements and acceptability. Findings

confirmed support for the intervention’s core components while identifying refinements required for implementation, including the need for automated exercise progression algorithms based on surgical timelines and simplified terminology for psychological support components.

Chapter 8 provides the discussion and conclusion for the thesis. The chapters synthesise findings across all five studies, addresses the research questions and considers the theoretical and practical contributions of the work. Limitations are acknowledged, including sample size constraints and the single-site context. The chapter concludes by outlining future research directions, including the need for feasibility testing and a randomised trial comparing family-inclusive versus standard prehabilitation approaches.

Chapter 3. Behaviour change techniques used in prehabilitation for CRC and ovarian cancer surgery, their association with intervention effectiveness, and acceptability: a mixed methods systematic review (Study 1)

3.1. Introduction

The use of behavioural science theory and implementing behaviour change techniques shown to be effective could increase uptake, adherence and effectiveness of prehabilitation. By Michie et al.'s description (2013), behaviour change techniques are active, observable, and replicable components of interventions which are designed to change behaviour. They ought to provide a standardised language for describing intervention content in relation to behaviour change, with the aim to enable researchers to identify and employ different techniques in interventions systematically. BCTs have been applied across various health behaviour change interventions, including physical activity, smoking cessation, and dietary change, with evidence suggesting that certain techniques, such as self-monitoring and goal setting, are particularly effective in promoting behaviour change and adherence to (Michie et al., 2009; Samdal et al., 2017).

Identifying BCTs used in past prehabilitation interventions is important as they already incorporate many behaviour change techniques, though these are rarely identified or reported systematically. Understanding which BCTs are currently being used, their acceptability to patients, and their association with intervention effectiveness could inform the design of more effective interventions. Comparing successful and unsuccessful interventions as well as assessing the acceptability of the BCTs used will allow future interventions to integrate those insights. The BCT taxonomy developed by Abraham and Michie provides standardised labels, definitions and examples of BCTs to provide a reliable and systematic approach to specifying and reporting behaviour change interventions (Abraham & Michie, 2008; Michie et al., 2013). Many prehabilitation interventions likely already incorporate BCTs implicitly, but these are rarely identified or reported systematically, and when they are included, they seem to lack clear evidence for their inclusion. This review aims to identify BCTs used in previous prehabilitation interventions, explore which BCTs might be associated with greater impact and effect, and assess their acceptability to participants, where reported, to inform future intervention development.

3.2. Aim of review and research questions

The primary aim of this review was to investigate the behaviour change techniques used in previous prehabilitation studies focusing on colorectal and ovarian cancer interventions and

compare those BCTs used in effective versus ineffective interventions. A secondary aim was to assess the BCTs used in effective versus ineffective interventions among patients who are scheduled for colorectal and ovarian cancer surgeries, to identify which techniques patients find more engaging and acceptable. Colorectal and ovarian cancers were selected due to their similar surgical approaches, which involve major abdominal resection, as well as CRC having a high incidence rate and an established evidence base in prehabilitation research.

3.3. Methods

3.3.1. Search strategy

A comprehensive literature search was undertaken and reported according to PRISMA guidelines. The initial search strategy was developed by CK, supported by SS, SM, KR and CT to reflect the eligibility criteria. The Population, Intervention, Comparison, Outcome and Study (PICOS) format was used to develop the search terms (Table 3). MEDLINE, Embase and PsycINFO databases were used to identify studies on prehabilitation in patients undergoing major colorectal and ovarian cancer surgery between June 2021 to August 2021. The MeSH headings used included: abdominal surgery, AND prehabilitation, AND exercise, AND pre-operative care, AND oncology, AND nutrition, AND physical activity, AND psychological support, AND stress management, OR cancer, OR tumour, OR malignancy, OR neoplasm. Additionally, other systematic reviews and keywords in papers within the prehabilitation for cancer surgery patients' context were used to develop a rigorous search strategy. All results were downloaded and stored in EndNote; EndNote was used to remove duplicates. Additional relevant studies were sought through screening of the reference lists of papers previously identified as eligible. Websites of relevance (Prehab4Cancer, Kent and Medway Prehabilitation, Australian College of Sports Medicine, Macmillan) were also searched for further relevant studies from June 2021 to August 2021.

3.3.2. Study selection

Studies were selected according to the PICOS framework, encompassing Population, Interventions, Comparators, Outcome(s) of interest, and Study design. The PICOS and inclusion and exclusion criteria can be found in Table 3.

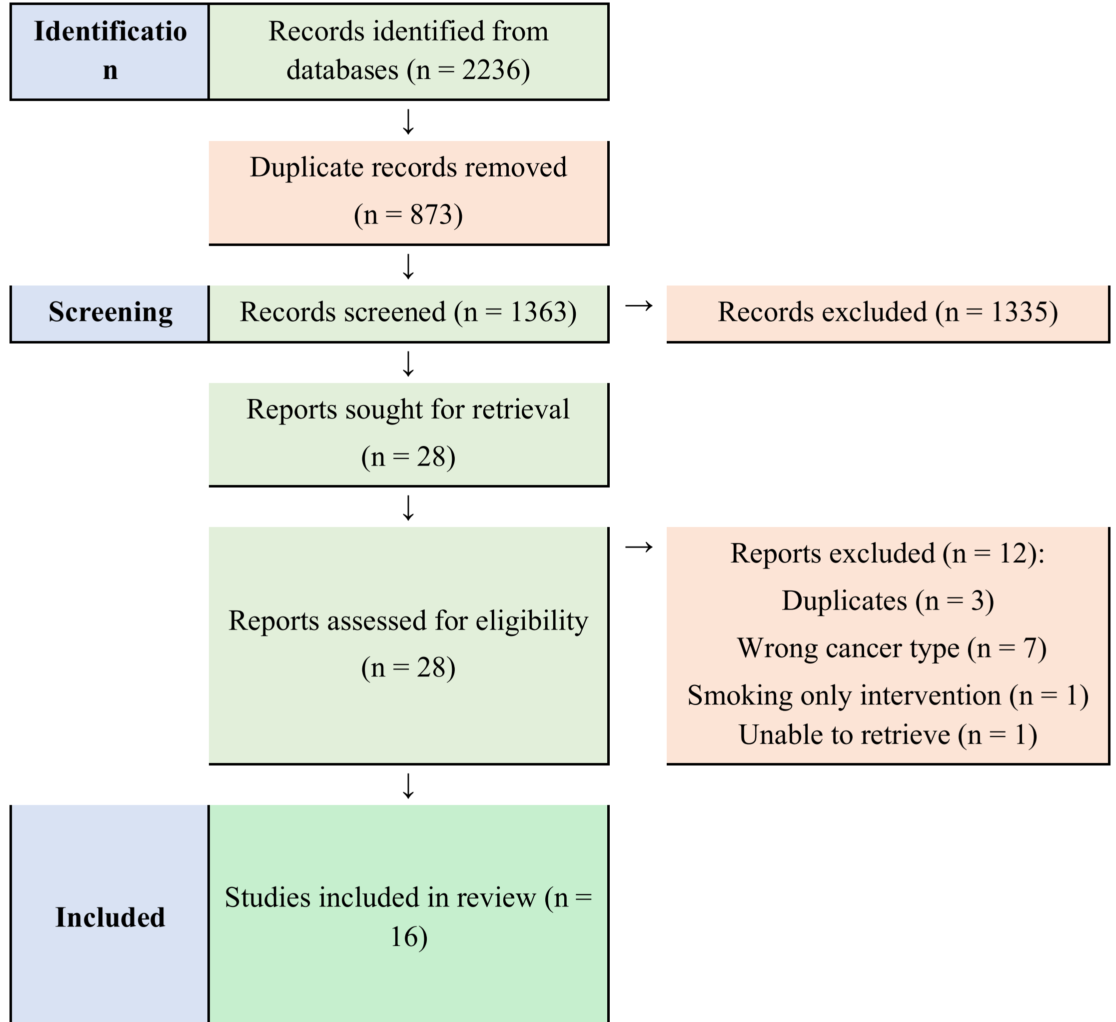
Table 3.: Inclusion and exclusion criteria, Study 1

PICOS Domain	Inclusion	Exclusion
Population	Participants must be colorectal or ovarian cancer patients and be over 18 years old Cancer patients must be undergoing surgery and be outpatients on a curative pathway, treatment plan consisting of curative surgery and can be followed by other therapies such as chemotherapy/ radiotherapy/ immunotherapy	Studies including healthy patients and/or patients with other physical or mental disabilities or diseases will be excluded Children will be excluded Cancer patients on a palliative care plan
Intervention	Lifestyle interventions focusing on: • solid nutrition • physical activity • psychological support Interventions can be unimodal or multimodal If it is a multimodal intervention and entails any of the interventions mentioned above, it can also incorporate either smoking cessation and/or alcohol reduction and/or sun exposure • Prehabilitation interventions • Rehabilitation interventions	Interventions involving only: • smoking cessation • alcohol consumption • sun exposure • immunonutrition or capsules • medication such as aspirin
Comparison	Standard care, no intervention, or alternative prehabilitation intervention	N/A
Outcomes	Self-reported barriers and facilitators to the engagement and adherence of the prehabilitation intervention Self-reported cancer preventive behaviour change in patients, including: • Physical activity • Diet • Weight change / muscle and fat mass	Reporting which only include smoking cessation and/or alcohol consumption and/or sun exposure

	• Phase angle • 6 Minute walk test • Grip strength • MUST diet assessment • Health - Quality of Life Interventions including smoking cessation and/or alcohol measures but ONLY if multimodal and also measuring outcomes mentioned above	
Study Design	• Randomised controlled trials • Cohort studies • Experimental • Quasi-experimental • Qualitative and mixed-methods studies	• Case-control studies • Cross-sectional studies • Case studies • Systematic reviews • Protocols

The selection process did not impose restrictions on publication dates, but it was limited to articles published in English. Studies involving adults (18+ years) with colorectal and ovarian cancer were included. Whilst these cancers fall within the broader gastrointestinal and intra-abdominal malignancies, this review focuses on these specific cancer types as they represent the most studied cancers in prehabilitation research and share similar surgical approaches of major abdominal resection. Cancer patients must have undergone surgery and be an outpatient on a curative pathway, with a treatment plan consisting of curative surgery, preceded or followed by other therapies such as chemotherapy/ radiotherapy or immunotherapy. Interventions could be unimodular (focusing on a single component such as exercise, nutrition, or psychological support) or multimodal (combining two or more of these components). Interventions entailed lifestyle components such as nutrition, physical activity, and psychological support; they may also have incorporated either smoking cessation and/or alcohol reduction and/or sun exposure. Unimodular interventions were excluded if only targeting smoking cessation, alcohol consumption, or sun exposure, as these are considered separate from the core trimodal prehabilitation intervention, in accordance with Macmillan's 2020 published guidance. The trimodal prehabilitation interventions, as defined by Macmillan (2020), consist of physical activity, psychological and nutritional support. The search encompassed a wide range of study designs, including randomised control trials, experimental, quasi-experimental, qualitative and mixed-methods studies. However, case studies, systematic reviews, and protocols were excluded from the analysis. Title and abstract screening were conducted by a single reviewer (CK). The literature search identified 2236 records in total, of which 873 were removed due to duplication. 1363 articles were screened by their title and abstract for eligibility, and 1335 were excluded due to not meeting the inclusion criteria. Overall, 28 studies were assessed for eligibility by full-text screening, of which 12 were excluded: three were duplicates, seven included cancer types other than colorectal or ovarian, one study only focused on smoking as an intervention, and one study could not be retrieved despite contacting the corresponding author. This process is illustrated in the PRISMA flow diagram (Figure 3).

Figure 3.: PRISMA Flow Diagram



3.3.3. Data extraction

CK independently identified and extracted data from the studies. Variables for data extraction included BCT extraction, study characteristics, patient demographics, prehabilitation intervention composition (exercise, nutritional, and/or psychological components), duration, mode of administration, compliance, outcomes measures used to quantify the impact of prehabilitation interventions (changes in functional capacity, cardiopulmonary fitness, psychological assessments, postoperative complications, and health-related quality of life), which can be found in Table 3.4.

To gain a better understanding of the BCTs incorporated in the selected studies, the BCT-taxonomy by Abraham and Michie (2008) was utilised to identify and extract BCTs in the selected studies. This original taxonomy contains 26 BCT items, which were chosen over the later expanded 93-item taxonomy (Michie et al., 2013) as the level of detail in the prehabilitation literature made the more detailed taxonomy impractical for reliable coding. Additionally, as BCTs were often not directly addressed in the studies and detailed descriptions of the BCTs implemented were not provided, the more in-depth taxonomy seemed too specific for the level of reporting within the different studies, complicating and hindering the identification of the BCTs. Once a familiarity with all 26 BCTs was established, the data extraction was conducted by CK, where each included study's methodology and implementation strategies of the interventions were read and matched to the 26-item BCT taxonomy. A second reviewer, AST, applied the same method, thereby strengthening the rigour and reliability of findings through independently coding 40% of the studies. In total, there were three disagreements, which were resolved through discussion and deeper analysis of the studies until mutual agreement was reached.

3.3.4. Quality assessment

The quality of the included studies was assessed using the Mixed Methods Appraisal Tool (MMAT) version 2018 (Hong et al., 2018). The MMAT is designed to appraise the quality of quantitative, qualitative, and mixed-method study designs. Each study was assessed against the five criteria specific to its methodological category, with responses recorded as 'Yes' (Y), 'No' (N), or 'Can't tell' (CT), therefore studies were not assigned numerical scores, as per

MMAT guidelines, but were categorised as ‘Good’ quality (all criteria were met), ‘Moderate’ quality (most criteria were met with minor concerns), or ‘Low’ quality (multiple criteria not met or significant methodological concerns). This quality assessment was conducted independently by one researcher (CK).

3.3.4.1. Overview of study quality

Of the 16 included studies, 10 were randomised controlled trials (RCTs), four were quantitative non-randomised studies, and two were qualitative studies. Tables 3.1-3.3. present a summary of quality ratings by study category. Overall, methodological quality was moderate to good across the included studies, with qualitative studies demonstrating the highest quality ratings. The rating key is as follows: Y = Yes (criterion met); N = No (criterion not met); CT = Can’t tell (insufficient information).

3.3.4.2. Randomised controlled trials

All ten RCTs were rated as moderate quality (Table 3.1.). All studies applied appropriate randomisation procedures (criterion 2.1), typically using computer-generated sequences with allocation concealment. The most common methodological limitations are related to outcome data completeness (criterion 2.3) and intervention adherence (criterion 2.5). Five studies received ‘Can’t tell’ ratings for complete outcome data, where loss to follow-up or post-hoc exclusions introduced potential attrition bias. For example, Fulop et al. (2021) excluded patients who underwent low-risk, minimally invasive surgery after study completion. Similarly, five studies received ‘Can’t tell’ or ‘No’ ratings for adherence, reflecting variable reporting of compliance to exercise protocols; Carli et al. (2010) specifically reported poor adherence in the intervention group. Blinding of outcome assessors (criterion 2.4) was achieved in most studies, though participant blinding was not feasible given the nature of prehabilitation interventions.

Table 3.1.: Category 2: Randomised controlled trials (n=10)

Study	2.1	2.2	2.3	2.4	2.5	Overall
Swaminathan 2020	Y	Y	Y	N	Y	Moderate
Van Rooijen 2019	Y	Y	CT	CT	Y	Moderate
Gillis 2014	Y	Y	Y	Y	CT	Moderate
Bousquet-Dion 2018	Y	CT	CT	Y	Y	Moderate
Carli 2010	Y	Y	Y	CT	N	Moderate
Gillis 2016	Y	Y	CT	Y	Y	Moderate
Haase 2005	Y	Y	CT	CT	Y	Moderate
Carli 2020	Y	CT	Y	Y	CT	Moderate
Burden 2017	Y	CT	Y	Y	CT	Moderate
Fulop 2021	Y	Y	CT	Y	CT	Moderate

Note: 2.1 = Randomisation appropriate; 2.2 = Groups comparable at baseline; 2.3 = Complete outcome data; 2.4 = Outcome assessors blinded; 2.5 = Participants adhered to intervention

3.3.4.3. Quantitative non-randomised studies

All four non-randomised quantitative studies were rated as moderate quality (Table 3.2.). Common strengths included representative participant samples (criterion 3.1), appropriate measurement tools (criterion 3.2), and complete outcome data (criterion 3.3). Most studies used validated instruments such as the 6-minute walk test and established quality of life questionnaires. The concern across all four studies related to confounders being accounted for (criterion 3), which received a 'Can't tell' rating. While baseline comparability between groups was generally demonstrated, formal adjustment for potential confounders through multivariate analysis was inconsistently applied. Chen et al. (2017), for instance, conducted a secondary analysis of RCT data but did not use statistical adjustment beyond baseline comparison, limiting causal inference.

Table 3.2.: Category 3: Quantitative non-randomised studies (n=4)

Study	3.1	3.2	3.3	3.4	3.5	Overall
Souwer 2018	Y	Y	Y	CT	Y	Moderate
Van der Vlies 2020	Y	Y	Y	CT	Y	Moderate
Li 2013	Y	Y	Y	CT	Y	Moderate
Chen 2017	Y	Y	Y	CT	Y	Moderate

Note: 3.1 = Participants representative; 3.2 = Measurements appropriate; 3.3 = Complete outcome data; 3.4 = Confounders accounted for; 3.5 = Intervention administered as intended

3.3.4.4. Qualitative studies

Both qualitative studies (Beck et al., 2020; Beck et al., 2021) were rated as good quality, meeting all five MMAT criteria (Table 3.3.). These studies used appropriate approaches of semi-structured interviews to explore patient perspectives on prehabilitation. Data collection methods were well-documented, including detailed interview guides, and analysis followed a systematic text condensation approach. Findings were substantiated by rich quotations from participants, and researchers acknowledged relevant limitations, such as the predominantly female sample and patients speaking hypothetically about facility-based prehabilitation. The balance between philosophical standpoints, data collection methods, and analytical approaches was clearly demonstrated in both studies.

Table 3.3.: Category 1: Qualitative studies (n=2)

Study	1.1	1.2	1.3	1.4	1.5	Overall
Beck 2020	Y	Y	Y	Y	Y	Good
Beck 2021	Y	Y	Y	Y	Y	Good

Note: 1.1 = Approach appropriate; 1.2 = Data collection adequate; 1.3 = Findings derived from data; 1.4 = Interpretation substantiated; 1.5 = Coherence between sources, collection, and analysis

3.3.4.5. Implications for evidence synthesis

The overall moderate to good quality of included studies provides reasonable confidence in the findings of this review. However, several limitations should be considered when interpreting the results. The inability to blind participants to prehabilitation interventions is an inherent limitation of this field, as it might introduce performance bias in either group.

Adherence to prehabilitation interventions was inconsistently reported across the RCT studies. While five studies reported specific adherence rates (ranging from 16% to 96.6%), four studies provided unclear or incomplete information, and one did not report adherence at all. This variability limits the ability to assess intervention fidelity across the evidence base.

3.4. Results

3.4.1. Study characteristics

The characteristics of the 16 included studies are listed in Table 3.4. The design of the studies included: ten randomised control trials, two qualitative studies, two cohort studies, one pre and post intervention study, and one study was a reanalysis of two randomised controlled trials' preoperative data. Fourteen studies investigated patients with colorectal cancer alone, and two studies focused on ovarian and colorectal cancer.

The interventions varied between studies. Eleven of the studies were multimodal, three studies focused on the nutritional aspect of prehabilitation, one focused only on assessing exercise, and one study focused on the impact of psychological support alone. The total number of patients included across all studies was 1891. Out of the 16 included studies, seven of these were carried out in Canada, three in the Netherlands, two in Denmark, and one from each of the UK, Germany, India and Hungary.

Table 3.4.: Study characteristics

Study	Design	Cancer Type	Country	Participants (n)	Duration	Intervention Type	Intervention	BCTs	Effectiveness
Gillis et al., 2014	RCT	CRC	Canada	77 (38 prehab; 39 rehab)	4 weeks	Multimodal	Moderate aerobic and resistance exercises, nutritional counselling with protein supplementation, and relaxation exercises	1, 2, 5, 8, 12, 13, 17, 18, 24, 25	6MWT (+), Functional recovery (+), Complications (NC), LOS (NC)
Li et al., 2013	Pre-post study	CRC	Canada	87 (42 control; 45 intervention)	~33 days (median)	Multimodal	Nutritional counselling, protein supplementation, anxiety reduction, and moderate exercise program	1, 2, 8, 10, 17, 24	6MWT (+), Functional recovery (+), Physical activity (+), Complications (NC), LOS (NC)
Carli et al., 2020	RCT	CRC	Canada	110 (55 prehab; 55 rehab)	4 weeks	Multimodal	Prehab vs rehab comparison in frail patients	1, 2, 5, 8, 10, 11, 12, 17, 24	6MWT (NC), 30-day CCI (NC), Complications (NC), LOS (NC)
Souwer et al., 2018	Cohort study	CRC	Netherlands	86	4-6 weeks	Multimodal	Multidisciplinary prehabilitation and rehabilitation program for elderly (≥75y): exercise training, nutritional support, geriatric counselling	1, 2, 8, 17, 24, 25	1-yr mortality (NC), Cardiac complications (+), Prolonged LOS (+), Severe complications (+)
Bousquet-Dion et al., 2018	RCT	CRC	Canada	80 (41 prehab; 39 control)	4 weeks	Multimodal	Moderate intensity aerobic and resistance exercise, nutrition counselling with whey protein supplementation, and anxiety-reduction strategies	1, 2, 6, 8, 12, 17, 24	6MWT (NC), Complications (NC), LOS (NC)

Study	Design	Cancer Type	Country	Participants (n)	Duration	Intervention Type	Intervention	BCTs	Effectiveness
Van der Vlies et al., 2020	Historical cohort	CRC	Netherlands	466 (127 MDT; 306 non-MDT)	Median 17 days pre-surgery	Multimodal	MDT-guided prehabilitation for frail patients: nutrition, mobility, cognition, medication, anaemia (IV iron), smoking cessation	8	Severe complications CD III-V (NC), Overall survival (-), 30-day mortality (NC)
Van Rooijen et al., 2019 (PREHAB trial)	RCT	CRC	Netherlands	251 (123 prehab; 128 control)	4 weeks	Multimodal	In-hospital high-intensity endurance and strength training, high-protein nutrition and supplements, smoking cessation, and psychological support	1, 2, 8, 9, 11, 12, 17, 24, 26	Severe complications (+), Medical complications (+), 6MWT at 4wks (NC), Functional recovery (+)
Carli et al., 2010	RCT	CRC	Canada	112	~52 days	Unimodal (exercise)	Bike and strength training vs walking and breathing exercises	7, 8, 9, 18	6MWT (NC), Complications (NC), LOS (NC)
Swaminathan et al., 2020	RCT	CRC	India	58 (29 intervention; 29 control)	7 days preop	Combined (ERAS + respiratory)	ERAS protocol with respiratory prehabilitation (incentive spirometry)	1, 8, 12	LOS (+), PEFR/Pulmonary function (+), Surgical complications (NC), Pulmonary complications (NC)
Gillis et al., 2016	RCT	CRC	Canada	43 (22 intervention; 21 control)	4 weeks	Unimodal (nutrition)	Whey protein supplementation vs placebo	8, 10, 12	6MWT (NC), Lean body mass (NC)
Haase et al., 2005	RCT	CRC	Germany	60 (20 imagery; 22	Perioperative	Unimodal (psychological)	Guided imagery and relaxation interventions	8, 22, 24	Pain (NC), Analgesia use (NC), Pulmonary

Study	Design	Cancer Type	Country	Participants (n)	Duration	Intervention Type	Intervention	BCTs	Effectiveness
				relaxation; 18 control)					function (NC), Ileus (NC), Fatigue (NC)
Burden et al., 2017	RCT	CRC	UK	101 (55 intervention; 46 control)	Diagnosis to surgery	Unimodal (nutrition)	Oral nutritional supplements + dietary advice vs dietary advice alone	4, 8	Infections/SSI (+), Weight loss (+), Skeletal muscle preservation (+)
Chen et al., 2017	Reanalysis of RCTs	CRC	Canada	116 (57 intervention; 59 control)	4 weeks	Multimodal	Exercise, nutritional supplementation, and counselling on relaxation techniques	8, 9, 10, 12	6MWT (+), Physical activity (+)
Fulop et al., 2020	RCT	CRC	Hungary	149 (77 intervention; 72 control)	4 weeks	Multimodal	Aerobic and breathing exercises, dietary goals, and therapy sessions vs ERAS	8, 10, 12, 13, 17	6MWT (+), Spirometry (+), Anxiety (+), Complications (NC), LOS (NC), Mortality (NC)
Beck et al., 2021	Qualitative	CRC & Ovarian	Denmark	79	-	Multimodal	Interview study	8, 12	N/A - Qualitative
Beck et al., 2020	Qualitative	CRC & Ovarian	Denmark	16	-	Multimodal	Interview study	1, 8, 12	N/A - Qualitative

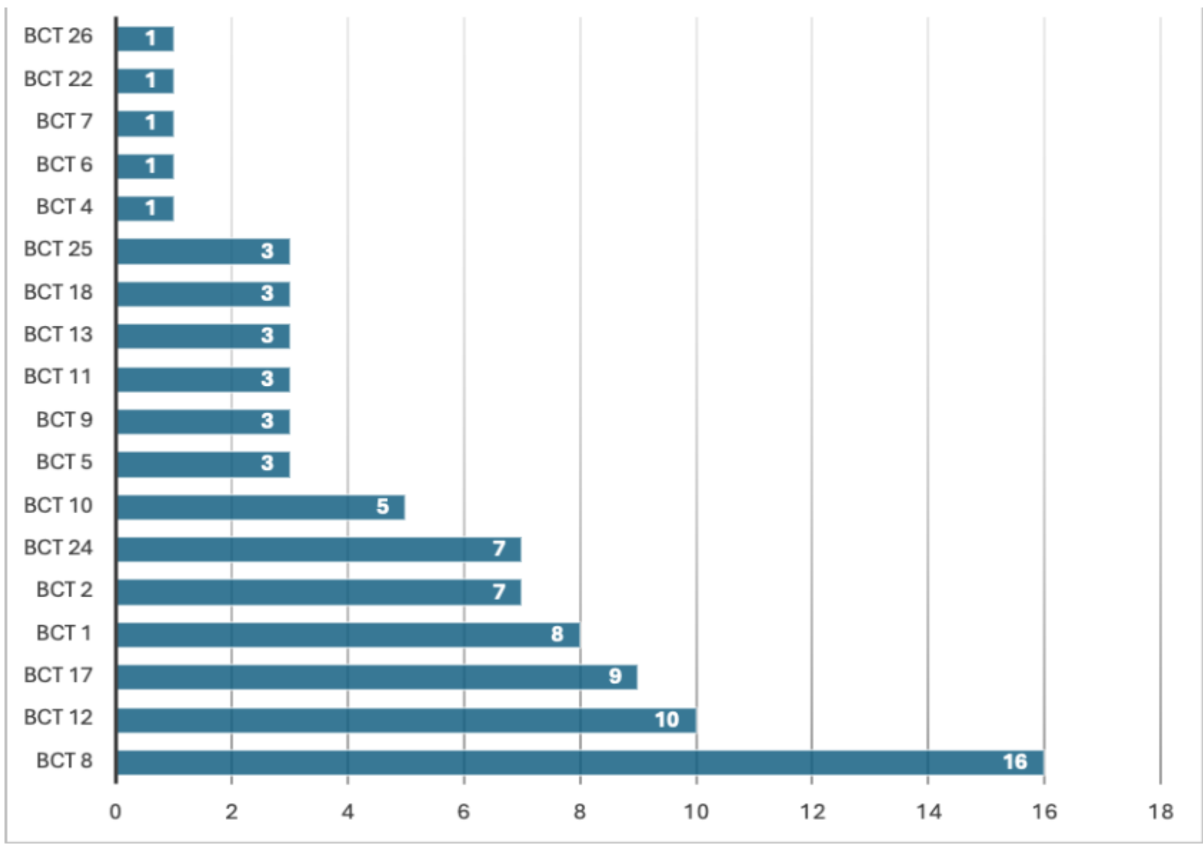
Key: (+) = significant improvement; (NC) = no change/not significant; (-) = significant decline

Note: BCTs = Behaviour Change Techniques; 6MWT = 6-Minute Walk Test; LOS = Length of Stay; CCI = Comprehensive Complication Index; SSI = Surgical Site Infection; PEFR = Peak Expiratory Flow Rate; CD = Clavien-Dindo; MDT = Multidisciplinary Team

3.4.2. Overall use of behaviour change techniques

The analysis included 16 studies, with all 26 BCTs from the Behaviour Change Taxonomy (Abraham & Michie, 2008) initially considered. Behaviour change techniques were incorporated into all 16 interventions (Table 3.4), although only some of the included studies explicitly described or labelled the technique. Among the 26 BCTs, a subset of 19 were utilised across the interventions (Figure 3.1.). All studies included in this review implemented at least one, if not multiple, BCTs within their intervention, with some using the same type of BCT for different parts of the intervention but never merely relying on just one BCT.

Figure. 3.1.: Included BCTs in all 16 Interventions



Note: Y axis demonstrates the BCTs, X axis represents frequency of them being employed.

BCT codes:1. Provide general information; 2. Provide information on consequences; 3. Provide information about others' approval; 4. Prompt intention formation; 5. Prompt barrier identification; 6. Provide general encouragement; 7. Set graded tasks; 8. Provide instruction; 9. Model or demonstrate the behaviour; 10. Prompt specific goal setting; 11. Prompt review of behavioural goals; 12. Prompt self-monitoring of behaviour; 13. Provide feedback on performance; 14. Provide contingent rewards;15. Teach to use prompts/cues; 16. Agree on behavioural contract; 17. Prompt practice; 18. Use follow-up prompts; 19. Provide opportunities for social comparison; 20. Plan social support/social change; 21. Prompt identification as a role model 22. Prompt self-talk; 23. Relapse prevention; 24. Stress management; 25. Motivational interviewing; 26. Time management

The most used BCT was BCT 8 "Provide instructions”, used in all 16 studies. This involved providing instructions to patients on performing specific behaviours, including exercise, breathing techniques, stress management, and nutrition.

The second most frequently reported BCTs were BCT 12 "Prompt self-monitoring of behaviours" with ten uses, closely followed by BCT 17 “Prompt Practice,” with an overall count of nine uses. In this context, *prompt self-monitoring of behaviours* meant patients were encouraged to keep records of their specified behaviours, such as exercise routines or dietary choices, as well as practice the behaviour. This approach not only served as a means of holding participants accountable for their actions but also acted as a tool for reinforcing behaviour change and measuring adherence to the intervention.

Additionally, BCT 1, "Provide information about behaviours-health link," and BCT 17, "Prompt practice," were reported in eight interventions each. These techniques involve informing individuals about the connections between their behaviours and health outcomes and encouraging participants to practice the behaviour that is suggested in the intervention. These behaviours could be, but are not limited to, practising certain exercises where not only the activity itself is practiced but also the implementation of a routine to practice exercise. These BCTs emphasise the importance of communicating knowledge about the direct impact of lifestyle choices on health and the need to translate this awareness into practical actions. Furthermore, BCT 24, "Stress management," and BCT 2, "Provide information on consequences," were employed in six of the studies included. These techniques highlight the recognition of the psychosocial aspects of prehabilitation and the importance of addressing stress management as a key component. Providing information on the consequences of behavioural choices can help individuals make informed decisions about their health-related actions. Notably, no studies incorporated BCTs related to social support, despite there being evidence suggesting that family member and peer support can enhance health behaviour change and increase adherence (Ormel et al., 2018; Beck et al., 2021).

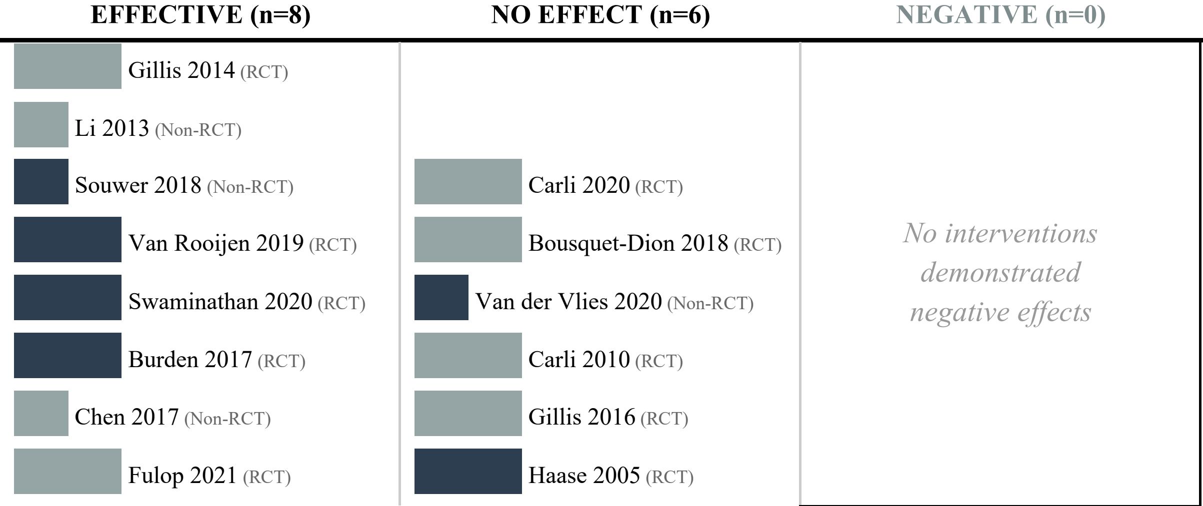
3.4.3. Classification of effective and ineffective interventions

To synthesise evidence on the effectiveness of prehabilitation interventions, a harvest plot was constructed following the methodology described by Ogilvie and colleagues (2008). The harvest plot is a graphical method for synthesising evidence from heterogeneous

interventions where meta-analysis is not feasible due to variability in outcomes, study designs, and intervention components. Interventions were classified into one of three categories based on their reported outcomes: (1) Effective when interventions demonstrating at least one statistically significant positive outcome ($p < 0.05$) favouring the intervention group compared to the control group; (2) No effect when interventions reporting no statistically significant differences between intervention and control groups on any outcome measure; and (3) Negative effect for interventions demonstrating statistically significant harm or deterioration in the intervention group compared to the control group. This is illustrated in Figure 3.2.

Each study is represented as a bar in the harvest plot, with visual features encoding key methodological characteristics: bar length represents study design quality (longer bars indicate RCTs, shorter bars indicate non-randomised interventions; bar colour represents the primary outcome type (black for clinical outcomes such as postoperative complications, mortality, and length of stay; grey for functional outcomes such as 6-minute walk test). Applying these criteria to the 14 quantitative interventions, eight interventions were classified as effective: Gillis et al. (2014), Li et al. (2013), Souwer et al. (2018), Van Rooijen et al. (2019), Swaminathan et al. (2020), Burden et al. (2017), Chen et al. (2017), and Fulop et al. (2021). Six interventions were classified as showing no effect: Carli et al. (2020), Bousquet-Dion et al. (2018), Van der Vlies et al. (2020), Carli et al. (2010), Gillis et al. (2016), and Haase et al. (2005). No intervention demonstrated negative effects, providing reassurance regarding the safety of prehabilitation interventions. It should be noted that several interventions classified as "effective" demonstrated mixed results, with positive effects on some outcomes but not others. For example, Gillis et al. (2014) showed significant improvements in the 6-minute walk test and functional recovery, but no significant differences in postoperative complications or length of stay. This heterogeneity in outcomes across interventions highlights the complexity of evaluating prehabilitation effectiveness and the importance of considering multiple outcome domains.

Figure 3.2.: Harvest plot: Effectiveness of prehabilitation interventions



Note: The bar length demonstrates whether the included interventions are a RCT (longer bar) or a non-RCT (shorter bar).

Bar length: *= RCT (randomised controlled trial;* *= non-RCT (cohort, pre-post)*

The bar colour demonstrates whether the included interventions focused predominantly on clinical outcomes (complication rates, LOS, mortality, etc., in dark grey) or on functional outcomes (6MWT, physical function, etc., in light grey).

Bar colour: *= Clinical outcomes;* *= Functional outcomes*

Classification Criteria:

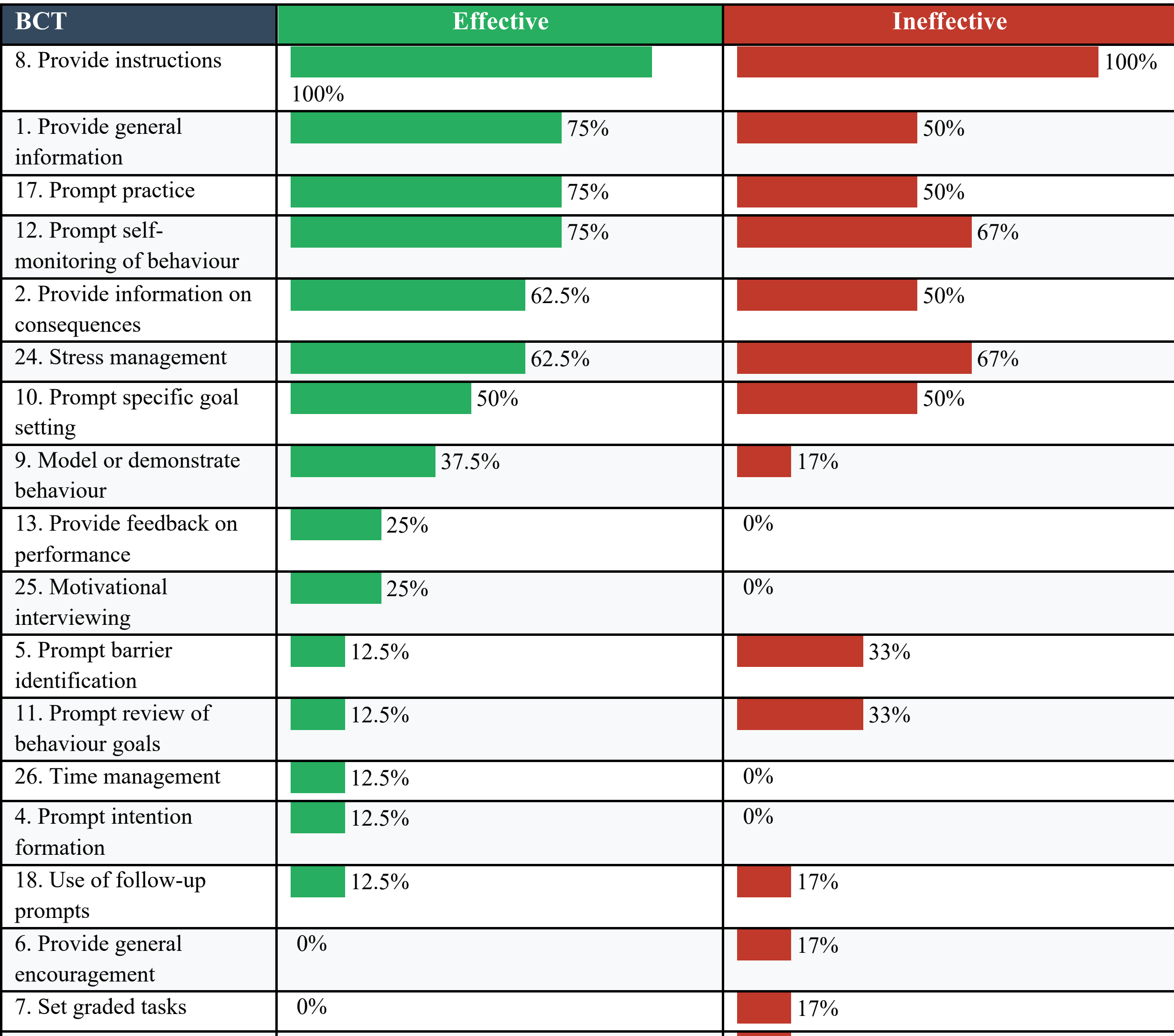
Effective: *≥1 statistically significant positive outcome ($p < 0.05$)*
No Effect: *No statistically significant differences between groups*
Negative: *Statistically significant harm to intervention group*

3.4.3.1. BCT use comparison

Out of the 16 studies, two were qualitative and therefore did not report on intervention effectiveness in terms of measurable outcomes. However, both studies provided valuable insights into patient experiences, which informed the assessment of BCT acceptability within this review. Six studies did not find a difference between the intervention and control groups, and the remaining eight studies did show the effectiveness of their intervention. To explore potential associations between specific BCTs and intervention effectiveness, BCT usage patterns were compared between the eight effective and six ineffective studies (Figure 3.3.). Descriptive patterns emerged, such as BCT 8 (provide instructions) was used universally across all 14 studies regardless of effectiveness, which may suggest it represents standard practice. BCT 1 (provide general information) was used in 62.5% of effective studies compared to 33.3% of ineffective studies, and BCT 17 (prompt practice) showed a similar pattern (62.5% vs 33.3%). Additionally, BCT 13 (provide feedback on performance) and

BCT 25 (motivational interviewing) were used only in effective studies (25% vs 0%), though in only two studies each. Effective studies used a slightly higher mean number of BCTs (5.6 BCTs per study, range: 2-10), compared to ineffective studies (4.5 BCTs per study, range: 1-9), suggesting that intervention comprehensiveness may play a role in effectiveness. These patterns, while not statistically significant, should be continuously investigated in larger samples.

Figure 3.3.: BCT usage in effective versus ineffective interventions



BCT	Effective	Ineffective
8. Provide instructions	100%	100%
1. Provide general information	75%	50%
17. Prompt practice	75%	50%
12. Prompt self-monitoring of behaviour	75%	67%
2. Provide information on consequences	62.5%	50%
24. Stress management	62.5%	67%
10. Prompt specific goal setting	50%	50%
9. Model or demonstrate behaviour	37.5%	17%
13. Provide feedback on performance	25%	0%
25. Motivational interviewing	25%	0%
5. Prompt barrier identification	12.5%	33%
11. Prompt review of behaviour goals	12.5%	33%
26. Time management	12.5%	0%
4. Prompt intention formation	12.5%	0%
18. Use of follow-up prompts	12.5%	17%
6. Provide general encouragement	0%	17%
7. Set graded tasks	0%	17%
22. Prompt self-talk	0%	17%

Note: Effective (n=8) Ineffective (n=6); *BCT = Behaviour Change Technique. Effective studies demonstrated at least one statistically significant positive outcome (p < 0.05). Ineffective studies showed no significant differences.*

Summary Statistics

Mean BCTs per study: Effective = 5.6; Ineffective = 4.5

BCT 8 (provide instructions) was used in 100% of all studies.

BCT 13 and BCT 25 were used exclusively in effective studies (25% vs 0%).

3.4.4. Acceptability of prehabilitation interventions

Acceptability of prehabilitation interventions was assessed through two approaches, depending on study type (qualitative vs. quantitative). For the two qualitative studies, acceptability was directly assessed through exploration of patient perspectives (Beck et al.,

2020; Beck et al., 2021). For the quantitative studies, acceptability was assessed indirectly through adherence rates. While acceptability encompasses patients' perceptions of whether an intervention is appropriate and engaging, adherence rates provide a proxy indicator of acceptability in practice.

The two qualitative studies (Beck et al., 2020; Beck et al., 2021) rated as good quality in the MMAT, provided direct insight into patient perspectives on prehabilitation acceptability. Beck et al. (2021), involving 79 patients undergoing major abdominal cancer surgery, found that patients were interested in and positive towards prehabilitation; however, it was emphasised that it must be provided on patients' own terms. More than 50% of patients adhered to greater than 75% of the recommendations provided in a prehabilitation leaflet, and patients from the ovarian cancer centre actually increased their weekly exercise sessions during the preoperative period. Beck et al. (2020), involving 16 patients, identified five key themes shaping acceptability, patients perceptions of preparation (extending beyond exercise to practical and emotional readiness), the tension between wanting between wanting more time yet wanting surgery completed quickly, preferences for home-based over facility-based interventions, the importance of support from healthcare professionals and family members, and motivations for taking action including self-motoring and contributing to future patient care.

Both studies identified consistent conditions that influenced acceptability, such as the fact that patients valued flexibility in how prehabilitation was delivered. There was a preference for an intervention that was tailored to individual circumstances and everyday life, with home-based interventions feeling safer and more practical, though patients did acknowledge that facility-based adherence may achieve higher adherence due to supervision. Self-monitoring (BCT 12), which was identified in both qualitative studies, was reported as particularly motivating, as patients stated that writing down their activities helped them stay engaged and accountable. However, patients did state that general recommendations of lifestyle changes alone were insufficient and that professional support and supervision to maintain engagement were important. Barriers to acceptability included time constraints, physical symptoms, and competing priorities such as spending time with family and attending appointments before surgery.

Adherence rates from the quantitative studies provided evidence of acceptability, although reporting was inconsistent (Table 3.5.). Of the 14 quantitative studies, only four reported

specific adherence rates, ranging from 16% to 96.6%. The highest adherence was observed in Gillis et al.'s (2016) study, a nutrition-focused intervention achieving 93.7-96.6% adherence, followed by Gillis et al. (2014) study, at 85% adherence, closely followed by Bousquet-Dion et al. (2018) at 83%. In contrast, Carli et al. (2010) reported poorer adherence at 16%, which was attributed to the structured bike and strength training regime being perceived as too demanding. Three studies provided unclear or incomplete adherence information (Carli et al., 2010; Burden et al., 2017; Fulop et al., 2021). And seven studies did not report adherence rates at all (Haas et al. 2005; Li et al., 2013; Chen et al., 2017; Souwer et al., 2018; Van Rooijen et al., 2019; Van der Vlies et al., 2020; Swaminathan et al., 2020). This variability in both adherence rates and reporting quality limits conclusions about overall acceptability; however, it may suggest that intervention design and delivery significantly influence patient engagement.

Table 3.5.: Acceptability of interventions

Study	**Design**	**Adherence Rate**	**Notes**
Randomised Controlled Trials (n=10)			
Gillis 2016	RCT	93.7–96.6%	Highest adherence; whey protein supplementation
Gillis 2014	RCT	85%	Multimodal intervention
Bousquet-Dion 2018	RCT	83%	Supervised exercise sessions
Carli 2010	RCT	16%	Poor adherence; structured regime too demanding
Carli 2020	RCT	Not clearly reported	Monitoring described but rates unclear
Burden 2017	RCT	Not clearly reported	Mentioned but unclear
Fulop 2021	RCT	Not clearly reported	Work diary mentioned
Haase 2005	RCT	Not reported	—
Swaminathan 2020	RCT	Not reported	—
Van Rooijen 2019	RCT	Not reported	—
Non-Randomised Studies (n=4)			
Li 2013	Pre-post	Not reported	—
Souwer 2018	Cohort	Not reported	—
Van der Vlies 2020	Cohort	Not reported	—
Chen 2017	Reanalysis	Not reported	Secondary analysis of RCT data
Qualitative Studies (n=2)			
Beck 2021	Qualitative	>50% adhered to >75%	Patient-reported via leaflet registrations
Beck 2020	Qualitative	Not measured	Interview study exploring perspectives

Note: 'Not clearly reported' indicates adherence was mentioned, but specific rates were not provided. 'Not reported' indicates no adherence information was included. 'Not measured' indicates the study design did not include adherence measurement.

To explore whether specific BCTs were associated with higher adherence, the techniques used in studies with reported adherence rates were compared (Table 3.6.). BCT 8 (providing instruction) was present in all five studies that reported adherence rates, regardless of the level of adherence. Though this may further underline that this specific BCT is a standard practice, it also suggests that it alone may not be impactful enough to differentiate between high and low adherence. Another pattern did emerge, which showed that BCT 12 (prompt self-monitoring of behaviour) was present in all four studies reporting high adherence rates; however, it was absent in Carli et al.'s (2010) study, which reported an adherence of only 16%. Similarly, BCT 1 (provide general information), BCT 17 (prompt practice), and BCT 24 (stress management) were common in some high adherence interventions but absent in the low adherence intervention. The low-adherence intervention was characterised by a more limited range of BCTs (n=4), focusing primarily on instruction and demonstration without self-monitoring or information provision components. This pattern aligns with the qualitative findings, where patients explicitly identified self-monitoring as a motivating factor that helped them stay engaged.

Table 3.6.: BCTs used in studies with adherence rate

Study	**Adherence**	**BCTs Used**	**Total BCTs**
High Adherence (≥83%)			
Gillis 2016	93.7–96.6%	8, 10, 12	3
Gillis 2014	85%	1, 2, 5, 8, 12, 13, 17, 18, 24, 25	10
Bousquet-Dion 2018	83%	1, 2, 6, 8, 12, 17, 24	7
Low Adherence			
Carli 2010	16%	7, 8, 9, 18	4
Qualitative (patient-reported)			
Beck 2021	>50% to >75%	8, 12	2

Note. BCT codes: 1 = Provide general information; 2 = Provide information on consequences; 5 = Prompt barrier identification; 6 = Provide general encouragement; 7 = Set graded tasks; 8 = Provide instruction; 9 = Model or demonstrate the behaviour; 10 = Prompt specific goal setting; 12 = Prompt self-monitoring of behaviour; 13 = Provide feedback on performance; 17 = Prompt practice; 18 = Use follow-up prompts; 24 = Stress management; 25 = Motivational interviewing.

The evidence suggests that prehabilitation is broadly acceptable to patients undergoing colorectal and ovarian cancer surgery, provided that interventions are flexible, tailored to patients' needs and supported by healthcare professionals. The reporting was inconsistent; the

evidence indicates that well-designed interventions can achieve high adherence rates, whereas overly structured or demanding interventions may result in poor adherence. The consistent presence of BCT 12 in high-adherence studies and its absence in the low-adherence study suggests this technique may be particularly valuable for promoting acceptability. Though these findings highlight the importance of patient-centred design in prehabilitation interventions and suggest that future interventions incorporate self-monitoring as a behaviour change technique, it is also important to be cautious with these findings, as it was a particularly small number of studies with reported adherence rates.

3.5. Discussion and conclusions

3.5.1. Key findings

Behaviour change techniques were present in all 16 interventions, emphasising their recognised importance in prehabilitation interventions for cancer patients. A total of 19 BCTs (from the 26-item taxonomy) were used across the studies, with multiple BCTs focusing on instruction provision, self-monitoring, and information about health behaviour link, while techniques addressing social support were notably absent. In regard to effectiveness, two studies were qualitative and could not assess effectiveness, six showed no significant difference between intervention and control groups, and eight demonstrated intervention effectiveness to some degree (i.e. on one or more outcomes). BCTs were used across the interventions, with multiple BCTs being used in each intervention, demonstrating a diversity of approaches in attempting behaviour change. The use of multiple BCTs across the different components of interventions likely reflects the complexity of behaviour change and the need to target multiple factors to achieve effective and sustained outcomes. Studies reporting effective interventions incorporated a higher number of BCTs (approximately 5.6) compared to ineffective studies (approximately 4.5). While no statistically significant pattern in BCTs was identified between effective and ineffective interventions, descriptive analysis suggests that BCT 1 (provide general information) and BCT 17 (prompt practice) were more often used in effective studies. These findings suggest that factors beyond specific BCT selection, such as implementation quality and intervention comprehensiveness, may influence the effectiveness of prehabilitation interventions for CRC and ovarian cancer patients.

Regarding acceptability, the two qualitative studies (Beck et al., 2020; Beck et al., 2021) indicated that patients were positive towards prehabilitation but required flexibility and

professional support for sustained engagement. Adherence rates in quantitative studies ranged widely from 16% to 96.6%, though reporting was inconsistent, with only four studies providing specific rates. BCT 8 (provide instruction) was present in all studies regardless of adherence, suggesting it represents standard practice but does not differentiate between successful and unsuccessful interventions. In contrast, BCT 12 (prompt self-monitoring) was present in all four studies reporting acceptable or high adherence (including Beck et al., 2021) but absent in the only study reporting poor adherence (Carli et al., 2010; 16%), suggesting this technique may be particularly important for patient engagement.

3.5.2. Interpretation of findings

Prehabilitation is an emerging research area, and it has been argued that a multimodal approach, consisting of physical activity, psychological wellbeing and nutritional support, is favourable to improve adherence and patient outcomes (Liao et al., 2025; Li et al., 2025). Behaviour change underpins the success of prehabilitation, and there is uncertainty as to which behaviour change technique/s or combination thereof are most effective to implement long-lasting behaviour change, as well as which techniques are best to improve adherence to the prehabilitation intervention.

The prevalence of instruction-focused BCTs across interventions suggests a model of prehabilitation that emphasises knowledge transfer (BCT 12) and skill development (BCTs 8, 9, 17). While this approach provides a foundation for behaviour change, the relative absence of more complex BCTs addressing psychological and social factors may limit the effectiveness of current interventions. The observation that effective studies used more BCTs on average and were more likely to include general information (BCT1) and practice-based techniques (BCT17) suggests that intervention comprehensiveness may contribute to effectiveness. However, effectiveness likely depends on factors beyond simply which BCTs are used within the intervention, and includes how they are delivered, the intensity of the intervention itself, how BCTs are combined and interact with each other, as well as individual patient and contextual factors.

The frequent use of self-monitoring techniques indicates recognition of the importance of patient engagement and reflection in the prehabilitation process. This aligns with broader behaviour change literature suggesting that active participation and self-regulation are key components of successful behaviour change (Hennessy et al., 2020). This is further supported

by the acceptability analysis, which found BCT 12 (prompt self-monitoring) present in all four interventions reporting acceptable or high adherence, but absent in the study with poor adherence (16%). Notably, BCT 8 (provide instruction) was present in all interventions regardless of adherence level, suggesting that while instruction is necessary, it is not sufficient for promoting engagement. Qualitative evidence from Beck et al. (2021) corroborates this pattern, with patients explicitly reporting that writing down their activities helped them stay engaged and accountable. However, the limited use of goal setting (only six interventions) and demonstration of behaviour (only four interventions) represents a potential missed opportunity to enhance intervention effectiveness (Meade et al., 2019).

These findings align with wider concerns in the prehabilitation literature regarding intervention adherence. Participants' drop-out is somewhat common for prehabilitation interventions, and reviews have noted that behavioural science should be considered in their intervention design (Copeland et al., 2020). Consistent with Grimmett et al.'s (2021) observations of the wider prehabilitation literature, few of the studies included in this review explicitly described the behaviour change components being targeted or how they addressed behavioural determinants. This limited attention to the mechanisms of behaviour change may contribute to the variable adherence rates observed across interventions. BCTs may increase intervention adherence to prehabilitation interventions for cancer surgery patients. However, the effectiveness of BCTs in promoting adherence can vary depending on several factors, including the specific techniques employed, the characteristics of the patient population, and the design and implementation of the prehabilitation intervention (Watts et al., 2024).

While BCTs can be effective in promoting adherence, it is important to recognise that adherence is influenced by various factors, including patient motivation, barriers to participation, and intervention accessibility (Mazzoni et al., 2021). Therefore, it is necessary for healthcare professionals and service providers to assess individual patient needs and tailor prehabilitation interventions accordingly. Maintaining patient engagement through the prehabilitation process remains a challenge, with adherence rates varying across studies (Berrio-Valencia et al., 2025). Various factors contribute to these engagement and dropout rates, such as disease progression and treatment burden. However, some factors might be influenced through behaviour change techniques being implemented in the interventions, such as lack of motivation and psychological factors, such as stress.

Evidence from related fields provides insight into which BCTs may be most effective for improving adherence. Successful behaviour change interventions need to understand the determinants that drive change and how to implement them. Providing instructions on the behaviour that needs to be addressed, like all the 16 interventions included in this review, provides a solid foundation; it alone is not sufficient to keep patients adherent to the behaviour change that is asked of them (Noah et al., 2017). Similarly, providing information on the health links and possible consequences is likely to have a limited impact on lasting behaviour change. The systematic review by Meade et al. (2019) on adherence to behaviour change in musculoskeletal pain suggested moderate evidence that factors such as demonstration of behaviours and practice of the behaviour, as well as social support and goal setting, improved exercise adherence. An observed gap in the interventions reviewed was the absence of social support as a BCT. None of the interventions included or addressed social support, although there is evidence that support from peers as well as family members can increase adherence to lifestyle changes (Ormel et al., 2018; Beck et al., 2021). A mixed-method systematic review of 23 studies on barriers and facilitators to prehabilitation for surgery patients found that social support was widely reported as a facilitator and further promotes intervention adherence, whereas a lack of social support acted as a barrier (van der Velde et al., 2023). The positive impact of social support was not limited to family and friends being engaged in the prehabilitation journey, but also peer interactions were mentioned as favourable.

3.5.3. Implications for practice

To achieve a sustainable prehabilitation intervention, it is desirable to include a selection of BCTs that offer a variety of tools and mechanisms to help the patients stay engaged. The findings of this review suggest several implications for clinical practice. First, prehabilitation intervention may benefit move beyond simply providing instructions and information to incorporate a more comprehensive range of BCTs, particularly those addressing social support, goal setting, and behavioural demonstration. These techniques have shown promise in other health behaviour change contexts and may help improve adherence to prehabilitation interventions. For example, goal setting can enhance self-efficacy and provide patients with clear, achievable targets, which have been associated with improved exercise adherence (Annesi, 2002). Behavioural demonstration increases patients' confidence in performing

exercises correctly, while social support provides motivation and accountability (Meade et al., 2019).

Second, the absence of social support elements in the reviewed interventions represents a gap that future interventions should address, as there is evidence that it can improve adherence and reduce dropout rates (Watts et al., 2024). Incorporating family members and peers into prehabilitation interventions could enhance adherence and effectiveness, particularly given the evidence that social support acts as a facilitator to intervention engagement (Sontag et al., 2024).

Third, the variation in BCT usage across studies highlights the need for more standardised approaches to prehabilitation intervention design. While personalisation is important, core elements of behaviour change support that have been shown as effective should be consistently implemented across interventions to ensure a standardised quality of care.

Fourth, the involvement of behaviour change specialists in prehabilitation intervention design and delivery could enhance the implementation of appropriate BCTs and potentially improve intervention outcomes. Multidisciplinary collaboration between exercise specialists, nutritionists, psychologists, and behaviour change experts would provide a more comprehensive approach to supporting patients through prehabilitation.

3.5.4. Future directions

Working with patients and iterative improvements based on their feedback is essential if interventions are to be truly patient-centred and engagement is to be maximised. Optimising self-efficacy to engage in interventions, as well as ensuring interventions are relevant to patients are of notable importance.

There is sufficient evidence indicating that some BCTs may be helpful for certain people but not for others, depending on their personality (Belmon et al., 2015). Furthermore, behavioural frameworks, such as the Theory of Planned Behaviour as well as the Health Belief Model, suggest that behaviour is influenced by multiple factors, which might be targeted through different BCTs in interventions. Given that individual responses to BCTs may vary based on personality and other personal factors, future research should explore the development of adaptive or personalised prehabilitation interventions. Similarly, the combinations of BCTs

which are most effective for specific cancer populations, recognising that different patient groups may respond differently to behaviour change approaches, should be explored. This means that interventions should be tailored to individual patient characteristics and preferences, inclusive of family engagement. Therefore, researchers should explore the role of family members and social support in enhancing prehabilitation adherence and outcomes, which aligns with a core aim of this thesis. Additionally, studies need to develop more personalised approaches to BCT implementation that account for individual differences in response to various techniques. The long-term maintenance of behaviour change following prehabilitation warrants further examination, as sustainable lifestyle modification may have implications for cancer survivorship beyond the perioperative period. Finally, research should investigate implementation factors that influence the delivery and effectiveness of BCTs in real-world clinical settings, including healthcare professional training and resource constraints.

3.5.5. Strengths of the review

This systematic review employed rigorous methodological approaches and strictly adhered to PRISMA guidelines, ensuring transparent and comprehensive reporting of the review process. The search strategy was developed through a collaborative effort of multiple researchers and implemented across three major databases: MEDLINE, Embase, and PsycINFO. This comprehensive approach was further strengthened by additional searches of reference lists and relevant organisational websites, ensuring broad coverage of the available literature.

The methodological framework was well-structured, utilising the PICOS framework to develop both search terms and inclusion criteria. The inclusion of multiple study designs, ranging from randomised controlled trials to qualitative studies, allowed for a comprehensive examination of both the effectiveness and implementation aspects of behaviour change techniques in prehabilitation interventions. The inclusion of qualitative studies enabled direct assessment of patient perspectives on acceptability, complementing the indirect evidence from adherence rates in quantitative interventions. The use of Abraham and Michie’s (2008) BCT taxonomy provided a standardised framework for analysis, enhancing the reliability and comparability of findings. The reliability of the coding process was strengthened through independent coding of 40% of papers by a second researcher. Initial agreement was high,

with discrepancies identified in three studies, which were resolved through discussion until consensus was reached. The decision to include studies regardless of their methodological quality, while still assessing and reporting their quality, demonstrated a balanced approach that minimised selection bias while maintaining transparency about study limitations. This approach allowed for a comprehensive synthesis of available evidence while providing context for interpreting findings.

3.5.6. Limitations of the review

Several methodological limitations should be considered when interpreting the findings of this review. First, title and abstract screening, full text screening, and data extraction were conducted by a single researcher (CK), which may have introduced bias in the selection and interpretation of data from the included studies. While this limitation was partially addressed through dual coding of behaviour change techniques for 40% of the papers, future reviews would benefit from dual screening and data extraction throughout the entire process.

The review was restricted to English-language publications, which may have resulted in the exclusion of relevant studies published in other languages. The focus on colorectal and ovarian cancers, while allowing for detailed analysis of these specific populations, limits the generalisability of findings to other cancer types, although this specific focus was intentional and aligned with the review's objectives. Additionally, the varied reporting quality of behaviour change techniques in the primary studies made it challenging to consistently identify and categorise BCTs. Many studies did not explicitly describe their behaviour change approaches, requiring interpretation of interventions to identify implicit use of BCTs. This limitation highlights the need for more standardised reporting of behaviour change components in future prehabilitation intervention studies. The heterogeneity of the included studies in terms of intervention design, components, duration, and outcome measures made direct comparisons challenging and limited the ability to conduct more sophisticated analyses of which BCT combinations might be most effective. Furthermore, the review was unable to account for the quality of BCT implementation, which may have influenced intervention effectiveness independently of which BCTs were chosen. Regarding acceptability, only four quantitative interventions reported adherence rates, which limits the conclusion about the relationship between BCTs and adherence-related acceptability. The two qualitative studies

were conducted by the same research group in Denmark, which may also limit the generalisability of patient perspectives to other settings and populations.

3.6. Conclusion

Prehabilitation for colorectal and ovarian cancer patients is an emerging research area that appears to improve surgical and post-operative outcomes; however, prehabilitation interventions vary considerably in their design, implementation and the behaviour change techniques they employ. While previous research and the Macmillan published guidance in conjunction with the Royal College of Anaesthetists, the National Institute for Health Research Cancer, and Nutrition Collaboration indicate that multimodal intervention (physical activity, nutritional support and psychological wellbeing) is the most effective approach, the theoretical frameworks and behaviour change techniques used to elicit both short and long-term behaviour change require further investigation.

This review has demonstrated that whilst BCTs are widely used in prehabilitation interventions, they are often not explicitly reported or systematically implemented. The most common BCTs focused on providing instructions and self-monitoring, with relatively little attention to social support and more complex techniques addressing psychological barriers. Effective studies tended to use more BCTs overall, suggesting that intervention comprehensiveness may be an important determinant of effectiveness alongside implementation quality, contextual factors, and individual patient characteristics. Regarding acceptability, qualitative evidence indicated that participants were positive towards prehabilitation interventions. BCT 12 (prompt self-monitoring) emerged as particularly important for adherence, being presented in all high-adhering interventions, whereas BCT 8 (providing instructions) alone was suggested to be insufficient. It should also be acknowledged that the relatively small number of included studies (n=16), combined with their use of different BCT combinations and limited explicit description of behaviour change techniques, makes direct comparison challenging as well as limits the conclusions that can be drawn about BCT effectiveness.

Based on the findings of this review, future multimodal prehabilitation interventions should consider implementing behaviour change frameworks and techniques in their intervention design to improve uptake and adherence. A more deliberate approach to selecting and implementing BCTs, guided by behaviour change theory and tailored to patient needs, may

enhance the effectiveness of prehabilitation interventions. In addition, working closely with patients and healthcare professionals/service providers to establish an intervention that is feasible and addresses patients' needs is essential. The absence of social support elements in current prehabilitation interventions represents a significant opportunity for improvement. Incorporating family members and peer support could enhance adherence and potentially improve outcomes, directly addressing one of the core aims of this thesis.

Chapter 4. Healthcare professionals and service providers' perspectives on optimising prehabilitation for cancer surgery patients and their family members (Study 2)

4.1. Introduction

While patient experiences remain central to prehabilitation research, healthcare professional perspectives offer unique and critical insights that cannot be learned from patient accounts alone (Beck et al., 2022). Healthcare professionals and service providers possess specialised knowledge of clinical pathways, system constraints, and implementation challenges that directly impact intervention development and effectiveness in its delivery (Fuchs et al., 2024). They observe patterns across numerous patients, allowing them to identify common barriers, facilitators, and opportunities for improvement that individual patients might not recognise (Powell et al., 2023). Therefore, healthcare professionals' and service providers' perspectives are valuable in developing effective prehabilitation protocols. Previously, healthcare professionals and service providers identified systemic barriers to prehabilitation implementation include resource allocation issues, interdepartmental communication challenges, and competing clinical priorities (Sontag et al., 2024). Multidisciplinary teams involved in prehabilitation delivery provide important insights into intervention integration within existing care pathways, which can shape more sustainable implementation strategies (Voorn et al., 2023). Their insights may also offer solutions for intervention timing and content modification that directly address patient adherence and engagement issues (Heil et al., 2022).

These insights are crucial to understand valuable perspectives on the feasibility and real-world application of evidence-based prehabilitation components. Previous qualitative studies have identified that healthcare professionals' and service providers ' perspectives are valuable for understanding implementation barriers, including knowledge gaps, resource limitations, inconsistent practice, and poor patient engagement (van der Velde et al., 2023). The importance of including healthcare professionals' and service providers' perspectives in service evaluation is well-established, as staff values and professional standards are essential elements in understanding how quality is co-produced in everyday service interactions (Farr & Cressey, 2015). In multimodal prehabilitation specifically, different professional groups must work together as a team, making their perspectives particularly important for understanding the implementation process (Fuchs et al., 2024). Healthcare professionals and service providers are ideally positioned to identify practical adaptations to interventions while

maintaining clinical effectiveness, as they possess both patient care expertise and administrative capabilities necessary to modify perioperative pathways (Engel, 2022).

Emerging qualitative evidence is exploring healthcare professionals' and service providers' perspectives on prehabilitation. Heil et al. (2022) interviewed healthcare professionals in the Netherlands about CRC prehabilitation, identifying key barriers such as evidence on cost effectiveness, inability to offer personalised intervention, complex logistics, and poor awareness among both professionals and patients. Similarly, Fuchs et al. (2024) explored German healthcare professionals' views on prehabilitation for elderly frail patients, finding that communication deficits, insufficient cooperation between professional groups, and organisational constraints were major barriers. Recently, Li et al. (2025) examined nurses' perspectives in China, highlighting that collaboration, knowledge gaps and organisational support influenced implementation. Daun et al. (2022) conducted a qualitative study in Canada with head and neck cancer patients and healthcare professionals, assessing the acceptability and perceived value of exercise prehabilitation. Healthcare professionals highlighted administrative barriers, the need for better branding and marketing to healthcare professionals, administrators and funders, and challenges in changing negative perceptions about exercise in cancer patients. Despite this emerging evidence, there remains limited understanding of healthcare professionals' and service providers' perspectives on prehabilitation within the specific context of the NHS, particularly regarding interventions that are already operational rather than in trial phases. Therefore, this qualitative study aims to identify challenges that healthcare professionals and service providers face while implementing prehabilitation protocols within their established services. Their perspectives offer valuable insights into the customisation of interventions, the integration of interdisciplinary approaches, and the development of comprehensive prehabilitation strategies tailored to diverse patient populations (Macmillan, 2020). Moreover, by examining the motivations, beliefs, and barriers perceived by healthcare professionals and service providers, this research contributes to the ongoing discourse on optimising preoperative care pathways and, subsequently, the overall experience for cancer surgery patients.

Previous research involving healthcare professionals and service providers has shown a growing interest in and recognition of the benefits of prehabilitation for cancer surgery patients (Engel, 2022; van der Velde et al., 2022; Fuchs et al., 2024). Collaborative efforts between healthcare professionals and service providers have focused on developing

comprehensive prehabilitation interventions tailored to the specific needs of cancer patients undergoing surgery (Daun et al., 2022; Heil et al., 2022). These initiatives have incorporated a multidisciplinary approach, involving physical therapists, nutritionists, psychologists, and other specialists to address both the physical and psychological aspects of patients' wellbeing (Fuchs et al., 2024; Li et al., 2025;). By encouraging collaboration among healthcare professionals and service providers, these studies contribute to the ongoing advancement of prehabilitation strategies for cancer surgery patients, aiming to optimise their overall health and recovery journey. Therefore, this qualitative study aims to identify healthcare professionals and service providers' perceived barriers and facilitators when implementing prehabilitation intervention as well as their suggestions on how to improve the service.

Research question 2: How can the existing patient-focused prehabilitation/rehabilitation for cancer surgery intervention be optimised to support cancer preventive behaviour change in cancer patients and their family members? A healthcare professional's and service providers' perspective

4.2. Methods

4.2.1. Study design and setting

One-to-one, semi-structured phone or video call interviews were conducted with healthcare professionals and service providers recruited from prehabilitation clinic based at a specific hospital in Scotland. The prehabilitation clinic at the selected hospital provides physical assessments and exercise classes to improve physical fitness for people undergoing cancer surgery (see 4.2.1.1.). As the prehabilitation clinic only constitutes of a small number of staff, the hospital name and location were redacted to insure the anonymity of the participants of this study.

All healthcare professionals and service providers were part of the prehabilitation intervention at the chosen hospital in Scotland in a direct (facilitating prehabilitation exercise classes) or indirect way (passing on information about treatment, recovery, as well as nutrition)

4.2.1.1. The prehabilitation intervention

At the time of data collection, the prehabilitation intervention at the chosen hospital in Scotland operated as follows. Patients with colorectal or ovarian cancer who were scheduled

for surgical intervention were eligible for the prehabilitation intervention. Patients were referred to the intervention after receiving their cancer diagnosis, confirmed by biopsy and being scheduled for surgery. The intervention was coordinated by physical activity leads who conducted initial assessments and guided patients through the intervention.

4.2.1.2. Initial assessment at the chosen prehabilitation clinic

All initial assessments took place on Fridays. Patients attended either alone or with a family member and underwent three standardised physical fitness tests: a grip strength test, a walking test, and a sit-to-stand test. Following the assessment, patients were invited to participate in structured exercise classes.

4.2.1.3. Exercise intervention components at the chosen prehabilitation clinic

The exercise intervention offered flexible options depending on capacity and individual circumstances. Patients could access community-based group classes, which consisted of weekly exercise sessions held at a local leisure centre/gym facility. Hospital-based group classes were also offered on a weekly basis, which facilitated circuit training sessions. Additionally, a home-based digital intervention was offered to some of the patients via a mobile application providing personalised exercise interventions. The application featured exercises selected by the physical activity facilitator for each individual patient; these were timed exercises which were demonstrated by an animated video. Patients also received notifications daily, prompting them to adhere to the intervention.

Some patients were offered access to one exercise option, whilst others could participate in multiple components (e.g., both group classes and the home app), depending on the physical activity facilitator's capacity at the time and individual patient circumstances.

4.2.1.4. Nutritional and psychological support at the chosen prehabilitation clinic

There was no formal nutritional component within the prehabilitation intervention. Physical activity facilitators occasionally discussed healthy food options or meal suggestions with participants, but this was not a structured part of the intervention. Patients who were fitted with a stoma received brief nutritional guidance from the stoma nurse as part of their clinical care.

Similarly, there was no formal psychological support component integrated into the intervention. However, physical activity leads would occasionally discuss mindfulness techniques with participants and provide referrals to cancer support centres such as Maggie's Centre or Macmillan Cancer Support when appropriate.

4.2.1.5. Intervention duration and continuity at the chosen prehabilitation clinic

Intervention duration varied considerably between patients, depending on the time available between diagnosis and scheduled surgery. Many participants transitioned from prehabilitation to rehabilitation following their surgery, maintaining continuity within the prehabilitation clinics intervention.
Family members were welcomed to attend exercise sessions alongside patients, though there was no formal policy requiring or structuring their participation. Family member involvement occurred informally based on individual patient and family preferences.

It is important to note that the intervention was not delivered as a structured trial with predetermined groups. Rather, the specific combination of interventions offered to each patient varied according to practical considerations such as facilitator availability and clinical circumstances. This pragmatic approach reflected real-world clinical delivery of prehabilitation services. Since the completion of data collection for this thesis, the intervention structure has been modified.

4.2.2. Participants

The researcher (CK) held a presentation about the study and its aims to professionals (n=8) involved with the prehabilitation intervention at the chosen hospital in Scotland. This purposive approach to sampling was done intentionally to achieve a mix of healthcare professionals and service providers. All participants who attended the presentation received a participant information sheet via email after the session commenced, detailing the study's aims, what participation would involve, how data would be used and stored, confidentiality procedure, and their right to withdraw (Appendix A.). Participants attending the presentation were then asked to reach out to the researcher if they were willing to take part in an interview. In total, 60% of attendees agreed to participate.

4.2.3 Data collection

The semi-structured interviews were conducted between March and April 2023. Interviews were arranged by email at times convenient for the participants. Before the interviews took place, a consent form (Appendix B) was presented to the participants to read and acknowledge, which had to be signed by the participants and then by the interviewer (CK). The interview (CK) also referred to the participant information sheet again (Appendix A) and gave participants the opportunity to ask any questions relating to their participation and the study itself. Participants agreed to participate and to be audio recorded by giving written consent. Notes were taken during and immediately after each interview to capture contextual information and initial reflections. The majority of the interviews took place online, via Teams, and two interviews were held in person, at the participants' workplace within the specific hospital in Scotland or the associated leisure centre in a private room to ensure confidentiality. The interview topic guide (Appendix C) was developed based on the research questions, the findings of the literature review (Chapters 1 & 2), the findings of the systematic review (Study 1). Covered topics including participants' experience of providing prehabilitation, the barriers and facilitators of prehabilitation and suggestions for improvement. Questions were open-ended to allow participants to raise issues important to them, and prompts were included to explore topics in greater depth. The guide was designed to be flexible, allowing the interviewer to follow up on developing themes and issues that arose through discussion.

Upon completion of the interviews, the recordings were transcribed and anonymised by the interviewer and primary researcher of this study.

4.2.4. Data analysis and framework

Thematic analysis was conducted following Braun and Clarke’s (2006) six-phase framework to identify and comprehend patterns within the data, aiming for an understanding of the issues discussed in the dataset. This method was selected as it provides a flexible yet rigorous approach to identify patterns within qualitative data without being tied to a specific theoretical framework. The interpretations were grounded in and substantiated by the data, employing an inductive, data-driven approach to comprehend participants' experiences and perceptions.

The analysis proceeded through the following stages:

Phase 1: Familiarisation with the interview data. Here, all interviews were transcribed verbatim by the researcher and were checked against the recording for accuracy. Those transcripts were read multiple times to achieve immersion, and initial analytical notes were taken.

Phase 2: Generation of initial codes. Each transcript was coded manually. Codes were generated inductively from data rather than using pre-existing concepts. Initial codes captured both semantic and latent meanings within the data.

Phase 3: Searching for themes. Using visual mapping techniques, codes were grouped together into potential themes, gathering all data relevant to each potential theme.

Phase 4: Reviewing themes. Themes were first checked against coded extracts and then against the entire dataset.

Phase 5: Defining and naming themes. Ongoing analysis refined the specifics of each theme, generating clear definitions and names. This was achieved through writing detailed descriptions and identifying what aspects of the data each theme captured.

Phase 6: Producing the report. The final themes were selected based on their relevance to the research question and their prevalence across the dataset. Extracts were chosen as examples to justify the results.

Following the six phases of thematic analysis outlined in the methods section, initial codes were generated. These codes were grouped into preliminary categories based on semantic similarities and conceptual relationships and were then refined into three overarching themes, which captured the key pattern across the dataset. For example, codes such as “two-week window”, “not enough time”, and “pushed pathway” made up the first theme: preparing is better than waiting.

While the analysis was conducted by one researcher, strategies were employed to ensure rigour and reduce bias. Regular meetings with the supervisory team were held to discuss and refine the analysis and developing codes and themes. Themes were checked against the original transcript to ensure interpretations remained grounded in the data.

Given the small sample size, particular attention was paid to analytical rigour. Each transcript was analysed in depth, with multiple readings, which ensured familiarity with the individual interviews. The small dataset allowed for detailed attention to each participant’s experience

while identifying patterns across professional groups. While claims of data saturation cannot be made, the analysis achieved depth over breadth, providing rich insights into this specific service context (Malterud et al., 2016).

As the data were analysed by one researcher, the breadth of interpretive perspectives might be limited. However, this approach encourages consistency in coding and deep familiarity with the data. The supervisors' input provided critical oversight and challenged interpretations where necessary.

4.2.5. Ethical considerations

The project was approved by the University of Glasgow MVSL ethics committee 200220027 (Appendix D) and complied with data protection and handling legislation. All participants received written and verbal information about the purpose of the interview study, advising them that participation was voluntary and that data would be anonymised. All participants had to give written informed consent. To ensure that anonymity was maintained, all potentially identifiable information was removed from quotations. This included removing references about patients, unique clinical cases or departments that could compromise confidentiality.

4.2.6. Research reflexivity

I believe that my age (born in 1993) and background (half German, half Greek, raised in Germany, then moving to the UK at age 17) might have influenced my analysis. Another factor that might have influenced my analysis is my own cancer experience. As a cancer survivor, I brought a personal understanding of the cancer journey to the interviews. Though it is important to note that I had no prior experience with prehabilitation services or the NHS Scotland healthcare context.

Whilst my personal cancer experience shaped my perspectives in complex ways, giving me insights into the patient journey and the physical and emotional challenge of cancer treatment, I had to remain mindful that my experience was individual and might not reflect others' experiences. Prior to the research, I held the belief that prehabilitation would likely have positive effects on patients, which might have been shaped by my own experience of feeling underprepared for treatment. This assumption was acknowledged through reflexive journaling.

My position as a research and cancer survivor, respectively, yet being an outsider to the clinical aspects of prehabilitation, created a unique dynamic for me in interviews. Participants were aware of my student status but not my cancer history; at some interviews, when it felt right to share, I would disclose this information at the end of the interview to the participants. However, I chose not to disclose this information at the beginning or in the middle of the interview to maintain professional boundaries and avoid biasing responses.

Throughout the analysis, I remained conscious of my tendency to focus on patient benefits and potentially overlook valid concerns about implementation challenges raised by staff. Regular check-ins with my supervisors helped me maintain an analytical balance, ensuring I captured both the enthusiasm for prehabilitation's potential and the practical constraints faced by healthcare professionals and service providers. My supervisor's various expertise in psychology, as well as clinical understanding, continuously challenged me to consider organisational and systemic factors.

4.3. Results

A combination of five healthcare professionals and service providers participated in this study. The interviews lasted between 25 and 35 minutes. Healthcare professionals and service providers were all female and included an ERAS nurse (Enhanced Recovery After Surgery nurse) (n=1), colorectal nurse specialist (n=1), physical activity facilitators (n=2) and a stoma nurse (n=1). Those classified as healthcare providers within the studies of this thesis are individuals with nursing or medical degrees, whereas those classified as service providers are personal trainers or physiotherapists. Table 4 lists the codes for the different participants, which they will be referenced by throughout this thesis.

Table 4.: HCP and SP interview participant codes and their associated role

Participant Code	Role
HCP1	Healthcare professional
HCP2	Healthcare professional
HCP3	Healthcare professional
SP1	Physical activity facilitator
SP2	Physical activity facilitator
SP-NI	Physical activity facilitator (not interviewed)

Note: Pseudonymous codes were assigned to protect participants' anonymity. HCP = Healthcare professional; SP = Service provider. SP-NI = Service provider - not interviewed: they are referenced throughout the thesis.

Data analysis resulted in 3 key themes, focusing on 1) preparing is better than waiting, 2) a problem shared is a problem halved and 3) structural system issues.

Each theme addresses the research question of how the existing prehabilitation intervention can be optimised to support cancer preventative behaviour change in cancer patients and family members from a healthcare professional and service provider perspective.

4.3.1. Preparing is better than waiting

Healthcare professionals and service providers consistently expressed that preparation time before surgery, however brief, was preferable to passive waiting, emphasising the importance of proactive intervention during the pre-operative window. The sentiment that "Preparing is better than waiting" was derived from the data repeatedly across all five interviews, reflecting healthcare professionals and service providers' shared frustration with the compressed time constraints they face. This emphasises the importance of time management as well as the healthcare professionals' and service providers' awareness of the short timeline between diagnosis and surgery. This challenge dominated the conversation, and participants shared practical as well as emotional dimensions of working with the restricted timeframe. One participant described their frustration: *"By the time I get told about the patient, they get all their sort of staging investigations, then they go through our multidisciplinary team meeting, which we have every Monday once all the investigations are completed. Then we get them up to the clinic as quickly as possible after that. And then it might only be a week or two weeks before they are actually going for their operation. Now that is not giving us a big window to get them active." SP1.*

This quote emphasises the importance of utilising the time leading up to surgery effectively. In the context of the conversation about optimising the period before surgery, the SP1 highlights a significant challenge but also points out a missed opportunity. The limited timeframe of a week or two weeks before the operation poses a constraint on the ability to engage patients in prehabilitation activities effectively. Healthcare professionals and service providers suggest that although a longer timeframe to implement prehabilitation might be useful, even two weeks is beneficial.

The same participant described the unpredictable nature of the referral time: *"Sometimes people are on the list [to take part in prehabilitation] because it's maybe not urgent. So, you could get anyone from two weeks before they are going to surgery. You can get someone that it's two months before their surgery. So, it could be any time. Because obviously the longer we've got, the more time we've got to get them active, get their fitness level up, all that kind of stuff. If you've only got somebody for two weeks, again, you can get them walking straight away if it's possible. You can get them doing something within those two weeks."* (SP1)

Though she acknowledged that anytime within prehabilitation is beneficial, she also pointed out the greater impact if patients are engaged in prehabilitation sooner/with more time. This underlines the critical need for healthcare professionals and service providers to implement relevant strategies and make the most out of the available time. It implies the necessity of developing efficient prehabilitation interventions that can be swiftly implemented within this narrow window. Furthermore, this comment also suggests the importance of proactive planning. This issue was explored by several participants and the HCP2 openly considered earlier referral, during the diagnostic phase: *"I think with what I might have to start doing is when I get told about a patient that might be a probable cancer (patient) and they're waiting on their investigation at that point do we refer them to the prehab clinic because then they're in the path."*. This sentiment was shared by another participant [SP2]: *"Looking at any time that we've got to be trying to focus on the patient and introducing them to something prior to them coming in because it's a huge part of their journey, isn't it? Getting them in the best condition before they come in is going to stand them in such good state for their recovery so we want to be doing what we can to get them in."*. The PA1 revealed internal discussions about extending timelines: *"There was talk of instead of having them [cancer patients] two or three weeks, maybe having them before they're properly diagnosed, so we know there's something going on, we know there is a chance of some kind of surgery happening, but they*

don't actually have a proper answer yet. But I would get them, so instead of that I would have them for six weeks, maybe at least, which gives you a longer process of getting them fitter." The balance of accepting short intervention timelines, paired with the knowledge that more time would bring greater impact, is also noted by the HCP3, who expresses scepticism about achieving truly impactful physical change in only two weeks: *"You're never going to strengthen somebody's core in two weeks"*

These viewpoints recognise that prehabilitation is not just a preparatory step; it is an integral part of the patient's entire healthcare journey, which would potentially benefit from more time. This theme demonstrates that healthcare professionals and service providers struggle with a system which rarely offers optimal preparation time. Their responses often offered pragmatic adaptations of the system setup whilst questioning the efficacy of minimal intervention timelines. Healthcare professionals and service providers expressed a consistent focus on making the most of available time to prepare patients as thoroughly as possible before surgery, reinforcing the shared view that preparing is better than waiting.

4.3.2. A problem shared is a problem halved

The idiom "a problem shared is a problem halved" highlights the healthcare professionals and service providers perceived pivotal role of family members in the prehabilitation process for cancer surgery patients; though the statement was not directly made by the participants, it was the sentiment that came across through analysing the data. All five participants emphasised the significance of involving family members throughout the prehabilitation journey. The HCP3 explained "*It's quite nice to have somebody there that can take all the information in for them or maybe say oh, we could get you there, I know how we can get you there [location of physical activity/leisure centre]*." This observation underlines the practical value of having an additional person present during consultations. Healthcare professionals and service providers described how patients struggled with information overload. The HCP3 noted spending about an hour in consultations covering anatomy, surgical procedures, and stoma care, acknowledging *"it is quite a lot for them to take in"*. Similarly, the SP2 observed that *"sometimes they've come through so much in that short time, they've had a new diagnosis, they're maybe going for treatment...it's a lot."*. SP1 and HCP3 both specifically voiced how family members helped with information retention, as SP1 remarks *"you only take so much information in. So, it's quite good to have somebody else there"*.

The analysis identified the motivational impact of family involvement as a significant factor across multiple interviews. The HCP1 acknowledges the challenges: *"So it's kind of hard to motivate people as well. If they're in with a family, you've got a better chance of doing something. The family members then take the role and encourage their relatives to do things more if it's going to help their recovery.*". This aligns with SP1, who provided a detailed observation about how partner involvement impacts attendance as well as confidence *"Would they come if their partner hadn't come? Probably not...And it may just be for a couple of weeks to get their confidence up...And sometimes it's quite nice to get them doing it together. Because then they'll go off and do something else [active] together. Like they say, 'Oh, we've joined the health walk, so we're now doing that together as well.' So, it's having that wee bit of motivation."* This extended extract shows how family involvement creates a positive cycle of shared activity which goes beyond the clinically structured prehabilitation process.

The analysis identified various motivational strategies; the SP1 described using health education as motivation, explaining to family members that activity recommendations are also beneficial for other general health benefits [outside of cancer prehabilitation]*"just to keep your physical health, basically to stop the things like diabetes, cardiovascular disease, cancer, strokes, all the scary stuff"*. The HCP2 noted that while patients and family members were initially quite apprehensive about physical activity, once they attended and met the prehabilitation coordinators, *"the feedback I've had most of them thoroughly enjoy it,"* suggesting that professional guidance and peer support (as the physical activity classes are group-based) also serve as motivation.

The HCP3 reinforced the importance of accompanied attendance from a different angle, suggesting that partners often ensure accountability. *"I think two heads are better than one. And I think, you know, if somebody is struggling, I think the other half [partner], saying, 'I'm coming with you, if you're not going to tell the nurse, then I'm going to tell the nurse.'"* This suggests that family members serve as advocates to support healthcare professionals and service providers who, at times, aren't fully informed about the patients' struggles.

However, participants also recognised that not all patients had available support and the SP2 cautioned against making partner inclusion seem mandatory: *"I don't know, I feel like if people were told that they should bring a partner, they might feel that they weren't really able to join in. It might be a barrier to some people."* This view highlights the need for inclusivity.

4.3.3. Structural and system issues

Healthcare professionals and service providers highlighted a significant structural challenge of schedule clashing between the consultations between patients and surgeons, the prehabilitation clinic, which administers testing and educates on prehabilitation, and the prehabilitation exercise classes themselves.

"The prehab clinic is on a Friday, and the class is on a Friday. That's my only issue. So, that's like a whole week since I've seen them before they get to go there (prehab class), but I would prefer to see them say, right, Friday's your class.". This remark by SP1 sheds light on the logistical hurdles within the healthcare system that hinder seamless patient care. The misalignment in scheduling creates a gap of a whole week between the clinic and the class sessions, impacting the continuity and effectiveness of the prehabilitation process. This structural issue reflects a systemic challenge where resources, including time and scheduling, are not optimised to support the patient's journey adequately. This was echoed by another interviewee: *"But if we've only got the first visit with the prehabilitation coordinator and then join a class or join a walking group, and they're only getting maybe one, that's no good" HCP2.* This concern aligned with the HCP3, who voiced: *"You're never going to strengthen somebody's core in two weeks".* Though this statement questioned the physiological possibility of achieving meaningful change in such a compressed time frame, none of the healthcare professionals and service providers further discussed the evidence base around minimal prehabilitation timelines or whether such brief interventions were still worth delivering. Instead, they appeared to accept the pragmatic sentiment the HCP1 nurse reported:*"[The head of the current prehabilitation intervention] will say even a couple of weeks is better than nothing",* which was similarly supported by the SP2: *"If you've only got somebody for two weeks, again, you can get the walking straight away if it's possible. You can get them doing something within that two weeks.".* Healthcare professionals and service providers seem to be aware of the disjointedness and are concerned about the limited time they have with patients, which echoes a broader issue in healthcare. The constraints faced by healthcare professionals and service providers due to high patient loads and limited appointment durations are also described by HCP1 nurse: "*This is where I struggle. We are doing about 140-ish stomas a year, and there is only me here, and this is where I find it difficult, where I could be spending more time with these patients. I feel as if I'm firefighting in the ward areas, so yeah, definitely another colleague.".*

Other issues that came up related to infrastructural issues, HCP1 nurse mentioned: *"The parking is horrendous. It's not the best location for patients to be coming. I think if there was some way of easier [parking], I know that we're in talks just now about trying to locate to somewhere else, but I think that's a big issue for patients to try and get parked"*. Here, the frustration of the hospital being inaccessible is addressed. This insight emphasises the need for a more patient-friendly accessibility of spaces and may suggest that alternatives in terms of location should be offered.

4.4. Discussion

The interviews with healthcare professionals and service providers established three main themes that offer insights into the implementation of an optimised prehabilitation intervention for cancer surgery patients. These themes encompass preparing for the upcoming surgery, the importance of having additional support when attending appointments with healthcare professionals, and overall challenges with the setup of the current prehabilitation intervention. The analysis reveals the complex nature of delivering effective prehabilitation services within the NHS Scotland context.

4.4.1. Time management and pre-operative preparation

The findings of the study demonstrate how healthcare professionals and service providers actively work to maximise even limited preparation periods, developing practical strategies to deliver meaningful improvements in patient fitness despite time constraints. This adaptation of prehabilitation delivery within available timeframes shows healthcare professionals' commitment to optimising patient care, even when faced with systemic limitations. Their emphasis on making the most of the pre-operative window, whether two weeks or longer, reflects a sophisticated understanding of how timing affects patient outcomes. This finding aligns with other qualitative research from similar contexts, where healthcare professionals and service providers identified short preoperative timeframes as a primary implementation barrier for prehabilitation (Heil et al., 2022; Voorn et al., 2023; Fuchs et al., 2024). Heil et al. (2022) similarly found that Dutch healthcare professionals shared complex logistic organisation and the inability to offer personalised prehabilitation interventions as key barriers, alongside low awareness of prehabilitation among both professionals and patients. Voorn et al. (2023), examining lung cancer prehabilitation, similarly reported that healthcare professionals emphasised the need for multiple professionals to facilitate referral, given the short preoperative period, concluding that prehabilitation should commence as soon as

possible after diagnosis. Fuchs et al. (2024) identified organisational barriers as most prominent among German healthcare professionals, including perceived staff shortages, communication deficits between professional groups, and insufficient cooperation across disciplines. The commonality of these findings across various healthcare systems suggests that time constraints represent a widespread implementation challenge rather than a context-specific issue. As patients are in contact with the healthcare system weeks prior for staging purposes (e.g. biopsies), it begs the question if prehabilitation should be implemented at an earlier point, before the multidisciplinary team meetings (see Figure 1) take place. While research has demonstrated that even brief prehabilitation interventions of four weeks can significantly reduce postoperative complications, the challenge identified by participants in this study is achieving even this minimal duration within current cancer pathways (Barberan-Garcia et al., 2018; Molenaar et al., 2023). This highlights a gap between evidence for intervention effectiveness and the practical realities of implementation within time-constrained healthcare systems.

4.4.2. The essential role of family support

Healthcare professionals and service providers clearly recognise that the patient's journey is not solitary but shared with their support network. Staff described that active involvement of family members strengthens the effectiveness of prehabilitation interventions, ensuring that patients receive comprehensive support both emotionally and practically. It emphasises the importance of considering the patient within the context of their family and social support system, reinforcing the collaborative approach between healthcare professionals and service providers, patients, and their families in optimising the prehabilitation experience for cancer surgery patients. The data suggest that partners not only provide encouragement but also serve as active participants, enhancing the patient's motivation and adherence to prehabilitation interventions. Their involvement was reported to create a supportive environment that goes beyond the formal prehabilitation sessions, permeating into the patients' daily lives and activities. This collaborative approach, involving the patient and their partner, may contribute to better preparedness and improved outcomes for cancer patients. This data has explored the importance of social support within these interventions. Shen et al. (2024) conducted a thematic synthesis of qualitative prehabilitation research, synthesising findings from 26 studies which comprised of 377 patients, 51 caregivers, and 156 healthcare providers across nine countries, including the UK, the Netherlands, the USA, and Canada. The review mapped findings against the COM-B model to identify barriers and facilitators to

prehabilitation engagement, and its analysis identified social support, including family, clinical, and group support, as a key facilitator for patients' engagement in prehabilitation interventions. This highlights the social context of patients and their diagnosis and disease management, suggesting that the support system surrounding patients may be equally as influential in achieving intervention effectiveness. Family support, though acknowledged as beneficial, remains an under-explored component in prehabilitation interventions, suggesting an important area for future intervention design and delivery.

4.4.3. Addressing structural and system challenges

The healthcare professionals and service providers identified significant structural and system issues that affect prehabilitation delivery. Optimising scheduling to ensure continuity of care and allowing healthcare professionals and service providers more time with patients proved to be essential factors. These findings are consistent with qualitative research within the prehabilitation for cancer patient context (Fuchs et al., 20234). Heil et al. (2022) examined the implementation of prehabilitation interventions in CRC cancer patients, finding that complex logistics, lack of intervention coordinators, and insufficient physician leadership were all reported by healthcare professionals and service providers, and these were said to hinder intervention success. Notably, healthcare professionals and service providers in this study appeared to adapt to these system-imposed constraints rather than challenging the evidence base for shortened intervention durations. This acceptance of pragmatic limitations, despite professionals' awareness that longer intervention may be more effective, reflects a broader tension between evidence-based practices and real-world implementation realities. A realist review by Sontag et al. (2024) synthesised implementation experiences of prehabilitation for frail patients in routine healthcare across 34 studies. The review found that successful prehabilitation implementation requires attention to context-specific organisational factors, such as adaptation to local healthcare systems, as well as adequate organisational infrastructure, including clear allocation of responsibilities within multidisciplinary teams and individualisation of programmes to meet patient's needs. Integrating insights from the research literature as well as the data of the interviews, a patient-oriented system may not only enhance the effectiveness of prehabilitation but also improve overall patient experiences and outcomes. The analysis underlines the importance of addressing these challenges to create a more supportive and patient-focused prehabilitation environment for cancer surgery patients as well as their families.

These challenges extend beyond simple resource limitations to include complex organisational factors such as clinic scheduling, staffing levels, and infrastructure accessibility. The experiences shared by healthcare professionals and service providers at a hospital in Scotland highlight how these systemic issues directly impact their ability to deliver optimal prehabilitation services. Their insights suggest that successful prehabilitation requires not just clinical expertise, but also careful attention to organisational and practical implementation factors. This aligns with past research, showing that different professional groups identify interconnected barriers. In a study by Li et al. (2025), nurses emphasised inadequate collaboration and are asking for specific role development. While Zhang et al. (2025) found that multidisciplinary teams identify insufficient communications between professional groups and lack of standardised referral pathways. Powell et al.'s (2023) examination of the NHS Greater Manchester Prehab4Cancer intervention specifically identified key barriers that healthcare professionals and service providers faced when referring patients to the intervention; competing information priorities at the stage of diagnosis were a key finding. The challenge of timing referrals close to the diagnosis, while managing information overload as well as the need for follow-up contact when referred, was noted. These barriers are similar to the findings with implementation challenges identified due to scheduling conflicts. The findings, combined with the Manchester-based conclusions, may provide relevant insight for the overall NHS context, particularly regarding the practical challenges of integrating prehabilitation referrals into existing cancer care pathways.

4.4.4. Strengths and limitations

This study's primary strength lies in its examination of healthcare professionals and service providers experiences within an operational NHS prehabilitation service. While focused on a single hospital site, the inclusion of diverse healthcare professional roles (ERAS nurse, colorectal nurse specialist, physical activity facilitators, and stoma nurse) provided multiple perspectives on intervention delivery and implementation challenges. The findings from the prehabilitation clinic offer valuable insights for developing and improving similar services within NHS Scotland and the broader UK context, particularly given the limited qualitative research examining operational prehabilitation interventions rather than trial-based interventions (Powell et al., 2023). The study addresses a critical gap by exploring healthcare professionals' perspectives on interventions already embedded in routine care, providing insights more directly applicable to real-world implementation.

Several limitations must be acknowledged when interpreting the findings of this qualitative study. The sample size of five participants is small, which limits the breadth of perspectives captured. The concept of information power proposes that sample size adequacy depends on five dimensions: the narrowness of study aims, sample specificity, use of established theory, quality of dialogue, and analysis strategy (Malterud et al., 2016). The study demonstrates strength in some of these dimensions; for example, the study's aims were narrow, focusing specifically on exploring healthcare professionals' and service providers' thoughts on barriers and facilitators of a prehabilitation intervention. As the sample was highly specific, consisting only of individuals directly involved with prehabilitation delivered by the hospitals prehabilitation clinic staff, and represented diverse professional roles within the prehabilitation pathway, it provided heterogeneous perspectives despite the small number. It should however, be noted that though a variety of healthcare professionals and service providers participated, insights from other significant professionals, such as surgeons or oncologists who refer patients were not captured. In regard to dialogue quality, the interviews (ranging from 25-35 minutes) produced detailed accounts as participants were open and focused, providing specific examples from their clinical practice rather than general or superficial responses. This is reflected in the quotations presented in the findings, where participants offered concrete examples of implementation challenges and nuanced reflections on both barriers and facilitators of prehabilitation. The inductive thematic analysis approach, with multiple readings of each transcript, allowed for detailed analysis of individual experiences while identifying patterns across these professional groups. However, the study's information power is limited in the absence of an established theoretical framework, such as the COM-B model or the Consolidated Framework for Implementation Research (CFIR), which could have guided the data collection.

Furthermore, considering the practical constraints of the setting, as prehabilitation clinic has a limited number of staff, with only three to five individuals directly facilitating exercise prehabilitation and nutritional support; the sample represents the key professional groups involved in service delivery. However, limitations remain as the small sample size constrains the generalisability of findings and may not capture the full range of experiences across all professional groups involved in overall prehabilitation delivery (dietitians, psychologists, surgeons). All participants were female, which may have influenced the perspectives shared and limits understanding of whether male healthcare professionals/service providers experience or perceive implementation challenges differently. The sample, though

purposively selected, as participants responded to an invitation, potentially introducing bias toward individuals with stronger opinions about or greater engagement with the prehabilitation intervention. This study aimed to provide initial insight into under-researched areas within NHS Scotland, serving as a foundation for future research rather than providing comprehensive, nation-wide insights.

The single-site nature of this research may limit the transferability of findings to other NHS Scotland hospitals or UK healthcare settings with different organisational structures, resources, or patient populations. The hospital in Scotland's prehabilitation clinic which was used in this study, represents an established physical activity intervention, and findings may not reflect the barriers and facilitators relevant to settings attempting to establish new prehabilitation services. More established prehabilitation interventions may also face different barriers than those established in this qualitative study.

Methodologically, thematic analysis was conducted by a single researcher, which might limit the interpretive breadth and means that alternative readings of the data were not systematically explored. While regular supervision meetings provided some oversight and critical challenge to interpretations, the absence of double-coding or independent verification of themes represents a limitation. The researcher's position as a cancer survivor, while providing insider understanding of patient experiences, may have introduced unconscious bias toward emphasising patient benefits and potentially undervaluing legitimate organisational and resource concerns raised by healthcare professionals/service providers. Although reflexive journaling was employed to acknowledge and manage this positionality, the influence of the researcher's perspective on data interpretation cannot be entirely eliminated.

Despite strong evidence that multimodal prehabilitation reduces complications, shortens hospital stays, and improves functional outcomes across multiple cancer types implementation into routine practice remains challenging (Moran et al., 2020; Lambert et al., 2021; Waterland et al., 2021). Qualitative research consistently identifies organisational and systemic barriers, including scheduling conflicts, communication challenges, and insufficient staffing, that significantly hinder effective implementation into cancer care pathways (Heil et al., 2022; Fuchs et al., 2024; Sontag et al., 2024). This study's findings align with these broader patterns, suggesting that demonstrated intervention effectiveness does not guarantee successful service delivery. The gap between evidence and practice highlights the critical

need for implementation research that examines not just whether prehabilitation works, but how it can be effectively integrated into existing healthcare systems with limited resources and competing priorities.

The findings from this study have several important implications for healthcare professionals and service providers, service managers, and policymakers seeking to implement or improve prehabilitation services for cancer surgery patients. First, the consistent identification of time constraints as a primary implementation barrier suggests that healthcare systems should consider earlier referral to prehabilitation interventions, potentially at the point of diagnostic investigation rather than waiting for multidisciplinary team meeting confirmation. This could extend the prehabilitation window and reduce pressure on staff to deliver comprehensive interventions in compressed timeframes. Healthcare professionals and service providers should explore opportunities to integrate prehabilitation referrals into existing cancer pathway protocols to reduce reliance on individual clinician memory in busy consultations.

Second, the critical role of family support identified by all participants suggests that prehabilitation intervention design should explicitly incorporate family members and partners, whilst potentially also offering inclusion of friends for support. This could include encouraging accompanied attendance at initial assessments, providing information materials designed for both patients and support persons, and considering the needs of patients without available family support through alternative support mechanisms such as peer mentoring or enhanced clinical contact. Intervention and referral materials should emphasise the benefits of partner involvement to normalise accompanied attendance.

Third, the structural and organisational challenges highlighted by participants, including scheduling conflicts between clinics and exercise classes, limited staff time, and infrastructure barriers, require system-level solutions rather than individual adaptations. Service managers should conduct workflow analyses to identify opportunities for better scheduling coordination, consider increasing staffing for prehabilitation coordination roles, and address practical access barriers such as parking and transportation to maximise patient attendance. The feasibility of delivering prehabilitation in community settings closer to patients' homes or online, rather than solely in hospital locations, should be explored.

Fourth, the findings highlight the importance of multidisciplinary team coordination and communication for successful prehabilitation delivery. Healthcare organisations should

establish formal communication channels between different professional groups involved in prehabilitation, implement shared documentation systems, and create regular multidisciplinary meetings to discuss individual patient progress and address implementation challenges collectively. Clear role delineation and care pathways that specify which professional is responsible for each aspect of prehabilitation delivery at each stage could reduce confusion and improve intervention coherence.

Finally, the evidence-practice gap identified in this study highlights the need for ongoing implementation research that moves beyond demonstrating clinical effectiveness to examining how evidence-based interventions can be successfully embedded in routine healthcare delivery. Healthcare organisations implementing prehabilitation should build in evaluation mechanisms to monitor not only patient outcomes but also implementation fidelity, staff experiences, and organisational barriers to sustainability.

4.4.5. Future directions

Future research should address the limitations of this study by examining prehabilitation implementation across multiple NHS sites with varying organisational structures and resource levels to identify common versus context-specific barriers. Larger studies with purposive sampling to ensure representation across all relevant professional disciplines, including dietitians, psychologists, surgeons, and administrative staff, would provide more comprehensive understanding of multidisciplinary implementation challenges.

The role of family support in prehabilitation adherence and effectiveness requires dedicated investigation, including examination of optimal approaches to family integration, support strategies for patients without available family members, and whether family involvement differentially impacts outcomes for particular patient subgroups. Implementation research employing established frameworks such as the CFIR (Damschroder et al., 2009) could systematically identify modifiable barriers and facilitators to inform intervention strategies.

Finally, longitudinal research examining the sustainability of prehabilitation interventions over time, factors influencing intervention continuation versus abandonment, and strategies for maintaining implementation fidelity in resource-constrained healthcare settings would support long-term integration of evidence-based prehabilitation into standard cancer care pathways.

4.5. Conclusion

This qualitative research provides insights into the implementation and execution of prehabilitation intervention from the perspective of healthcare professionals and service providers. The findings call attention to both the potential benefits of prehabilitation and the practical challenges of delivering the intervention within the NHS setting. Within the interviews, healthcare professional and service providers demonstrated their commitment to maximising the pre-operative window, knowing how impactful prehabilitation can be, whilst also emphasising the role of family support in enhancing intervention effectiveness. The findings suggest that several key areas of prehabilitation interventions require development. The research indicates a need for earlier identification and engagement of patients in the prehabilitation process, alongside greater integration of family support into these interventions. Furthermore, improved alignment of clinical schedules and resources, coupled with enhanced accessibility of prehabilitation services, emerged as important factors for service improvement.

This study may inform future discussions and evidence-based advancements in the field of prehabilitation. Research building on these findings might inform future studies discussing the views of cancer patients who participated in the current prehabilitation intervention. Including patients in future research might prove beneficial in improving services as well as potentially increasing uptake. These insights from healthcare professionals and service providers at the hospital in Scotland contribute to the understanding of how to effectively implement prehabilitation services within the NHS. Their experiences emphasise that successful prehabilitation requires attention to both clinical care and practical implementation factors, including the role of family support and organisational systems. The findings emphasise the importance of developing comprehensive, accessible, and well-supported prehabilitation interventions that can effectively serve cancer surgery patients while working within the constraints and opportunities of the NHS framework.

Chapter 5. Cancer patients’ and family members’ perspectives on optimising prehabilitation and enhancing family inclusion (Study 3)

5.1. Introduction

While multimodal interventions have shown positive results in improving functional capacity and quality of life (Durrand et al., 2019; Molenaar et al., 2022), the role and experience of family members in supporting patients through prehabilitation remains largely unexplored. Family members often serve as primary carers and can significantly influence patients' engagement with healthcare interventions, yet their perspective is rarely incorporated into intervention development and evaluation. Furthermore, a family member's diagnosis of cancer can also prompt reflection on one’s own health behaviours and encourage the adoption of more preventative health behaviours.

This study draws on Family Systems Theory, as outlined in Chapter 1 (Section 1.9.2.), recognising that patients’ prehabilitation engagement often occurs within interconnected family systems (Bowen, 1978). This theoretical lens informed both the decision to interview patient-family member dyads and the interpretation of findings related to family dynamics.

Limited research has examined why patients disengage from prehabilitation and how family dynamics contribute to this. Clemons et al. (2024) conducted a qualitative study interviewing 11 patients in the United States who had declined participation or demonstrated low adherence to a prehabilitation intervention for major abdominal surgery. The findings identified seven barriers to participation across three themes: communication failure (poorly timed recruitment, misconceptions about dietary recommendations), external barriers (competing priorities, lack of family alignment), and beliefs about prehabilitation (perceived lack of benefit, concerns over intervention components, belief that prehabilitation helps others but not themselves). Lack of family alignment emerged as a barrier, with participants describing the inconvenience of preparing separate meals when family members had different food preferences. The authors concluded that involving family, friends, and caregivers in the prehabilitation process may reinforce adherence. However, it should be noted that Clemons et al. (2024) focused on patients who did not engage or struggled to adhere, whereas understanding perspectives from patients and family members who do participate in prehabilitation may provide complementary insights into how family inclusion could support sustained engagement.

Smyth et al (2024) conducted a mixed-methods evaluation of exercise prehabilitation, surveying 244 participants (cancer patients, family members, and healthcare professionals) and interviewing 31. Only 20% of cancer patients had actually participated in exercise prehabilitation; the remaining 80% were asked about the acceptability of a hypothetical intervention, and family members had not participated in prehabilitation themselves. All three groups reported high acceptability of the intervention. Participants highlighted psychological benefits, particularly feeling more in control of their situation, but also identified challenges, which included travel burden, frequency of hospital appointments, and the demands of the illness itself. These findings suggest that interventions should address practical barriers where possible and that perspectives from patients and family members who had directly experienced prehabilitation may offer additional insights.

This chapter aims to explore the experiences of cancer patients who participated in a prehabilitation intervention, and their family members, in order to identify opportunities for intervention optimisation and enhance family inclusion. This study addresses Research Question 3: How can the existing patient-focused prehabilitation/rehabilitation for cancer surgery intervention be optimised to support cancer preventative behaviour change in cancer patients and their family members from a cancer patients and family member perspective.

5.2. Methods

5.2.1. Study design

This study employed a qualitative design, using semi-structured interviews. A dyadic interview approach was used, whereby cancer patients were interviewed alongside one of their family members to capture both perspectives. In the invitation letter, the option was given to include family members, friends, or carers. Interviews were conducted via phone, video call, or in person, according to the participant's preference.

5.2.2. Recruitment

Participants were recruited from a prehabilitation clinic based at a hospital in Scotland, within NHS Greater Glasgow and Clyde. A full description of the prehabilitation clinic including its patient population and intervention components, is provided in Chapter 4 (Section 4.2.1.1.). As the prehabilitation clinic only constitutes of a small number of staff, the hospital name and location were redacted to insure the anonymity of the participants of this study.

Recruitment took place between December 2023 and August 2024. Patients were eligible if they were aged 18 or older, were diagnosed with CRC or ovarian cancer, and were enrolled in prehabilitation at the chosen hospitals prehabilitation clinic within the previous 12 months. Patients only undergoing chemotherapy or radiation were excluded, as this study focused specifically on prehabilitation before surgery. Patients who received chemotherapy or radiation after surgery were eligible. As the study was not able to offer translators due to limited funds, all participants needed to be able to communicate fluently in English. Family members, carers, or close friends of patients were eligible if they were aged 18 or older and fluent in English. The aim was to recruit 10 patient and family dyads, with purposive sampling to achieve balance of female and male patients, and variation of CRC and ovarian cancer.

Over 50 patients were invited to participate, invitations which included an invitation letter (Appendix E) and participant information sheet (cancer patient - Appendix F / family member Appendix G), were sent out by members of the clinical team of the chosen hospital in Scotland and the prehabilitation clinic staff. The participant information sheet outlines the purpose of the study and what would be required of the participants. It also mentioned that a £20 pound voucher would be offered to participants to thank them for their time and input. Those interested in participating were asked to contact the researcher (CK) directly, via phone or email, to arrange an interview date and location or ask more questions.

5.2.3. Interview participants

Fourteen participants were recruited, eight cancer patients and six family members. Six patients were interviewed as dyads with a family member; two patients were interviewed alone. Of the two patients interviewed individually, one chose not to involve a family member, and the other did not have a family member they felt close enough to invite.

5.2.4. Data collection

For telephone (n=2) and video call (n=1) interviews, participants and the interviewer were in their own homes. In-person interviews were conducted in private rooms at either location (Hospital=4; University of Glasgow=1).

Prior to each interview, the researcher (CK) reviewed the participant information sheet with participants and answered any questions. Written informed consent was obtained from all

participants before the interview commenced. All participants agreed to audio recordings. A topic guide (Appendix H) was used for the semi-structured interview and aimed to focus on participants' ideas and perceptions of the prehabilitation intervention. It was developed based on findings from the literature review (Chapter 1 & 2), the systematic review (Study 1), and the interviews with healthcare professionals (Study 2).

The interviews were conducted between February 2024 and August 2024 and lasted between 40 and 127 minutes. All interviews were audio recorded and transcribed verbatim by the primary researcher (CK).

In dyad interviews, cancer patients tended to contribute slightly more to discussions than family members, with an approximate 60% (patient) to 40% (family member) split. Family members actively integrated themselves into the conversation, and interestingly, individual interviews with patients alone were not necessarily shorter in duration than dyad interviews (see Table 5). When the researcher (CK) noticed either participant was quieter, questions were directed to them specifically, to encourage and prompt engagement. Through this approach, both participants appeared to become more comfortable and confident as the interview progressed, with conversations often easing into a natural flow in the middle and towards the end of the interview. This pattern of slightly unequal but collaborative contribution in patient-family dyads has been observed in previous dyadic interview research (Morgan et al., 2013; Szulc and King, 2021)

5.2.5. Data analysis and theoretical framework

The researcher familiarised herself with the interviews through transcribing the data and listening to the interviews multiple times to check for accuracy of the transcript. This process also allowed for familiarisation with the data. The researcher conducted thematic analysis to identify and comprehend patterns within the data (Braun and Clarke, 2006). The interpretations were grounded in and substantiated by the data, employing a mix of deductive and inductive approaches to comprehend participants' experiences and perceptions. Anonymised transcripts were printed, and initial codes were generated using highlights and annotations. Codes were then grouped together into preliminary themes. These themes were then reviewed to assess their relevance to the research question, and themes that substantively addressed the research question were retained.

Once themes were developed, the COM-B model (Michie et al., 2011) was used to further the interpretation and map findings to the framework. This mapping was conducted using an Excel spreadsheet. The data were organised by each aspect of prehabilitation (physical activity, nutrition, psychological support) and analysed through the three key factors: capability, opportunity and motivation. The approach of using both inductive and deductive analysis aimed to strengthen the qualitative findings. The initial inductive approach through the thematic analysis allowed the researcher to discover patterns that might have been missed if only a deductive approach had been applied. Following the theoretical framework of the COM-B model, applying the initial inductive analysis offered a more structured understanding of how capability, opportunity, and motivation influence participants' prehabilitation experiences.

(Please find the reflexivity statement in Chapter 4, section 4.2.6.)

5.2.6. Ethical considerations

The project was submitted to IRAS (Project ID:312935), complying with data protection and handling legislation. Ethical approval was granted by the Health and Social Care Research Ethics Committee A (HSC REC A; reference 23/NI/0137; Appendix I). Site approval was confirmed by the NHS GG&C Research and Innovation (by UGN23ON094; Appendix J). All participants received written and verbal information about the project, advising them that participation was voluntary and that data would be anonymised. All participants provided written informed consent. To ensure anonymity was maintained, any contextual information which might identify participants was removed from quotations.

5.3. Results

5.3.1. Characteristics of participants

Semi structured interviews were conducted with six patient family member dyads and two patients totalling 14 participants. Seven of the eight cancer patients were male, and one was female. Of the six family members, two were male, and four were female. All cancer patients took part in the prehabilitation intervention, followed by surgery and chemotherapy and/or radiotherapy. Though CRC and ovarian cancer patients were eligible, all participants had various stages of CRC. Participants were at varying stages in their cancer journey at the time

of interviews, ranging from those currently in prehabilitation to those who had completed surgery and chemotherapy/radiation. Table 5 shows the participant characteristics.

Table 5.: Participant characteristics

Participant ID	Role	Gender	Cancer Type	Interview Format	Interview Mode	Duration (minutes)
PT1	Patient	Male	Colorectal	Dyad	In-person (H)	127
FM1	Family member	Female	-	Dyad	In-person (H)	127
PT2	Patient	Male	Colorectal	Dyad	In-person (UofG)	59
FM2	Family member	Female	-	Dyad	In-person (UofG)	59
PT3	Patient	Male	Colorectal	Dyad	In-person (H)	42
FM3	Family member	Male	-	Dyad	In-person (H)	42
PT4	Patient	Female	Colorectal	Dyad	In-person (H)	44
FM4	Family member	Male	-	Dyad	In-person (H)	44
PT5	Patient	Male	Colorectal	Dyad	In-person (H)	40
FM5	Family member	Female	-	Dyad	In-person (H)	40
PT6	Patient	Male	Colorectal	Dyad	Online (Teams)	52
FM6	Family member	Female	-	Dyad	Online (Teams)	52
PT-S1	Patient	Male	Colorectal	Individual	Phone	48
PT-S2	Patient	Male	Colorectal	Individual	Phone	41

Note: H=Hospital; UofG=UniversityofGlasgow.

5.3.2. Thematic analysis findings

The thematic analysis addressed the research question by exploring two key aspects, intervention optimisation and family inclusion. Three themes addressed how the current prehabilitation intervention could be optimised, technology-enhanced interventions, comprehensive support system integration, and structured family inclusion. Table 5.1. presents an overview of all themes and subthemes.

Table 5.1.: Cancer patients and family members' perspective on optimising family-inclusive prehabilitation intervention

Theme	Sub-theme	Key Focus
1. Technology-enhanced personalised physical prehabilitation		Digital apps, remote monitoring, automated reminders, and technological accessibility
2. Comprehensive support integration	2.1. Nutritional guidance	Gaps in dietary information, post-surgical guidance needs, collaborative approaches
	2.2. Psychological support	Variable receptiveness, cultural/generational factors, timing of support needs
3. Structured family inclusion	3.1. Family inclusive flexible physical activity participation options	Optional family participation in exercise sessions
	3.2. Collaborative decision-making	Family attendance at appointments, shared information processing, communication patterns, privacy considerations
	3.3. Family member support and education	Nutritional education needs, caregiver psychological wellbeing

5.3.2.1. Theme 1: Technology-enhanced personalised physical prehabilitation

This first theme was identified across multiple interviews and encompassed participants' experiences with the digital application and monitoring tools used during their prehabilitation

intervention. Participants expressed generally positive experiences with technology-based tools used during their physical prehabilitation. Digital applications were identified as valuable components that enhanced engagement and adherence to prescribed exercise regimens. One patient (PT2) highlighted how the app provided structure and guidance: *"I was using the app, which I found really quite helpful, because it guides you through it, it timed everything, so you knew how long you were supposed to do it for and so on."*. The automated reminder features of the apps were particularly valued for promoting consistent engagement and accountability. As described by participant PT3: *"So he [SP-NI] gave me that to work with again, so that just pops up on your phone, so if you've not done it that day, it just keeps pinging up on your phone, kind of thing, like so it makes you go and do it."*

An important motivational aspect of the technology was the remote monitoring capability, which created accountability for participants. As participant PT5 explained: *"He [SP-NI] was monitoring it, so I think he could, I'm assuming he could monitor what I was doing, to see that I was keeping up with it. So that was an incentive."*

However, some participants raised concerns about technological accessibility across different demographics, noting: *"I'm not sure if the app would work for somebody older, though."* This highlights an important consideration for technology-enhanced interventions regarding their suitability for diverse patient populations.

Several participants independently adopted additional digital tools to monitor and enhance their physical activity. Participant PT-S1 described: *"I bought a Fitbit, and I walk as much as I can. I try and do five miles a day. The weather's been a bit unclear recently to do that, but I've even found myself going to the shopping mall just to try and get my steps in."*. Beyond the immediate benefits, participants recognised potential long-term advantages of technology-supported exercise continuation post-surgery. Participant PT3 reflected: *"Yeah, and even if it was the app that was kept going for the exercise side of things after the operation, surely that's got to be beneficial long term for the percentage cut down of the cancer reoccurring at some point if you're doing something to help it continue, cutting that risk again."*

5.3.2.2. Theme 2: Comprehensive support integration

Participants expressed a need for clear healthcare communication and more comprehensive support, particularly regarding nutritional guidance and psychological support.

Theme 2, sub-theme 1: Nutritional guidance

A significant gap identified by participants was the lack of structured, personalised nutritional information both before and after surgery. As one participant (PT1) expressed: *"There was no other information given before surgery, and when I was released, unfortunately."*. This participant further elaborated on the absence of specific dietary guidelines: *"We weren't sent away with a nutrition sheet saying this is what you should have, this is the food you should be eating under the circumstances, these are the foods you should be eating to build yourself back up again. There was none of that."*. In response to this gap within the prehabilitation intervention, several participants took the initiative to seek out nutritional information themselves. One family member (FM2) who handled cooking responsibilities noted: *"We did download that menu thing [they found on a cancer website] which was of great help to me actually because I do all the cooking."*

When nutritional guidance was provided, participants particularly valued the collaborative, non-prescriptive approach that empowered them to make informed dietary choices rather than simply following rigid guidance. Participant PT6 highlighted this consultative style: "*So again, just having somebody there telling you or going over what you're doing, and right, can we maybe change this this week, can we maybe do that. Not, he [SP-NI] never ever told you. Or [SP1] never ever told you [what to do]. It was could we maybe, or could you try."*. This collaborative approach to nutrition education appeared more effective than directive advice in supporting dietary behaviour change. The nutritional component of prehabilitation appeared to catalyse positive dietary changes for some participants. As PT-S2 reported: *"I've brought fish back into my diet and stuff like that. It has helped. It [talking to SP-NI] made me do it."*

Another participant (PT3) emphasised the educational value of the nutrition mentioned in the session they attended: *"And on the first session again, a lot about food and stuff, nutrition, that kind of thing, which was really helpful. I didn't look into food in that much detail until now."*. However, participants also noted confusion about specific dietary restrictions, as PT5 explained: *"You're supposed to be on a low-fibre diet, but you don't really know for how long and also you don't know what things are really dangerous to eat."*

Theme 2, sub-theme 2: Psychological support

Participants expressed varying needs and receptiveness to psychological support. Cultural and generational factors influenced some participants' willingness to engage with mental health services. As participant PT5 in his 60s reflected: *"Men of my generation anyway have kind of grown up not wanting to display weakness."*. This participant mentioned being introduced to coping strategies: *"[SP-NI] came on to me a bit about mindfulness... he was saying how he gets up in the morning before the rest of the family and he goes and stands by the back door [to meditate]."* However, PT5 did not adopt mindfulness practices himself, illustrating how patients may acknowledge the value of psychological strategies while choosing not to implement them personally. Therefore, the value of psychological support appeared to vary across different contexts and times in the treatment journey. Participant PT4 observed the benefits for others: *"I watched people there and they were getting a huge amount out of it at the Maggie Centre, particularly very elderly gentlemen on their own. And I think it was huge for them."*. From the same interview, the cancer patient noted a critical gap in psychological support during the rehabilitation phase: *"I think for me... this point is the hardest... psychologically this point [after surgery and chemo] is where it really needs it [psychological support] in rehab where you're suddenly going from this fabulous attention you get everybody there, nurse specialists and all the rest of it and then suddenly three months on from the end of your chemo there's still things happening."*

This observation suggests that the intensive support and attention patients receive during the prehabilitation and active treatment phases may buffer against psychological distress, reducing the perceived need for formal psychological interventions during this period. However, the transition to post-treatment rehabilitation emerged as a particularly vulnerable time when psychological support needs intensified but formal support structures diminished. This finding has important implications for the timing and duration of psychological support provision within cancer care pathways. Some participants, like PT6, expressed a preference for self-reliance: *"I can do this myself kind of thing do you know that way?"*. This preference for self-reliance may reflect both a personal coping style and broader cultural norms around independence and self-sufficiency. While self-reliance can be a strength that supports resilience, it may also prevent individuals from accessing psychological support that could be beneficial. This highlights the challenge for prehabilitation intervention in engaging patients who value independence, suggesting that psychological support may need to be framed as enhancing self-management capabilities rather than addressing weakness or inability to cope. Similarly, participant 59DD dismissed the need for psychological support: *"I kind of thought,*

I don't need that, I'm okay, I'm dealing with this. I'm here to show off, I'm not panicking.". These varying perspectives highlight the importance of tailored psychological support that recognises individual differences in coping styles and needs at different stages of the cancer continuum. While patients' psychological support needs varied considerably, the psychological wellbeing of family members was derived from the data as an equally important and distinct concern, discussed in detail in section 5.3.2.3.1.

5.3.2.3. Theme 3: Structured family inclusion

The inclusion of family members into the prehabilitation process developed as a key theme, with participants highlighting various aspects of family involvement that either enhanced or could potentially improve their experience.

Theme 3, sub-theme 1: Flexible physical activity participation options

Participants emphasised the value of having flexible options for family members to participate in physical activities offered through the exercise classes by the prehabilitation intervention. Some family members actively joined the exercise sessions, which appeared to benefit both the patient and the family member. As one family member (FM1) explained: *"Well, when he [PT1] first communicated with [SP2], she said you know, if your wife wants to come as well. And I decided to do it, A, because I needed a bit of exercise myself, but B, also to encourage him [PT1]."* This same family member noted the mutual benefits of exercising together: *"So, when we go, we exercise together because we're always sort of put into groups to do the circuit training. So, we exercise together, and I actually find that helpful, and I think [PT1] does too.".* However, participants also recognised that family participation should remain optional rather than mandatory. As patient PT-S2 noted: *"I think give them the opportunity to come along, but as I say, probably we [him and family member] didn't do anything that way because I go and do things myself when I used to go to the gym, go and swim, and I just go and do it myself."*

One family member (FM3) highlighted how joint participation could encourage mutual accountability and care: *"And then it also becomes a thing of like caring for one another on a different level right so you know maybe if [PT3], you one day don't want to do it but I [FM3] then like oh no come on let's just go for like a 10 minute walk or whatever and then vice versa you're there to kind of motivate and look out for each other's health."*

Theme 3, sub-theme 2: Collaborative decision-making

The analysis gathered family members' attendance at medical appointments as an important aspect of collaborative decision-making, with particular relevance for prehabilitation engagement and adherence. Many family members consistently attended appointments to provide support and help process information, which includes an explanation by clinicians of why prehabilitation is offered to patients. As one family member (FM1) described: *"I did go to every appointment that [PT1] had, I think bar one. I went with him [PT1], obviously, to know what was going on and also to support him in every which way. I didn't ever really want him to be in a situation he was on his own and no one to talk to."*

This collaborative approach was particularly valuable for prehabilitation, where the novelty of the intervention meant patients were receiving substantial new information about the exercise regimen, which benefited from shared processing for information retention. Their presence during prehabilitation consultations enabled them to better support patients' engagement with prescribed activities at home. The value of having two perspectives during consultations was emphasised by another cancer patient who wasn't married, but had his sister come along for appointments at the beginning of his cancer continuum (PT-S1): *"I think there's two people in the room, you understand things differently, or you remember things differently or, you know."*. This was particularly valuable during prehabilitation intervention briefings, where exercise instructions, safety precautions, and progression plans were explained. Having two people process this information improved retention of key intervention details and helped ensure correct execution of exercises at home. Patient PT-S2 acknowledged the reassurance of having family support available: *"I think it's always beneficial because there's somebody there if you need them."*. Family members could also provide healthcare professionals with additional perspectives on the patient's condition. As one family member (FM5) explained: *"He [SP-NI] did ask me questions about your [PT5] mental health, what kind of person he was... I think it was important that I was there because I can be objective about him."*. This objective perspective from family members was valuable for prehabilitation intervention tailoring, as it helped healthcare professionals understand patients' typical activity levels, motivation patterns, and potential barriers to engagement. For prehabilitation intervention specifically, this collaborative decision-making facilitated informed consent to participate, helped participants to accurately execute home-based

exercises, and enabled intervention tailoring based on a fuller understanding of patients' circumstances.

Family member FM4 highlighted the practical benefits of having both patient and family member present at important consultations: *"Being together at crucial meetings, both of us went. We'd hear different things, you know, so when we come out, I can remember bits and so on. I was focused on certain bits of things and then [PT4] picked up a few things."*. However, some patients indicated tendencies to shield family members from the full extent of their condition. As patient PT-S1 revealed: "*I tend to be... This is not a strength; this is a weakness, but I tend to keep things to myself. I don't share problems. I don't like to burden people with my problems."*. This same patient continued: *"My family, obviously, I've got children, and they know about my problem, but they don't know the extent of it. They don't know what I go through. They just see me now as back to normal."*

These accounts suggest that while family inclusion was generally valued, there remains a need for more nuanced approaches to define roles, set appropriate boundaries, and ensure that both patients and family members receive adequate support throughout the prehabilitation journey.

Theme 3, sub-theme 3: Family member support and education

Beyond structural integrations, participants identified specific needs for supporting and educating family members to enhance their effectiveness in the prehabilitation process.

Past the nutritional guidance gaps identified by patients (Section 5.3.2.2), family members who assumed primary responsibility for meal preparation required comprehensive education to fulfil their caregiving role effectively. One family member (FM2) described taking charge of dietary management after surgery, and once a stoma was placed: *"I think other people who've got bad diets they need to have guidance. And also, there are shortcuts that you can take. For instance, I would have a proper potato myself with the skin, but I would buy him ready-produced mashed potato with swede or carrot in it, because it had no fibre in it."*. This same family member expressed frustration about the lack of structured dietary information provided: *"My role really was to make sure we had the right food. And in that area, we did feel that there wasn't enough information, and we had to go online and look and there were other hospitals that actually gave you a diet plan after the operation."*

The importance of including family members in nutritional education was highlighted by another family member (FM3), particularly when they were responsible for meal preparation: *"I think that would be good and especially for the two of us then because obviously if, well, everybody's different but I do most of the cooking in the house and so if I'm going to be changing [PT3] diet or helping him to change his diet, it'd be better if the two of us involved and if there is a nutritional expert put in place it's better for the two of us to do it so that I can control the meal plans better sort of thing."*

While section 5.3.2.2. explored patients' varied receptiveness to psychological support, family members' psychological needs emerged as a distinct yet interconnected dimension of the prehabilitation experience. The psychological wellbeing of family members emerged as an important consideration. The recognition of family members' wellbeing by prehabilitation staff was appreciated by some patients. Participant PT4 noted: *"Every time I've spoken to them (SP1/SP2/SP-NI), they have always asked how [FM4] is. And that is so nice when you realise that that's the level of care and involvement.".* This recognition of family members' wellbeing by prehabilitation staff, though informal, helped create a supportive environment that may have enhanced family members' willingness to actively participate in supporting patients' prehabilitation activities, whilst also feeling looked after themself.

One family member FM6 mentioned that they were frustrated never to be asked how they are coping with it all: *"Well all you ever get was a phone call saying how is he [PT6]? The one that always bugged me when he was in a long term [in hospital] was you go in and the family come in and they all sit and chat to each other and you just sit there."* and then continued: *"Because sometimes I feel you'd be scared... but you know what I mean, some people might be scared to sit in front of their partner in case they upset them [with their own worries]".* These accounts reveal considerable variability in family members' experiences of support and recognition. While some family members, like FM4, felt consistently acknowledged by healthcare professionals who enquired about their wellbeing, others, like FM6, experienced a sense of invisibility, overlooked by both healthcare professionals who focused exclusively on the patient and by extended family members who provided social support to each other but not to the primary carer. This variability in support experiences among family members suggests that the integration of caregiver wellbeing into prehabilitation and cancer care more broadly may depend on individual healthcare professionals' practices rather than systematic intervention design. Furthermore, family members' ability to access emotional support from

their broader social networks varied considerably, with some family members isolated by patients' preferences for privacy about their diagnosis. The same family member also suggested the following: *"A games night or something for partners. Because then they'd sit and chat...in a hospital, there's some once a month where partners could come along to... Because if you say it's like a discussion or things like that... I don't think people would come, yeah. Whereas if you put just get a break away, come and play a game, get a cup of tea".*

One family member (FM2) described the emotional burden of limited communication when the patient preferred privacy: *"Yeah, well the biggest, the toughest thing for me was because [PT2] didn't want anybody to know. So, I had to keep it a secret. And I'm not... I am somebody who needs to share my burdens. So that was very hard.".* This highlights how patients' preferences for privacy could sometimes conflict with family members' needs for communication and support, suggesting the importance of facilitating more open dialogue within families about communication preferences and emotional needs. These emotional challenges faced by family members have direct implications for prehabilitation engagement. Family members under psychological strain may be less able to provide the encouragement and practical support needed to help patients adhere to exercise and nutritional recommendations. Addressing family member psychological wellbeing could therefore indirectly improve prehabilitation outcomes. Another family member (FM5) echoed these sentiments, as their partner also chose not to share his diagnosis: *"I had nobody to share it with... I felt like I needed somebody to give me a hug."*

These emotional challenges faced by family members have direct implications for prehabilitation engagement. Family members experiencing psychological distress and isolation may be less able to provide the encouragement, practical support, and accountability that help patients adhere to exercise and nutritional recommendations. When family members are emotionally burdened without adequate support, their capacity to actively participate in prehabilitation activities alongside patients or to reinforce healthy behaviours at home may be impacted. Addressing family member psychological wellbeing could therefore indirectly improve prehabilitation outcomes by ensuring the patient's primary support system is itself adequately supported. The value of broader support networks beyond the immediate patient-family member dyad was recognised by several participants. One patient (PT4) acknowledged the importance of extended support: *"I think I've got the support from family and friends. We'll be very lucky, we've had great support.".* This contrast highlights the

potential benefit of developing family-inclusive activities and peer support networks that could provide additional layers of support for both patients and family members, particularly for those who lack extensive natural support systems.

These findings suggest that effective prehabilitation interventions should consider not only the immediate practical aspects of patient-family integration but also the longer-term relational dynamics that could contribute to sustainable health behaviours and psychological wellbeing for both patients and their family members.

5.3.3. COM-B model mapping analysis

Following the thematic analysis, the COM-B model was applied to systematically identify factors that support, or hinder behaviour change within prehabilitation, and to highlight areas for intervention optimisation (Michie et al., 2011). The model's three components, Capability (physical and psychological), Opportunity (physical and social), and Motivation (automatic and reflective), provided a structured framework for understanding which aspects of the current intervention are working well and where enhancements could improve patients' and family members' engagement. The following sections present findings mapped to each COM-B component, with implications for intervention optimisation.

5.3.3.1. Capability

Capability in the COM-B model refers to an individual's physical and psychological ability to engage in behaviours. This analysis revealed several key findings related to both physical and psychological capability.

5.3.3.1.1. Physical capability

Participants consistently reported improvements in physical fitness through the prehabilitation intervention. Most participants understood the physical activity requirements and successfully incorporated them into their routines: *"I was advised to get 150 minutes of exercise to make myself fit for the operation."* (PT3)

The structured exercise interventions effectively built strength and improved overall fitness, as evidenced by multiple participants: *"And certainly, before the operation I'm sure I was a lot fitter than I was prior to actually starting MoveMore [exercise intervention]."* (PT1)

The same sentiment was echoed by this participant, who also pointed out the necessity of routine and repetition: *"And every week I went at the same time every week and SP-NI measured [me], there was an improvement in my fitness."* (PT-S1)

Technology-enabled exercise interventions enhanced participants' physical capability by providing clear guidance: *"I was using the app, which I found really quite helpful, because it guides you through it, it timed everything, so you knew how long you were supposed to do it for and so on."* (PT2)

Participants valued specific exercises that targeted relevant muscle groups and continued these beyond the intervention duration: *"He [SP-NI] gave me a load of exercises for my back, just 30-second things. And to be honest, I'm still doing them now because I think they're that good."* (PT-S2)

The intervention facilitated diverse physical activities beyond structural exercise sessions, with participant PT1 describing: *"So we joined the class and thoroughly enjoyed it. We also did walking locally. And we got and we've got a couple of bikes, bicycles, albeit they're electric, but we also use those a little bit more than we had before."*

This variety in physical activity options supports the development of physical capabilities through multiple types of exercise. Some participants reported significant improvements in their overall physical condition prior to surgery: *"By the time I went in for surgery, I was actually feeling the best I'd felt for a long time."* (PT4)

Practical skills development to support oneself after surgery was also highlighted as an important component: *"Some of the work that we did, which was so practical, was things like exercises after your surgery to make sure that you were able to get out of bed properly and set yourself up properly and function and get dressed."* (PT4)

However, despite prehabilitation efforts, some participants experienced post-surgery physical limitations that affected their capability: *"It's compromised him [PT5] a little bit... he likes to do very long walks, but he can't be far from a loo"* (FM5)

5.3.3.1.2. Psychological capability

The analysis revealed varying levels of psychological capability across different aspects of prehabilitation. Participants generally demonstrated good understanding of the importance of exercise but had limited nutritional knowledge, particularly regarding post-surgical dietary requirements. This knowledge gap, identified as a key theme in section 5.3.2.2. and further explored from family members' perspective in section 5.3.2.3.1., emerged as a barrier to effective nutritional behaviour change within the COM-B framework. Participants articulated uncertainty about dietary requirements:

"We weren't sent away with a nutrition sheet saying this is what you should have, this is the food you should be eating under the circumstances..." (PT1)

This sentiment was echoed by PT2:

"But they didn't actually give us any ideas. So that wasn't a question of looking for a healthy diet that was just looking for a correct diet post-surgery."

This knowledge gap prompted some family members to seek information independently:

"We did download that menu thing, which was of great help to me, actually, because I do all the cooking." (FM2)

Uncertainty about post-surgery dietary restrictions was particularly problematic:

"You don't really know what things are really dangerous to eat or what you can eat as long as you chew properly" (PT5)

The pattern of self-directed information seeking discussed in Theme 2 takes on additional significance when viewed through the COM-B framework. This highlights how limitations in psychological capability (nutritional knowledge) intersect with limited opportunity (access to structured nutritional guidance). Therefore, it might be suggested that if formal education is unavailable, those with greater health literacy could compensate, while others remained uncertain, which revealed potential inequalities not addressed in the prehabilitation intervention. The educational component of prehabilitation enhanced psychological capability for some participants:

"Because even though you know things, to have somebody telling you or go over it with you, it just puts your mind in a totally different...I think we learned a wee bit from that." (PT6)

Mental preparation for surgery emerged as an important aspect of psychological capability:

"And mentally, he [SP-NI] was trying to get me ready for this major operation, which was difficult for me because of what I'd gone through." (PT-S1)

Participants showed varying receptiveness to psychological interventions, with some finding mindfulness techniques or other stress-relieving methods challenging:

"I'm of a generation and of an upbringing where I find the whole idea of mindfulness a bit kind of weird" (PT5)

Conceptual framing of the cancer experience influenced psychological capability, with some participants finding certain framing particularly helpful:

"...SP-NI said, it's actually more of a journey. Yeah. And that just made so much sense to me." (PT1)

Post-surgical psychological capability was enhanced by specific physical achievements:

"The minute you're up and sitting in the chair, you feel as a patient much less invalided... you start to feel more normal" (PT4)

Determination emerged as an important psychological factor that supported capability:

"I was determined to get through it, and I didn't miss it. We got through the eight weeks" (PT4)

The findings related to capability highlight both strengths and gaps in the current prehabilitation intervention. While participants demonstrated improved physical capability through exercise interventions, there were notable psychological capability gaps, particularly regarding nutritional knowledge and post-surgical dietary requirements. These findings suggest opportunities to enhance psychological capability through more comprehensive educational components and tailored post-surgical guidance.

In summary, while Theme 2 identified nutritional guidance as a gap in comprehensive support, the COM-B analysis reveals this gap specifically as a limitation in psychological capability that was not adequately addressed through environmental opportunity (structured education). This capability-opportunity deficit likely had subsequent effects on motivation and behaviour change, as participants struggled to implement dietary recommendations they didn't fully understand. For intervention optimisation, these findings suggest that enhancing psychological capability through structured nutritional education, particularly regarding post-surgical dietary requirements, represents a key area for improvement. Additionally, providing practical skills training for post-surgical self-care could further strengthen physical capability.

5.3.3.2. Opportunity

Opportunity in the COM-B model describes external factors that make behaviour possible or prompt it. The analysis examined both physical and social dimensions of opportunity that influenced participants' engagement with the prehabilitation intervention.

5.3.3.2.1. Physical opportunity

Physical opportunity refers to environmental factors, including access to resources, time, and facilities that enable prehabilitation behaviours.

Participants frequently mentioned access to structured exercise classes as a key physical opportunity:

"...so we joined the class with [SP1] on a Tuesday, the MoveMore..." (PT1)

The duration of access to these interventions varied based on individual circumstances:

"At the start they said I would get two, maybe three weeks of (SP-NI), but because I'd asked to put the operation back, I got seven weeks, which was great." (PT6)

Digital resources, such as exercise applications, extended physical opportunities beyond formal sessions:

"I've got the app to work on with me and my phone and what have you." (PT3)

Many participants independently acquired equipment or tools (e.g. fitbits, electric bikes) to support ongoing physical activity:

"I bought a Fitbit, and I walk as much as I can I try and do five miles a day" (PT-S1)

"And we got and we've got a couple of bikes, bicycles, albeit they're electric..." (PT1)

Some participants reported plans to access community exercise facilities after completing the intervention:

"I'm going to join just a local gym that's opening up I'm just going to join a local gym and try and get myself a bit more fit." (PT-S1)

Access to healthcare professionals outside scheduled sessions represented another important physical opportunity:

*"Even between my surgeries when he [SP-NI] wasn't supposed to be doing things, he said, come and see me and I'll give you exercise to do" (*PT4)

However, geographical barriers affected some participants' access to exercise facilities:

"It's slightly inconvenient, because it's a long way... It's 45 minutes' drive" (PT5)

In contrast to generally positive access to exercise resources, participants consistently reported limited physical opportunity for nutritional guidance:

"My role really was to make sure we had the right food. And in that area, we did feel that there wasn't enough information, and we had to go online and look" (PT2)

"We had to go online and look and there were other hospitals that actually gave you a diet plan" (FM5)

Some participants received practical cooking demonstrations that enhanced their physical opportunity for implementing dietary changes:

"[SP-NI] showed me how to do this chicken just with vegetables, and it's so simple" (PT6)

5.3.3.2.2. Social opportunity

Social opportunity includes interpersonal influences, social cues, and cultural norms that facilitate or inhibit behaviours.

Healthcare professional relationships provided an important social opportunity for intervention engagement:

"(SP1) was amazing because I think she's amazing, actually, because it [cancer diagnosis], although it affected me because of (PT1), is how she interacts with everyone." (FM1)

"The Dr answered all... Spent about an hour, over an hour, probably an hour and a quarter with her (PT5)" (FM5)

Family and group support created social opportunities for some participants:

"*So, when we go, we exercise together because we're always sort of put into groups to do the circuit training."* (PT1)

"I think I've got the support from family and friends. We are very lucky; we've had great support." (PT4)

However, family involvement varied considerably, with some participants choosing limited family engagement:

"No, she [family member] never. I didn't invite her; I didn't tell her. I used to tell her the day later; I had been or something like that." (PT-S2)

"I tend to keep things into myself. I don't share problems" (PT-S1)

Interaction with peers in similar situations represented a valuable social opportunity:

"It's just they'll say, how are you today? It's more that, I think it's a wee bit more supportive." (PT1)

"I think just meeting up with some other people and saying hi, I mean, we don't exactly spend much time talking because most of the time we're doing steps, yeah, bicycling, yeah" (PT2)

Group exercise environments facilitated social connection:

"Meeting up with some other people and saying hi... you kind of have the odd chat the odd time of day with somebody" (PT5)

Some participants observed peer support benefits for others:

"We saw people at Maggie's Centre that really got the benefit of it... they had a place to go and people to support them" (PT4)

Privacy concerns sometimes limited social opportunities, particularly for family members:

"Yeah, well, the biggest, the toughest thing for me was because (PT2) didn't want anybody to know. So, I had to keep it a secret." (FM2)

"(PT5) didn't want anybody to know." (FM5)

Participants suggested several ways to enhance social opportunity outside the intervention, in their own homes:

"A games night or something for partners. Because then they'd sit and chat." (FM6)

"Yeah, or having a family if it's a bigger, wider family, having a family session at night for people if they don't want to go into a group session." (FM3)

Some participants noted how family involvement could enhance mutual support for maintaining health behaviours:

"And then it also becomes a thing of like caring for one another on a different level, right, so you know maybe if PT3, you one day don't want to do it, but I do, then like oh no come on let's just go for like a 10-minute walk or whatever and then vice versa." (FM3)

Some also expressed a desire for more peer connection opportunities:

"We've got a friend... if we met him, you know, then I would probably compare notes with him" (PT5)

These findings continue to highlight a contrast between generally well-provided physical opportunities for exercise and limited physical opportunities for nutritional guidance. Social opportunities varied significantly, suggesting potential for enhancing the intervention through more structured family and peer support options. In regard to intervention optimisation, expanding physical opportunities for nutritional guidance (e.g., structured dietary resources, recipes, shopping lists) and creating more formal social opportunities (e.g. family sessions, peer support groups, partner activities) could address the gaps identified by participants.

5.3.3.7. Motivation

The analysis of the interviews revealed several key motivational factors that influenced participants' engagement with the prehabilitation intervention. Following the COM-B model, we identified distinct elements of both reflective and automatic motivation.

5.3.3.7.1. Reflective motivation

Participants consistently expressed unwavering determination to adhere to the prehabilitation intervention. This high level of commitment was often deeply connected to their desire for optimal surgical outcomes, as exemplified by participant PT4, who described dedication to the healthcare team's recommendations:

"Absolutely everything that was asked to do by everybody, I did it for [SP-NI], to make sure that the outcome was as best as I could possibly make it." (PT4)

Similarly, participant PT5 demonstrated a resolute trust in healthcare professionals' guidance, showing how professional advice became internalised as personal commitment: *"If that's what he (SP-NI) says I should do, that's what I'm gonna do."*

The relationship with healthcare professionals often served as a powerful reinforcement mechanism for commitment. Participant PT4 described how not wanting to disappoint the healthcare team became a significant motivational driver: *"And you feel that if you didn't do what he was asking you to do, you would horribly let him [SP-NI] down, which is brilliant because it makes you more determined to do it properly."*

Beyond surgical outcomes, some participants framed adherence as essential for maintaining psychological resilience during a challenging period. Participant PT-S2 expressed this in a direct and simple way:

"You've got to, if you don't, you just fall apart." (PT-S2)

Participants demonstrated sophisticated cognitive understanding of the physiological benefits of exercise for surgical preparation and recovery. Their reflections often revealed how this understanding motivated their participation. Participant PT1 acknowledged the perceived benefits with confidence: *"So I'm sure it was a great benefit to me."*. This understanding extended to recognising the physiological logic behind prehabilitation, as participant PT3

articulated the connection between physical preparation and surgical outcomes: *"It makes sense that you prepare your body for something that's so major, to it surgery-wise."*.

The daily structure provided by exercise was also recognised as beneficial for mental wellbeing during a challenging time, as noted by participant PT5: *"It gave you something to focus on, it gave you something to do every day."*

Particularly notable was participants' recognition of potential long-term health benefits extending beyond the immediate surgical context. Participant PT2 connected prehabilitation to broader ageing-related concerns and quality of life: *"I've often thought to myself, actually, you need to do more of that now as you're getting older because you know I still want to be able to do heavy gardening."*

The potential for exercise continuation to reduce cancer recurrence emerged as a powerful motivator, as articulated by participant PT3: *"Yeah, and even if it was the app that was kept going for the exercise side of things after the operation, surely that's got to be beneficial long term for the percentage cut down of the cancer reoccurring."*

The fear of future regret also motivated adherence, as powerfully expressed by participant PT4: *"I don't care if I have to have my head in a bucket for eight weeks, I'm doing it because I don't want to wake up in five or ten years' time and say oh god, I should have kept that going."*

Many participants established specific, personally meaningful goals related to preparing for surgery. Participant PT6 identified weight loss as a targeted objective with clear anatomical reasoning: *"I was wanting to lose weight before I went in because I knew it would be here and that's where all my weight was."*

The broader goal of general fitness for surgery provided motivation for participant PT1:*"...to make myself fit for the operation."*

External validation from healthcare professionals reinforced these preparatory goals, as described by participant PT6: *"That was my goal because they both said that if I do everything I'm told, because that was, so that was fine."*

Attitudes toward psychological aspects of the intervention varied considerably, revealing different coping strategies and perceptions of mental health support. Some participants initially resisted psychological components, as illustrated by participants PT2 and PT5 who shared nearly identical perspectives: *"I kind of thought, I don't need that, I'm okay, I'm dealing with this. I'm here to show off, I'm not panicking."* (PT2)

The cancer diagnosis and treatment process fundamentally challenged participants' sense of control over their lives. One family member (FM5) provided insight into how this affected their partner: *"His (PT5) biggest fault is that he wants to control everything. And he felt out of control."*.

The emotional atmosphere created by healthcare professionals contributed significantly to participants' motivation through positive affect. The collaborative, non-directive approach used by healthcare professionals evoked positive emotional responses that reinforced engagement. Participant PT6 appreciated the suggestive rather than prescriptive communication style: *"So again, just having somebody there telling you or going over what you're doing, and right, can we maybe change this this week, can we maybe do that... It was could we maybe, or could you try. And that's, I thought it was, I used to say that to him."*.

Many participants experienced an emotional response to being included in the intervention, feeling valued and cared for within the healthcare system. Participant PT2 articulated this emotional reassurance: "*So it was, I guess, getting the invitation to go to the* prehabilitation *was quite encouraging because it made me feel, ah, somebody's caring about me, somebody's interested, you know, and there is some sort of process going on here."* (PT2)

5.3.3.7.2. Automatic motivation

Participants experienced various emotional responses to their diagnosis that influenced their motivation. Participant FM5 described the initial emotional impact:

"I did feel shocked by the diagnosis."

Ongoing anxiety about the future remained present even during prehabilitation, as candidly expressed by participant FM5: *"I am still worried in the back of my mind that it might crop up somewhere else."*

Participants developed emotional coping mechanisms that helped them manage difficult feelings. Participant PT4 described the protective psychological distancing that helped them cope: *"It's easier for the patient than the person sitting at the side, because if you tackle it properly, it's like tunnel vision."*. This same participant articulated the pragmatic emotional approach that supported their resilience: *"You just have to get on with it. Switch off and get on with it."*.

These findings illustrate the complexity between reflective and automatic motivational factors in a prehabilitation context. While reflective motivation was characterised by conscious commitment and understanding of benefits, automatic motivation was influenced by emotional responses, environmental cues, interpersonal connections, and the development of health-promoting habits and behaviours. The variation in motivation across participants suggests the importance of multi-faceted approaches to support engagement that address both decision-making and emotional-habitual responses. For intervention optimisation, these findings highlight the importance of maintaining the positive healthcare professional relationships that encourage commitment, whilst recognising that motivational strategies may need to be tailored to individual coping styles and pretences.

5.4. Discussion

This qualitative study exploring the experiences of cancer patients and their family members in a prehabilitation intervention revealed several important findings related to intervention optimisation and family inclusion. The results highlight both strengths and limitations of current prehabilitation practices while offering insights into potential improvements.

5.4.1. Technology-enhanced personalised physical prehabilitation

The findings demonstrate that technology-based tools significantly enhanced participants' engagement with physical prehabilitation. Digital applications provided structure, accountability, and motivation through features such as automated reminders and remote monitoring. This automated accountability mechanism represents a significant advantage of digital interventions over traditional exercise prescriptions that rely solely on patient memory and initiative. These findings align with recent evidence that digital technologies in cancer prehabilitation can support patient adherence through remote monitoring, goal setting and real-time feedback (Barberan-Garcia et al., 2021; Zhang et al., 2024).

The remote monitoring capability created meaningful accountability, with participants indicating that awareness of being monitored served as a powerful motivational factor. This finding can be understood through Self-Determination Theory (SDT), which distinguishes between controlled and automated forms of accountability (Oussendik et al., 2017). While external monitoring initially represents controlled accountability, research suggests this can facilitate the internalisation of motivation over time. This motivational aspect may also be further strengthened when combined with positive relationships with healthcare professionals and service providers who are doing the monitoring. The consistent positive responses to monitoring in this study suggest that participants were experiencing what Oussedik et al. (2017) termed "autonomous accountability", an internal desire to meet expectations out of respect towards healthcare professionals and service providers, rather than achieving accountability and adherence purely out of being controlled.

However, concerns about technological accessibility across different demographics, particularly older patients, highlight the need for tailored approaches. This observation raises important questions about digital equity in public health interventions, particularly in areas with higher levels of deprivation, where digital literacy and access to technology may vary considerably. Digital literacy remains a potential barrier to engagement with technology-based health interventions, especially among older populations. Research examining digital health technology use among older adults with cancer has identified persistent socioeconomic and racial disparities, with younger age, higher education, and greater income consistently being associated with higher technology adoption (Zhou et al., 2023). Common barriers include limited digital skills, visual or cognitive limitations, concerns about privacy, and interfaces that are not age-friendly (Hasnan et al., 2022; Hepburn et al., 2025). These findings highlight the importance of offering tiered technological engagement options to accommodate diverse preferences and capabilities, ensuring that the possible benefits of technology-enhanced prehabilitation do not inadvertently exacerbate existing health inequalities.

The spontaneous adoption of additional digital tools by some participants (e.g., Fitbits, electronic bikes) demonstrates patients' willingness to embrace technology for health monitoring beyond prescribed interventions. This self-directed technological engagement indicates a potential for healthcare interventions to catalyse broader health monitoring behaviours, which is consistent with evidence that digital activity trackers can improve self-

efficacy and provide real-time feedback to enhance motivation (Schaffer et al., 2019). Significantly, participants recognised the potential long-term benefits of technology-supported exercise continuation post-surgery, demonstrating an understanding of the connection between sustained physical activity and cancer recurrence risk reduction. This insight suggests that technology-enabled interventions may support longer-term health behaviour change. These suggested findings should be further investigated through longitudinal studies, as current evidence on the long-term sustainability of telehealth exercise interventions in cancer populations remains limited (Batalik et al., 2024).

5.4.2. Comprehensive support integration

5.4.2.1. Nutritional support gaps

A significant finding was the perceived gap in structured, personalised nutritional guidance throughout the cancer care continuum. Despite nutritional optimisation being a core component of multimodal prehabilitation, participants consistently reported inadequate dietary information, particularly post-surgery (Durrand et al., 2019). This finding reflects broader concerns in the literature; as a recent scoping review by Gillis et al (2021) found that prehabilitation research frequently lacks standardised nutritional assessment and is often conducted without evidence-based nutrition interventions. Furthermore, research indicates that nutritional support remains insufficiently integrated into cancer care, with diagnosis of malnutrition occurring later and less frequently than clinical guidelines recommend (Corr et al., 2024).

The initiative taken by participants to independently seek nutritional information demonstrates both the importance of this component and the current insufficiency of provided resources. The participants of this study reported that they sourced dietary information online, which may highlight the demand for more structured guidance as patients actively engage in addressing information gaps. This pattern of self-directed information seeking raises important questions about equity of access, as patients with lower health literacy or limited internet access might be at a disadvantage in supplementing formal nutritional guidance with self-sourced information. Research has identified that cancer survivors are often vulnerable to nutritional misinformation, and access to evidence-based guidance is not always readily available, even when resources exist (Keaver et al., 2020).

The confusion around post-surgical dietary restrictions was particularly problematic for participants, particularly the duration of dietary restrictions for stoma care was expressed. This ambiguity created unnecessary anxiety during recovery and potentially compromised nutritional status at a time when optimal nutrition was crucial for healing and rehabilitation. Post-operative dietary management following CRC surgery can be complex, and specific guidance is needed, especially around fibre intake not to irritate the healing tissue. This information needs to be communicated effectively, in a way where patients do not forget (verbal instructions) or misplace (paper-based instructions) this information (Weimann et al., 2021; Lewandowska et al., 2022). The lack of clear, individualised guidance reported by participants represents a significant gap in the care continuum.

Interestingly, when nutrition guidance was provided, participants particularly valued the collaborative, non-prescriptive approach. Participants described appreciating a consultative style, where healthcare professionals or service providers offered suggestions rather than directives. This may suggest that effective nutritional components of prehabilitation should empower patients and family members through education rather than rigid dietary prescriptions. This aligns with patient-centred care principles, which emphasises shared decision-making and patients' empowerment (Trujillo et al., 2018). Research suggests that cancer survivors view nutrition as a tool for empowerment and control, and an aspect of care they can actively influence during a time when many decisions are made by their oncological team (Keaver et al., 2020). Studies have also found that patients who understand the rationale behind nutrition interventions demonstrated greater adherence to dietary guidelines (Shanmugasundaram Prema et al., 2025).

For some participants who received more direct input on nutrition, the nutritional component of prehabilitation catalysed positive dietary changes beyond the immediate surgical context. Participants reported making sustained dietary improvements, such as reintroducing nutritious food and developing a greater understanding of nutritional content. These reflections suggest that well-designed nutritional education within prehabilitation interventions might have broader impacts on long-term dietary patterns, potentially contributing to secondary cancer prevention through improved nutrition. This is consistent with evidence that increasing dietary fibre intake after CRC diagnosis is associated with lower cancer-specific mortality (Lewandowska et al., 2022)

5.4.2.2. Psychological support variability

The varying receptiveness to psychological support observed in the study reflects the complex interplay of cultural, generational, and individual factors influencing mental health engagement. This variability aligns with Carolan et al.'s (2017) systematic review, which reported that reasons for seeking, accepting, or declining help for emotional distress in cancer patients depend on multiple factors, including a person's social network and wider socio-cultural context, including gender.

The reluctance among some male participants to engage with psychological support reflects established patterns of male help-seeking behaviour in health contexts. Participants described feeling that displaying emotional vulnerability conflicted with generational expectations of masculinity. This gender-based reluctance presents a challenge for comprehensive prehabilitation interventions and suggests the need for approaches that acknowledge and accommodate these cultural and generational factors. This finding is consistent with substantial evidence that conformity to masculine gender role norms represents a significant barrier to men's psychological help-seeking (Yousaf et al., 2013; Fish et al., 2015). Research indicates that men often perceive help-seeking for emotional concerns as a feminine activity, with traditional masculine socialisation emphasising emotional suppression as a marker of strength (Courtnenay, 2000; Addis & Mahalik, 2003). A recent systematic review confirmed that adherence to traditional masculinity norms had a profound negative effect on men's willingness to seek mental health support, with emotional suppression identified as a major barrier (Mokhwelepa & Sumbane, 2025). Importantly, barriers and facilitators influencing men's access to supportive care services include not only individual factors but also how services are delivered and communicated, with evidence suggesting that services emphasising active participation in recovery may be more appealing to men (Montiel et al., 2023). This gender-based reluctance presents a challenge for comprehensive prehabilitation interventions and suggests the need for approaches that acknowledge and accommodate these gender, cultural and generational factors.

Notably, the findings indicate that psychological support needs may vary throughout the cancer treatment journey. Some participants identified the post-treatment rehabilitation phase as particularly challenging, as this is often a time when formal support structures diminish, yet psychological distress may persist or even intensify. This variation in psychological support needs suggests that prehabilitation interventions should consider extending

psychological support beyond the immediate pre-surgical period. This aligns with qualitative research demonstrating that cancer patients often feel abandoned by the healthcare system after being discharged, whilst experiencing ongoing distress and lacking someone to turn to for physical and psychological needs (Mikkelsen et al., 2008). Furthermore, fear of cancer recurrence can persist for years and represents a significant source of ongoing psychological distress (Grassi et al., 2017). These findings suggest that continued psychological support should transition from active treatment into survivorship.

5.4.3. Family member inclusion and support

5.4.3.1. Structured family inclusion

The study revealed that family inclusion in prehabilitation occurs across multiple dimensions, including physical activity participation, appointment attendance, and collaborative decision-making. The value of flexible options for family participation in physical activities was highlighted, with benefits observed for both patients and family members when exercising together.

The importance of having family members present at medical appointments emerged as a key factor in effective information processing and decision-making. This collaborative approach to medical consultations can potentially improve information retention and enhance patient-provider communication. Participants described how having a family member at consultations helped capture and retain information that might otherwise be missed and provided different perspectives on what was discussed. This finding is well-supported by research demonstrating that family presence at medical visits is associated with better patient satisfaction, improved information exchange, and enhanced care coordination (Wolff & Roter, 2011; 2011; Laidsaar-Powell et al., 2013). A study examining caregiver behaviours during healthcare appointments found that more than half of caregivers' contributions involved clarifying and expanding on patients' medical information and history (Wolff & Roter, 2011).

However, this studies findings also revealed tensions between patients' preferences for privacy and family members' needs for information and support. Some patients reported tendencies to shield family members from the full extent of their condition, which created challenges for family members attempting to provide support. This dynamic highlights the need for more nuanced approaches to family integration that respect patient autonomy while

ensuring adequate support for family members. Research on dyadic coping in cancer couples confirms that information flow within families significantly impacts both patient and caregiver adjustment, with selective disclosure creating differential access to information that can complicate support provision and shared decision-making (Traa et al., 2015; Chen et al., 2021).

5.4.3.2. Family member support and education

The findings identified specific needs for supporting and educating family members, particularly regarding nutritional management and caregiver psychological wellbeing. Family members frequently assumed primary responsibility for dietary management yet reported feeling inadequately prepared for this role, expressing uncertainty about nutritional requirements during and after treatment. This aligns with broader evidence that family caregivers often feel unprepared and receive little guidance from oncology teams for their caregiving role, despite institutional protocols being in place (Frambes et al., 2017).

It is important to note that for most NHS hospitals, providing nutritional guidance in these circumstances is protocol. This includes the prehabilitation clinic at the chosen hospital in Scotland, where recipes of nutritious food are handed out, however not formally discussed, and for those patients receiving stomas, sheets are shared listing stoma-friendly foods and eating habits. However, the apparent gap between available information and participants' perceptions suggests potential issues with information delivery, accessibility, or timing. Research on caregiver education emphasises that preparing caregivers should be an ongoing process incorporating both standardised information and opportunities for peer support, with group models and caregiver mentorship programmes showing promise for addressing informational and emotional needs simultaneously (Applebaum & Breitbart, 2012; Kent et al., 2016).

Beyond informational needs, family members also reported unmet emotional support needs. Systematic reviews report prevalence rates of depression and anxiety of approximately 42% and 47% respectively, among cancer caregivers, yet dedicated support for this population remains inconsistent (Geng et al., 2018).

Participants expressed a desire for caregiver-specific support that acknowledges their unique experiences and challenges. Evidence-based reviews have identified psychoeducation,

supportive care interventions, and cognitive behavioural approaches as recommended strategies for reducing caregiver strain and burden (Jadalla et al., 2020). A recent meta-analysis found improvements in caregiver quality of life, anxiety, and depression following targeted interventions (Hartman et al., 2023). These findings underscore the importance of integrating caregiver support as a core component of prehabilitation interventions rather than treating it as peripheral to patient care.

5.4.4. Theoretical implications

5.4.4.1. COM-B Model applications

Mapping the findings to the COM-B model provided valuable insights into the complexity of behaviour change in the prehabilitation context. The analysis revealed that while the current intervention effectively addresses physical capability through structured exercise interventions, there are notable gaps in psychological capability, particularly regarding nutritional knowledge and post-surgical dietary management. This pattern of uneven development across COM-B domains is consistent with systematic reviews examining prehabilitation uptake, which have identified psychological capability and physical opportunity as commonly under-addressed components in cancer prehabilitation interventions (Shen et al., 2024).

The data revealed significant improvements in physical capability through the prehabilitation intervention. Participants consistently reported measurable improvements in fitness prior to surgery, attributing these gains to the structured exercise programme. Participants valued the regular assessment and feedback on their progress, which provided objective evidence of improvement. These objective improvements in physical capability likely contributed to better surgical outcomes, though the study did not measure clinical endpoints. This finding aligns with evidence that prehabilitation exercise interventions can improve health-related fitness in cancer patients awaiting surgery, with supervised interventions demonstrating particular effectiveness in building physical capacity (Campbell et al., 2019; Yang et al., 2024).

In contrast, psychological capability, particularly regarding nutritional knowledge, showed notable gaps. Participants expressed uncertainty about dietary requirements during and after

treatment, indicating gaps in nutritional knowledge despite institutional protocols for providing such information. Family members often attempted to fill this knowledge gap through independent information-seeking, highlighting both the inadequacy of existing support and family members' motivation to contribute to patient care. The disparity between well-supported physical capability and limited psychological capability related to nutrition represents a significant opportunity for intervention enhancement. Research using the Behaviour Change Wheel framework has identified that effective multimodal prehabilitation requires balanced attention to all COM-B domains, with education, training, and enablement functions needed to address capability gaps alongside environmental restructuring to enhance opportunity (Michie et al., 2011; Grimmett et al., 2021).

Opportunity factors varied considerably across the COM-B domains. Physical opportunity was generally well-provided for exercise through classes and digital resources. Participants accessed structured group exercise sessions and many independently acquired digital activity trackers to support ongoing physical activity. However, social opportunity showed greater variation; some participants benefited substantially from family and group support for exercise, while others experienced constrained social opportunity when patients' preferences for privacy limited family members' ability to seek support from their usual networks. The importance of social support for exercise adherence is well-established in cancer survivorship literature, with group-based programmes and peer support identified as key determinants of exercise maintenance (Ranes et al., 2022). The role of wearable activity trackers in supporting self-monitoring and accountability has also been linked to improved physical activity outcomes among cancer survivors (Gresham et al., 2018; Roberts et al., 2017).

Motivation developed as particularly complex in the analysis, with distinct patterns in reflective and automatic domains. Reflective motivation was characterised by commitment to following healthcare recommendations. Participants demonstrated reflective motivation characterised by commitment to following healthcare recommendations and optimising their surgical outcomes. Fear of future regret and recognition of the long-term preventative potential of health behaviours also motivated sustained engagement. This pattern of reflective motivation driven by health beliefs and anticipated regret aligns with Self-Determination Theory applications in cancer care, where identified and integrated regulation, understanding and personally valuing health behaviours support more sustained behaviour change than externally imposed motivation (Teixeira et al., 2012).

Automatic motivation was influenced by positive responses to monitoring. Participants described how professional monitoring created accountability that influenced automatic motivation, and the sense of being observed and supported by healthcare professionals provided an incentive for continued engagement. The positive interpersonal manner and emotional atmosphere created by healthcare professionals also contributed to motivation through positive affect. Research on exercise adherence in cancer populations supports the importance of healthcare professional engagement in motivating patients, with supervised programmes consistently demonstrating higher adherence than unsupervised home-based interventions (Campbell et al., 2019). The quality of the therapeutic relationship and social support from exercise instructors has been identified as a key determinant of exercise adherence among cancer survivors (Ranes et al., 2022).

This complex interplay of capability, opportunity, and motivation factors supports Michie et al.'s (2011) contention that effective behaviour change interventions must address multiple components simultaneously. The findings suggest that the current prehabilitation intervention could be enhanced by better balancing its approach across all COM-B domains, particularly by strengthening psychological capability for nutrition and expanding social opportunity for family members. Recent applications of the COM-B model and Behaviour Change Wheel in cancer prehabilitation have similarly identified the need for multimodal approaches that integrate behaviour change techniques such as goal setting, graded tasks, and self-monitoring to promote longer-term behaviour change beyond the immediate intervention period (Grimmett et al., 2021; West et al., 2022).

5.4.5. Practical implications for intervention improvement

Based on the findings, several practical implications for prehabilitation intervention optimisation were developed:

1. **Enhanced technological integration**: Develop tiered technology options to accommodate varying digital literacy levels while leveraging the motivational benefits of digital monitoring and reminders.
2. **Comprehensive nutritional guidance**: Implement structured, personalised nutritional education throughout the cancer care continuum, with particular emphasis on post-surgical dietary management.

3. **Flexible psychological support**: Offer varied psychological support options that acknowledge cultural and generational differences in help-seeking behaviour and address changing support needs throughout the cancer journey.
4. **Structured family inclusion**: Develop clearer protocols for family member involvement that balance patient autonomy with family support needs, including optional participation in physical activities and educational sessions.
5. **Dedicated family member support**: Implement specific resources and activities for family members that address their unique informational and emotional needs, potentially including peer support opportunities.
6. **Post-intervention continuity**: Consider extending support beyond the immediate prehabilitation period to address psychological and physical needs during the rehabilitation phase.

5.4.6. Strengths and limitations and future research

5.4.1. Strengths and limitations

Several limitations should be acknowledged. The sample was small (14 participants) and lacked diversity in several respects. Only one female cancer patient was represented, limiting the ability to explore gender differences in prehabilitation experiences. All participants had colorectal cancer, which may limit generalisability to other cancer types where prehabilitation needs and family dynamics may differ. The age range of participants (estimated to be 50-70 years) constrained exploration of age-related differences in technology acceptance and digital literacy.

Recruitment through a single prehabilitation intervention at a hospital in Scotland limits transferability to other healthcare settings and geographical contexts. Additionally, the study did not record the time between participants' surgery and their interview date, limiting the ability to contextualise reflections about post-surgical experiences. The timing of when patients reflect on their prehabilitation experience may influence how they evaluate different intervention components.

5.4.2. Future research

Future research should explore prehabilitation experiences across more diverse patient populations, including broader age ranges, ethnic diversity, and different cancer types.

Longitudinal studies examining the long-term impact of family-inclusive prehabilitation on both patient outcomes and family member health behaviours would provide valuable insights into potential broader benefits. Investigation into the effectiveness of technology-enhanced prehabilitation for older adults and those with limited digital literacy would help address concerns about technological accessibility. Finally, intervention studies testing various approaches to family inclusion and support, including research on how privacy preferences affect family dynamics, could inform more effective and person-centred intervention designs.

5.5. Conclusion

This study explored how prehabilitation can be optimised to support cancer preventive behaviour change in patients and their family members. The findings demonstrated strengths as well as gaps in current interventions, which highlighted implications for intervention development.

Three key findings were identified. First, technology-enhanced physical activity components were effective in maintaining engagement, though flexible approaches are needed to accommodate varying digital literacy. Second, nutritional support represented a significant gap, with participants reporting inadequate guidance despite institutional protocols, suggesting issues with delivery, timing, or format rather than absence of resources. Third, psychological support needs potentially varied by gender and changed across the cancer journey, with particular unmet needs during post-treatment rehabilitation.

Family members were identified as central and possibly underutilised in current prehabilitation practice. While many actively participated in exercise sessions and medical appointments, they often felt peripheral to formal healthcare processes and lacked targeted support for their own informational and emotional needs. The tension between patients' privacy preferences and family members' need for support highlights the complexity of family inclusion, requiring approaches that respect autonomy while ensuring adequate caregiver support. These findings suggest that future prehabilitation interventions should adopt comprehensive, family-inclusive approaches addressing physical, nutritional, and psychological needs throughout the cancer care continuum.

Chapter 6. Development of an optimised family-inclusive prehabilitation intervention for cancer surgery patients (Study 4)

6.1. Introduction

This chapter presents the development of an optimised prehabilitation intervention which is based on findings from the three studies conducted as part of this thesis: a systematic review of behaviour change techniques used in prehabilitation for colorectal and ovarian cancer patients (Study 1), interviews with healthcare professionals and service providers who facilitate aspects of prehabilitation (Study 2), and interviews with cancer patients and their family members who participated in the current prehabilitation intervention (Study 3). These three studies identified critical gaps in the current prehabilitation approach, particularly the absence of systematic family-based social support, inadequate nutritional guidance, and implementation barriers within the healthcare setting. The optimised intervention integrates behaviour change techniques with technology-enhanced support, designed to work within the practical constraints healthcare professionals as well as patients face during the cancer continuum, whilst also integrating family members. Therefore, the particular aim of this optimised intervention is to improve long-term preventative behaviour change not only in patients but also in their family members.

This chapter addresses Research Question 4: How can evidence from healthcare professionals and service providers, patients and family members be synthesised to develop an optimised family-inclusive prehabilitation intervention?

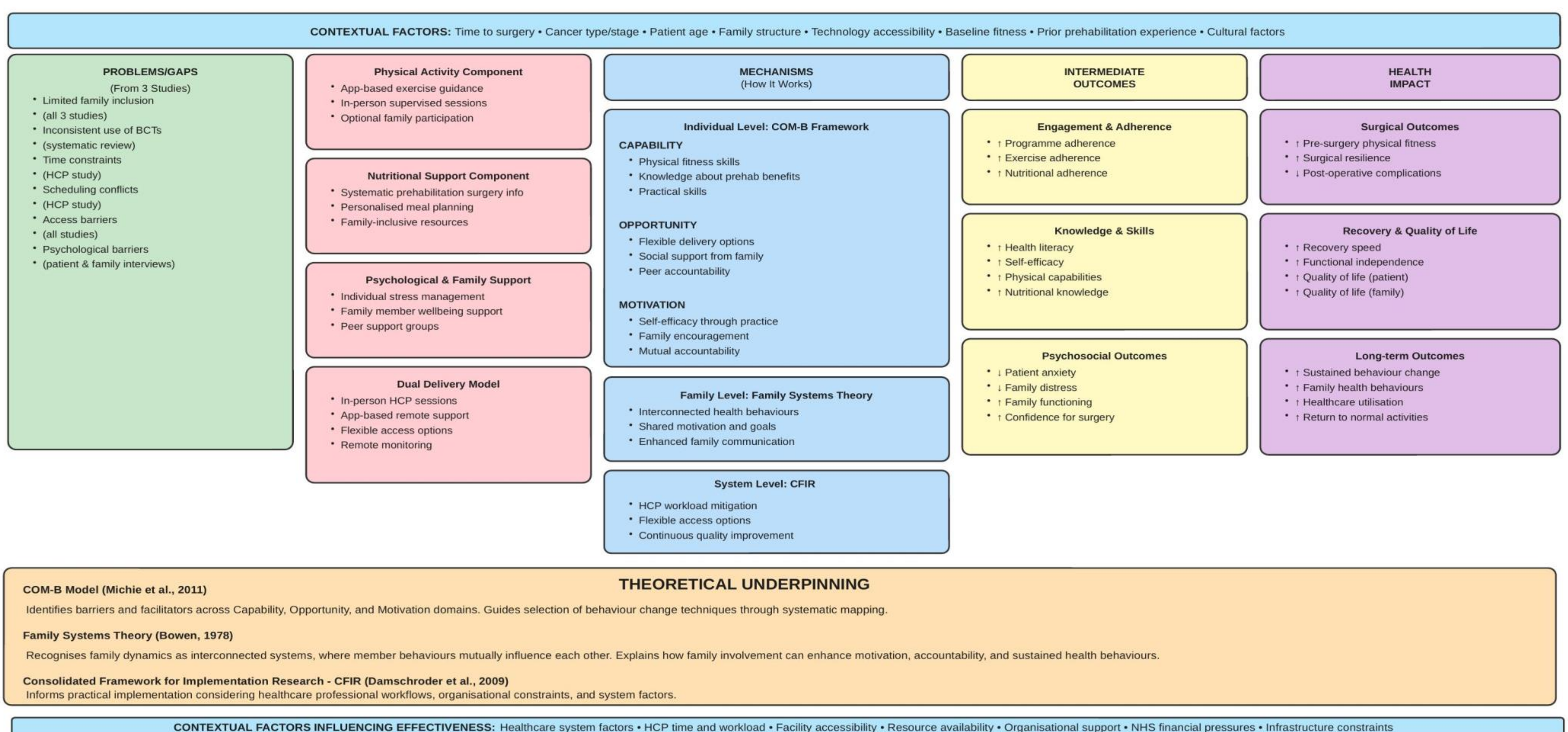
6.1.1. Approach to intervention development

The development of the optimised intervention followed the six steps in quality intervention development (6SQuID) framework (Wight et al., 2016). This framework provides a pragmatic approach to developing public health interventions as it emphasises understanding the problem and its causes before developing solutions. 6SQuID was selected because it aligns with the Medical Research Council (MRC) framework for developing and evaluating complex interventions, which recommends that intervention development should be based on existing evidence and appropriate theory as well as involve relevant stakeholders, and consider implementation from the outset (Skivington et al., 2021). The 6SQuID framework consists of the following six steps: (1) defining and understanding the problem and its causes; (2) identifying which causal or contextual factors are modifiable and which have the greatest

scope for change; (3) deciding on the mechanisms of change; (4) clarifying how these will be delivered; (5) testing and adapting the intervention; and (6) collecting sufficient evidence of effectiveness to proceed to rigorous evaluation (Wright et al., 2015). This chapter addresses Steps 1 through 4. Step 5 is partially addressed through the focus group evaluation presented in Study 5, with Step 6 representing future work beyond this thesis.

Three complementary theoretical frameworks inform the optimised intervention: the COM-B Model (Michie et al., 2011) as the primary behaviour change structure, Family Systems Theory (Bowen, 1978) for understanding and leveraging family dynamics, and the CFIR (Damschroder et al., 2009) for addressing practical delivery considerations. These frameworks were selected because they address the different levels at which change needs to occur, which include individual behaviour, family dynamics, and healthcare systems. Figure 6 presents the intervention theory model, which provides an overview of how the identified problems, theoretical frameworks, intervention components, mechanisms of change, and expected outcomes connect. This figure (6) is presented early on to orient the reader to the overall intervention logic and structure before the detailed development process is described.

Figure 6.: Intervention theory model for the optimised family-inclusive prehabilitation intervention



6.1.2. Chapter structure

The chapter is structured according to the 6SQuID framework (Wight et al., 2016). Section 6.2 synthesises findings from the three studies to define and understand the problem (Step 1). Section 6.3 identifies modifiable factors through COM-B analysis (Step 2). Section 6.4 presents the theoretical frameworks and mechanisms of change (Step 3). Section 6.5 details the optimised intervention components and proposed delivery mechanisms (Step 4). Section 6.6 elaborates on the programme theory, explaining how the intervention components are expected to enable the desired outcome. Section 6.7 discusses the development process, limitations, and implications.

6.2. Step 1: Defining and understanding the problem

The first step of the 6SQuID framework requires a thorough understanding of the problem and its causes before attempting to design a possible solution. This section synthesises findings from all three studies to identify the key gaps in current prehabilitation interventions.

6.2.1. Systematic review findings

The systematic review (Study 1) of 16 studies examining behaviour change techniques in prehabilitation interventions concluded that every study used one to multiple behaviour change techniques, which demonstrates BCTs recognition. Nevertheless, specific behaviour change frameworks were not mentioned in any of the studies, which may indicate that although behaviour change is a key factor in these health behaviour interventions, some lack systematic application of these techniques. This may also explain why none of the studies provided a reason as to why specific techniques were incorporated within their interventions. The most commonly used technique was 'provide instructions', appearing in all included studies, followed by 'prompt self-monitoring of behaviours' used in ten, and 'prompt practice' incorporated in nine studies. This pattern may suggest that current interventions focus on telling patients what to do, how to execute the behaviour, and asking them to track their behaviours for accountability purposes. The review identified a critical gap, as none of the 16 studies included social support behaviour change techniques. This absence is significant given the evidence to support social support for behaviour change in the literature. Berrio-Valencia and colleagues (2025) identified lack of social support as one of several patient-level barriers to prehabilitation adherence, alongside logistical issues and health conditions.

The complete absence of social support techniques in the reviewed prehabilitation interventions, therefore, may represent a notable disconnect between current practice and evidence about effective behaviour change. The review was also unable to identify clear patterns regarding which behaviour change technique combinations led to more effective interventions.

6.2.2. Healthcare professional perspectives

The qualitative study with healthcare professionals and service providers (Study 2) from a hospital in Scotlands prehabilitation intervention revealed both commitments to helping patients and significant challenges in the delivery process. Three themes emerged which may benefit an optimised intervention design.

'Preparing is better than waiting' captured healthcare professionals' and service providers' awareness of time constraints in cancer care. The typical window between diagnosis and surgery is only one to two weeks, limiting opportunities to create substantial physiological change through health-based interventions. Healthcare professionals and service providers expressed a desire for earlier patient referral, possible during the diagnostic phase, recognising that even brief interventions can be beneficial: *"If you've only got somebody for two weeks, again, you can get them walking straight away if it's possible"* (SP1).

'A problem shared is a problem halved' reflected healthcare professionals' and service providers' understanding of the value family members hold in supporting patients. They observed that family involvement improves information retention, motivation, and accountability. HCP3 noted: *"It's quite nice to have somebody there that can take all that information in for them."*. However, no formal structures existed in the current prehabilitation intervention to support systematic family involvement, and healthcare professionals expressed concern about making partner involvement seem mandatory, acknowledging that not all patients have available support.

'Structural issues' identified barriers including scheduling conflicts (prehabilitation clinic and exercise classes both scheduled on the same days, creating week-long gaps), infrastructure problems (parking difficulties, poor location accessibility), and inadequate staffing. Table 6 summarises the implementation barriers identified by healthcare professionals and service providers and outlines how the optimised intervention aims to address each.

Table 6.: Implementation barriers identified by healthcare professionals (Study 2) and intervention ideas

Barrier type	Findings from Study 2	Implication for practice	How optimised intervention addresses this
Time constraints	Typical 1-2 week window between diagnosis and surgery	Limited time for physiological change; need for efficient intervention design	App enables immediate intervention start; content prioritised by time available
Lack of family inclusion mechanisms	Healthcare professionals and service providers recognised family importance, but no formal structures exist	Ad hoc rather than systematic family involvement; patients without support may be disadvantaged	Structured but flexible family roles; their own app dashboard with family-specific educational resources; optional joint participation protocols
Scheduling conflicts	prehabilitation clinic and exercise class both on Friday, creating one-week gap	Continuity of care disrupted; limited engagement opportunities	App provides continuity between sessions; flexible scheduling options; multiple access points
Infrastructure issues	Parking described as 'horrendous'; location 'not the best for patients'	Physical barriers to attendance; may disproportionately affect patients without transport	Home-based exercise options via app; community venue alternatives; reduced reliance on hospital attendance for physical activity classes
Inadequate staffing	Example: 140 stomas/year with one stoma nurse; Healthcare professionals and service providers report 'firefighting'	Limited time for individualised patient care; workload prevents comprehensive support	Technology amplifies healthcare professionals' and service providers expertise; app handles routine instruction and monitoring; dashboard of the app enables efficient oversight of multiple patients and points out those who need more individualised support

6.2.3. Patient and family experiences of facilitators and gaps

Interviews with cancer patients and family members (Study 3) identified aspects of the current programme that are valued, whilst also pointing out missed opportunities. Three themes emerged from the analysis.

'Technology-enhanced personalised physical prehabilitation' revealed that mobile applications for exercise, which were only offered to some participants, were perceived as providing structure, guidance, and accountability. Patients appreciated having timed exercises with clear instructions and found that the remote monitoring by service providers created meaningful accountability. As one patient explained: *"He (SP_NI) was monitoring it, so I think he could, I'm assuming he could monitor what I was doing, to see that I was keeping up*

with it. So that was an incentive". However, participants raised concerns about accessibility for older adults less familiar with technology.

'Comprehensive support integration' identified nutritional guidance as a major gap. Patients and family members consistently reported inadequate information about pre-surgery and post-surgery nutrition. One family member stated: *"We weren't sent away with a nutrition sheet saying this is what you should have, this is the food you should be eating under the circumstances"*. Another noted: *"My role really was to make sure we had the right food. And in that area, we did feel that there wasn't enough information"*.

Suggested psychological support showed variable interest, with some participants finding that mindfulness practices had been helpful; however, most expressed reluctance to engage with a more formal psychological or mindfulness intervention.

'Structured family inclusion' highlighted the informal role family members play. Where family members participated in activities, positive experiences were reported, so one family member said, *"So, when we go, we exercise together because we're always sort of put into groups to do the circuit training. So, we exercise together, and I actually find that helpful, and I think [cancer patient] does too"*. Shared participation sometimes led to broader lifestyle changes extending beyond the intervention, yet family members often wanted more information about how to provide effective support. The interviews also revealed complexity around family communication and privacy. Some patients chose to limit disclosure about their diagnosis, which created challenges for family members providing support. One family member described the difficulty of maintaining secrecy whilst managing their own emotional needs, highlighting that family-inclusive approaches must respect patient autonomy whilst still supporting family members. Table 6.1 summarises patient and family priorities for intervention improvement.

Table 6.1.: Patient and family member priorities from Study 3

Theme	What worked well	What was missing or needed
Technology	Apps with reminders and monitoring provided structure and guidance; remote monitoring created accountability	Accessibility concerns for older adults; need for tiered technology options and support; options for those who can't/don't use smartphones
Nutritional support	Collaborative, non-prescriptive approach when provided; empowered informed choices	Structured, personalised information before and after surgery; specific dietary guidelines; resources for family members who prepare meals
Psychological support	Helpful for anxiety management for some participants	Flexible options acknowledging cultural and generational differences; support during post-treatment phase; alternatives to formal psychological sessions
Family inclusion	Attendance at appointments and exercise sessions valued; shared activities increased adherence and motivation	Formal inclusion in healthcare process; information about how to support patient effectively; recognition and support for family members' own needs

6.2.4. Synthesis: key gaps across studies

Synthesising the findings across all three studies suggested evidence around four critical gaps in current prehabilitation approaches. Table 6.2. presents these gaps with supporting evidence from each study.

Table 6.2.: Synthesis of gaps across the three studies

Gap identified	Study 1 (systematic review)	Study 2 (Healthcare professionals and service providers interviews)	Study 3 (patient/family interviews)
Absence of social support	None of 16 studies included social support BCTs despite evidence of importance in behaviour change; self-monitoring was presented in high-adherence interventions	Healthcare professionals and service providers recognised family value ('a problem shared is a problem halved') but no formal structures	Family members described as 'essential' but felt peripheral; wanted guidance on how to help
Inadequate nutritional guidance	Only 3 of 16 studies focused on nutrition; BCTs for nutrition less detailed in reporting	Not specifically discussed as barrier or facilitator by healthcare professionals and service providers	Major gap identified: 'no information given prior to surgery'; families sought information independently
Implementation barriers	Not specifically discussed	Time constraints, scheduling conflicts, infrastructure issues, staffing pressures	Technology valued but accessibility concerns for some; travel difficulties
Variable psychological support	'Stress management' BCT used in 6 of 16 studies	Healthcare professionals and service providers recognised psychological impact of diagnosis but pragmatic about limited time	Needs varied; gender and cultural factors influenced engagement; post-surgery phase particularly challenging

This synthesis demonstrates that whilst current prehabilitation interventions provide a foundation, they may miss opportunities for improvement. The complete absence of social support behaviour change techniques across the reviewed studies, combined with consistent stakeholder recognition of family importance, represents a possible component that should be included in the optimised intervention. Similarly, the disconnect between institutional assumptions about nutritional information provision and patient/family experiences indicates a need for structured nutritional education. Furthermore, the implementation barriers identified by healthcare professionals should be addressed for the optimised intervention to be deliverable in practice.

6.3. Step 2: Identifying modifiable factors

The second step of 6SQuID requires identifying which causal or contextual factors are modifiable and which have the greatest scope for change. The COM-B model (Michie et al.,

2011) provides a systematic framework for this analysis, proposing that behaviour results from the interaction of capability, opportunity, and motivation.

6.3.1. COM-B analysis of findings

Mapping the findings from all three studies onto COM-B components revealed patterns around intervention optimisation and identified which components should be prioritised.

6.3.1.1. Capability

Physical capability was generally improved through the current prehabilitation intervention. Patients reported improved fitness levels and felt better prepared for surgery, suggesting that exercise prescription and supervision are adequate. However, psychological capability showed significant gaps, particularly around nutritional knowledge. The disconnect between information hospitals believe they provide and what patients and families understand or retain suggests problems with how and when information is delivered. Family members taking responsibility for meal preparation often lacked the knowledge needed to fulfil this role effectively.

6.3.1.2. Opportunity

Physical opportunity for exercise was generally sufficient through classes and apps, though some participants reported inability to attend group classes due to distance and travel issues. The structural barriers identified by healthcare professionals (scheduling conflicts, infrastructure problems) represent physical opportunity constraints that the optimised intervention can address through flexible delivery mechanisms.

Social opportunity emerged as an opportunity worth exploring. Family members who participated in exercise sessions reported positive experiences and mutual benefit, yet such participation was informal rather than systematically facilitated. Healthcare professionals recognised the value of family involvement but lacked protocols to support it consistently.

Technology provided opportunities for engagement but raised accessibility concerns for older adults.

6.3.1.3. Motivation

Motivation for prehabilitation was generally strong. Patients understood prehabilitation benefits, showed commitment to following healthcare provider recommendations, and were often motivated through understanding the consequences they might experience when not engaging with prehabilitation components such as nutrition and physical activity. Being monitored by healthcare professionals created accountability that supported engagement, but the absence of consistent cues and habit formation may result in limited sustained behaviour change. Emotional responses to diagnosis and relationships with healthcare professionals and service providers also influenced engagement, which needs to be taken into consideration when considering digital integration.

Table 6.3. summarises the COM-B analysis and identifies priority targets for intervention.

Table 6.3.: COM-B analysis identifying modifiable factors

COM-B component	Current strengths	Identified gaps	Modifiable?
Physical capability	Patients reported improved fitness through intervention participation	Variable baseline fitness; some unable to attend classes due to access issues	Yes - graded exercise prescription
Psychological capability	Exercise knowledge generally adequate after instruction	Significant nutritional knowledge gaps; information overload at diagnosis impairs retention	Yes - structured education with appropriate timing
Physical opportunity	Exercise classes and apps available	Scheduling conflicts; accessibility barriers; limited home-based options in current intervention	Yes - flexible delivery mechanisms
Social opportunity	Some family involvement occurs when self-initiated	No systematic social support; family members feel peripheral to formal process	Yes - structured family inclusion
Motivation	Patients understand benefits; fear of regret motivates engagement; Monitoring creates accountability; habits can develop with practice	Psychological readiness varies; some resistance to formal psychological support; Inconsistent cues; limited systematic habit formation support	Partially - through education and flexible support options; reminders, monitoring, routine building

6.4. Step 3: Deciding on mechanisms of change

The third step of 6SQuID requires specifying the mechanisms through which change will occur. This section presents how the theoretical frameworks inform behaviour change technique selection and intervention design.

6.4.1. Application of theoretical frameworks

As introduced in Section 6.1.1, three complementary frameworks guide the optimised intervention; this section focuses on their application to the findings.

6.4.1.1. COM-B model application

The COM-B model provides the primary structure for linking identified barriers to intervention components. The behaviour change wheel (Michie et al., 2014) associates COM-B components with intervention functions and behaviour change techniques, enabling systematic selection of techniques to address identified gaps.

Healthcare professional insights map directly onto COM-B. The theme 'preparing is better than waiting' addresses capability and opportunity, time constraints limit capability development, and healthcare professionals show willingness to adapt their approaches to maximise brief timeframes. The theme 'a problem shared is a problem halved' addresses social opportunity and motivation. Healthcare professionals observed that family involvement improves patient motivation and outcomes, demonstrating how enhanced social opportunity directly influences behaviour change. The theme 'structural issues' maps to physical opportunity barriers that operate independently of individual capability or motivation.

6.4.1.2. Family systems theory application

Family Systems Theory (Bowen, 1978) recognises that families function as interconnected systems where changes in one member affect others. Several findings from the patient and family interviews illustrate this principle in the prehabilitation context. Interconnected health behaviours were evident when family members participated in prehabilitation activities. Joint participation created opportunities for mutual support and sometimes led to broader lifestyle changes extending beyond the intervention, such as increased cycling and walking. This demonstrates how interventions targeting one family member can catalyse health behaviour change throughout the family unit. Communication patterns significantly influenced support

provision. Having family members present at appointments improved information retention and understanding. However, when patients chose to limit disclosure about their diagnosis, this created subsystems within families with differential access to information, complicating support provision and creating emotional burden for family members maintaining confidentiality. Family members developed coping strategies that affected their capacity to provide support. Privacy preferences created isolation for some family members who needed to share their burden but were constrained by patient wishes. The theory suggests that effective interventions need to address the needs of the entire family system, not just the diagnosed member.

6.4.1.3. CFIR application

The CFIR (Damschroder et al., 2009) addresses practical implementation challenges through five domains. Applying CFIR to the healthcare professional findings:

Intervention characteristics: The intervention must be adaptable to varying time constraints whilst maintaining levels of effectiveness. Healthcare professionals' emphasis on maximising brief preparation periods suggests the need for modular designs delivering benefits regardless of the available timeframe.

Outer setting: NHS system constraints, including financial pressures, affect implementation capacity. The optimised intervention must align with existing priorities and available resources rather than requiring substantial additional investment.

Inner setting: Healthcare professionals showed high commitment to patient outcomes but faced structural constraints, including staffing pressures and scheduling conflicts. Communication and coordination between departments appeared challenging. The intervention must work within these organisational realities.

Characteristics of individuals: Healthcare professionals demonstrated understanding of prehabilitation benefits and readiness to implement family-inclusive approaches if provided with appropriate support and protocols.

Process: Implementation should include mechanisms for ongoing modification based on feedback. Not every hospital is configured identically, so the intervention must offer flexibility to accommodate different contexts.

6.4.2. Behaviour change technique selection

Based on the COM-B analysis and theoretical framework application, specific behaviour change techniques were selected to address identified gaps. The selection was built on techniques shown to be used most often in the systematic review, whilst adding techniques to address the social support gap.

Table 6.4. presents the BCT selection rationale, linking each technique to the target COM-B component, implementation approach, and evidence source.

Table 6.4.: Behaviour change technique selection and rationale

Target COM-B component	BCT selected	Rationale	Implementation in intervention	Evidence source
Social opportunity	Social support (practical)	Addresses complete absence of social support in reviewed interventions	Structured family roles; guidance for family members on practical support provision	SR gap; all three studies
Social opportunity	Social support (emotional)	Family members experience burden; need support structures for own wellbeing	Family member wellbeing resources; peer support opportunities; Healthcare professionals and service providers recognition of family needs	Patient/family interviews
Psychological capability	Information about health consequences	Knowledge gaps especially for nutrition; information timing problematic	Structured education at appropriate times; family-inclusive information sessions; accessible written materials	Patient/family interviews
Physical opportunity	Adding objects to environment	Need flexible access beyond hospital setting	App-based exercise guidance enabling home participation; reduced reliance on hospital attendance	Healthcare professionals and service providers interviews; patient/family interviews
Physical opportunity	Restructuring physical environment	Scheduling and infrastructure barriers limit access	Multiple delivery options; community venue alternatives; flexible timing	Healthcare professionals and service providers interviews
Automatic motivation	Self-monitoring of behaviour	Valued by patients; creates accountability; most common BCT in SR	App tracking of exercise and nutrition; Healthcare professionals and service providers dashboard for remote monitoring	SR; patient/family interviews
Automatic motivation	Prompts/cues	Supports habit formation; addresses inconsistent engagement	Automated app reminders; customisable notification schedule	Patient/family interviews
Reflective motivation	Goal setting (behaviour)	Used in only 6 of 16 reviewed studies despite evidence of effectiveness	Collaborative goal-setting with patient and family; shared goals where appropriate	SR; Family Systems Theory

The integration of Family Systems Theory with COM-B suggests that some behaviour change techniques could be enhanced through family involvement. For example, goal setting could involve both patients and family members setting shared health-related goals,

leveraging family dynamics to create mutual accountability. Information provision could be delivered to patients alongside family members, addressing knowledge gaps that might otherwise create confusion or anxiety for either party.

6.5. Step 4: Clarifying how the intervention will be delivered

The fourth step of 6SQuID specifies the practical delivery of the intervention. This section details the optimised intervention components and delivery mechanisms, explaining how each addresses the identified gaps and incorporates the selected behaviour change techniques.

6.5.1. Intervention overview

The optimised family-inclusive prehabilitation intervention comprises four core components: physical activity, nutritional support, psychological and family support. These are delivered through a dual-delivery model combining in-person healthcare professional and service provider sessions with app-based remote support. This structure directly addresses time constraints and accessibility barriers whilst maintaining the valued human connection with healthcare professionals and service providers alike.

6.5.2. Physical activity component

The physical activity component builds on the current intervention whilst addressing identified limitations. It comprises three elements: in-person supervised sessions, app-based exercise guidance, and optimised family inclusion.

6.5.2.1. In-person supervised sessions

In-person supervised sessions continue the structured approach patients valued, with healthcare professionals providing individualised assessment, exercise technique guidance, and progress monitoring (such as weight check ins/grip strength testing). Initial assessment establishes baseline fitness levels, identifies any contraindications or modifications needed, and enables personalised exercise prescription tailored to the individual's capacity and time until surgery. The collaborative style identified as effective in patient interviews is explicitly incorporated. Rather than prescriptive instruction, healthcare professionals use consultative language that empowers patient choice whilst providing expert guidance. This approach was valued by patients who appreciated being asked what they could manage rather than being told what to do. Sessions include practical skills development, such as exercises for post-

surgery recovery, helping patients prepare for the physical demands of getting out of bed, moving safely, and regaining independence after their operation. Progress monitoring during in-person sessions provides an opportunity for intervention adjustment. Healthcare professionals can modify exercise intensity, address any difficulties patients are experiencing, and provide encouragement based on observed improvements. This face-to-face contact maintains the human connection both patients and healthcare professionals valued, even when supplemented by technology-based support.

6.5.2.2. App-based exercise guidance

App-based exercise guidance provides flexibility for patients unable to attend regular sessions in person or completely wanting to supplement in-person sessions. The app delivers timed exercises, with demonstration videos of the exercise, timing cues, and guidance on correct technique to ensure safe and effective home-based practice, addressing what patients found valuable in the current intervention. The app incorporates several behaviour change techniques identified as important in the systematic review and COM-B analysis. Automated reminders should support habit formation by providing consistent cues for exercise at times chosen by the patient. Self-monitoring features enable patients to track their activity, creating the accountability they find motivating. The app will also include visualisation of patients' progress over time, such as weight loss or gain, depending on the patient's surgical preparation needs, to reinforce the benefits of continued engagement. Exercise content is structured to accommodate varying timeframes before surgery. Patients with longer preparation periods can progress through more comprehensive intervention, whilst those with limited time receive prioritised content focusing on the most beneficial exercises for surgical preparation. This modularity addresses the time constraint concerns raised by healthcare professionals.

6.5.2.3. Optional family participation

Optional family participation addresses the social opportunity gap identified across all three studies. Family members are invited to participate in exercise sessions where appropriate, building on the positive experiences reported in interviews where joint participation created mutual benefit and enjoyment. Joint participation can create mutual accountability, with family members and patients motivating each other on days when one party feels less inclined to exercise. This reciprocal support leverages family system dynamics to strengthen motivation for both parties. Some families in the interview study reported that shared

participation led to broader lifestyle changes extending beyond the intervention, such as taking up walking or cycling together. However, participation remains explicitly optional, respecting that not all patients want family involvement in exercise and not all patients have available support persons. The intervention is designed to be fully effective for individual participants, with family involvement enhancing rather than being essential to the intervention. This approach addresses healthcare professionals' concerns about equity for patients without available support, whilst still enabling family involvement where desired.

6.5.3. Nutritional support component

The nutritional component directly addresses the most significant gap identified in patient and family interviews, where participants consistently reported inadequate guidance about what to eat before and after surgery. Three elements comprise this component: structured pre-surgery and post-surgery information, practical meal planning resources, and family-inclusive education.

6.5.3.1. Structured nutritional information

Structured information addresses patient and family requests for clear dietary guidance throughout the surgical journey. Pre-surgery information covers nutritional strategies to optimise physical preparation, including adequate protein intake for muscle maintenance and appropriate hydration. Information about any specific pre-operative dietary requirements, such as bowel preparation protocols, is provided with sufficient time for patients to plan and adjust. Post-surgery nutritional guidance addresses the transition back to normal eating, which patients identified as particularly confusing. This includes information about dietary progression in the immediate post-operative period, foods that may need to be temporarily avoided or introduced gradually, and longer-term nutritional strategies to support recovery and healing. For patients undergoing procedures affecting digestion, such as bowel surgery and/or stoma placement, specific guidance addresses managing dietary changes related to altered digestive function. Here, information is provided at appropriate times rather than overwhelming patients at diagnosis when their capacity to absorb information is compromised. Written materials supplement verbal guidance to support retention, addressing the observation that patients often cannot recall information provided during stressful consultations. Materials are designed to be accessible, avoiding overly technical language whilst providing sufficient detail for practical application.

6.5.3.2. Practical meal planning resources

Practical meal planning resources respond to the disconnect between institutional assumptions about information provision and actual patient and family experience. Rather than abstract dietary principles, these resources provide concrete, actionable guidance including recipe suggestions appropriate for different stages of preparation and recovery, shopping lists and meal planning templates, practical tips for adapting family meals to meet patient dietary needs, and guidance on managing appetite changes and food preferences that may occur during the cancer journey. These resources acknowledge the reality that family members often take responsibility for meal preparation. Providing practical tools enables those preparing food to fulfil this role effectively without requiring extensive nutritional expertise. The resources are designed to be integrated into normal family eating patterns where possible, rather than requiring entirely separate meal preparation for the patient.

6.5.3.3. Family-inclusive nutritional education

Family-inclusive education recognises that those preparing meals need knowledge to support the patient effectively. Where family members are involved in food preparation, they are offered access to nutritional education resources and, where possible, inclusion in nutritional consultations. This addresses the finding that family members often felt excluded from information provision despite taking primary responsibility for implementing dietary recommendations. The collaborative, non-prescriptive approach valued by patients is maintained throughout. Rather than imposing rigid dietary rules, the intervention empowers informed choices by explaining the rationale behind nutritional recommendations and offering flexibility in how these are achieved. This approach respects patient autonomy and accommodates diverse food preferences, cultural dietary practices, and practical constraints that families face.

6.5.4. Psychological and family support component

This component addresses the variable psychological needs identified whilst systematically integrating family support, responding to the social support gap evident across all three studies. The component recognises that psychological needs vary according to individual preference, timing in the cancer journey, and cultural and generational factors.

6.5.4.1. Patient psychological support

Flexible psychological support options acknowledge that receptiveness to formal psychological intervention varies considerably. Some participants in the interview study found psychological support helpful, particularly for managing pre-operative anxiety. Others, particularly some male participants, expressed discomfort with formal psychological approaches, viewing them as inconsistent with their coping style or generational norms.

To accommodate this variability, the intervention offers multiple pathways. Practical stress management techniques are integrated into other intervention components rather than requiring separate formal psychological sessions. For example, breathing exercises may be incorporated into physical activity sessions, and relaxation techniques can be accessed through the app without being labelled as a psychological intervention. This provides benefit to patients who might not engage with explicitly psychological services. For patients who want more structured psychological support, this remains available through referral to appropriate services. The intervention does not replace specialist psychological care where needed, but ensures that basic emotional support and stress management are accessible to all participants, regardless of their willingness to engage with formal services. The timing of psychological support is also considered. Interview findings suggested that psychological needs vary throughout the cancer journey, with the post-treatment phase possibly being particularly challenging for some patients as well as family members. Whilst the prehabilitation intervention focuses on the pre-surgery period, information about ongoing psychological support resources is provided to help patients access help when needed throughout their journey.

6.5.4.2. Family member wellbeing support

The intervention provides resources addressing family members' own wellbeing needs, not just their role in supporting patients. This responds to findings that family members experience significant emotional burden, which may be compounded when maintaining confidentiality about the diagnosis at the patient's request. Family members described feeling isolated and unsupported despite carrying substantial caring responsibilities. Resources for family members include information about common emotional responses to a family member's cancer diagnosis, strategies for managing their own stress whilst providing support, guidance on maintaining their own health and wellbeing during the caregiving period, and information about when and how to seek additional support for themselves. Peer support

opportunities enable family members to connect with others in similar situations. This addresses the isolation some family members experienced, particularly those constrained by patient privacy preferences from discussing the situation with their usual support networks. Peer support can be facilitated through group sessions where family members can share experiences, or through signposting to existing support groups and organisations.

6.5.4.3. Healthcare professional recognition of family members

Healthcare professionals' recognition of family members is systematically incorporated into intervention protocols. Building on instances identified in interviews where healthcare professionals asked about family member wellbeing, the intervention includes prompts for acknowledging and enquiring about family members during patient contacts. This simple recognition was described as meaningful by family members who often felt invisible within the healthcare system, but also in their home setting. Where family members are present at appointments, they are actively included in discussions where appropriate and with patient consent. This addresses findings that family members sometimes felt like passive observers despite attending to provide support. Protocols guide healthcare professionals/service providers in balancing the inclusion of family members with respect for patient privacy and autonomy.

6.5.5. Proposed delivery

The optimised intervention uses a dual-delivery model to address implementation barriers whilst leveraging the technology features that patients valued. This comprises in-person components, app-based components, and a healthcare professional/service provider dashboard.

6.5.5.1. In-person component

Face-to-face sessions with healthcare professionals or service providers provide initial assessment and personalised intervention prescription, supervised exercise with technique guidance, opportunities for family member attendance and participation, collaborative goal-setting using the consultative approach patients valued, and nutritional and psychological support as needed. The in-person component maximises brief contact opportunities, recognising healthcare professionals' and service providers' observations that even short

timeframes can be meaningful. Sessions are structured to deliver essential content efficiently whilst maintaining the personal connection both patients and healthcare professionals valued.

6.5.5.2. App-based component

A mobile application extends intervention between in-person sessions, addressing scheduling and accessibility barriers. The app provides structured exercise guidance with timing and demonstrations, building on positive patient experiences with the existing technology. Automated reminders support habit formation through consistent cues. Self-monitoring features enable patients to track their activity and nutrition, creating the accountability that patients find motivating. Nutritional resources and meal planning tools are accessible to both patients and family members through independent dashboards, meaning both parties will have individual logins. Recognising accessibility concerns for older adults or those less comfortable with technology, the intervention includes tiered interface options with simplified versions, tutorial videos demonstrating app use, ongoing technical support throughout participation, and the option for family members to assist with technology engagement.

6.5.5.3. Healthcare professional dashboard

A separate interface enables healthcare professionals to efficiently monitor multiple patients without requiring additional face-to-face time, directly addressing workload concerns identified in interviews. The dashboard provides aggregated patient progress data showing engagement patterns and exercise completion, alert systems identifying patients who may need additional support or who are experiencing difficulties and streamlined communication tools for efficient patient contact. This approach amplifies healthcare professional expertise rather than replacing it. Routine monitoring is automated, allowing healthcare professionals to focus their limited time on patients requiring personalised attention. The dashboard supports the accountability relationship that patients valued whilst working within realistic resource constraints.

6.5.6. Family inclusion protocols

Rather than leaving family involvement to chance, the intervention defines structured but flexible protocols for family inclusion across all components. These protocols operationalise the social support behaviour change techniques identified as absent from current

interventions, whilst respecting the diversity of family situations and preferences identified in the studies.

6.5.6.1. Initial assessment of family involvement preferences

At intervention entry, patients are asked about their family situation and preferences for family involvement. This conversation explores whether the patient has a family member or other support person who might be involved, what level of involvement the patient would like (ranging from no involvement to full participation), the patient's preferences regarding information sharing with family members, and any specific circumstances that might affect family involvement, such as geographical distance or family member health issues. This assessment is conducted sensitively, recognising that not all patients have available family support and that some may prefer to manage their prehabilitation independently. The conversation avoids assumptions about family structure or availability and is framed to normalise both individual and family-inclusive participation pathways.

6.5.6.2. Family member onboarding

Where a family member is identified, and the patient consents to their involvement, the family member is offered information about the intervention and how they can participate. This onboarding includes an explanation of the intervention components and timeline, information about how family members can contribute (practical support, emotional support, joint participation in activities), access to family-specific resources through the app or written materials, and guidance on supporting without taking over, respecting patient autonomy.

Family members are also informed about support available for their own wellbeing, signalling from the outset that the intervention recognises and values their needs as well as their supportive role. Where family members cannot attend in person, remote options for involvement are explained, including app access and telephone support.

6.5.6.3. Flexible participation options

Family members can participate at different levels according to patient and family preferences and practical constraints. Options include attending in-person sessions with the patient, participating in exercise activities (either in supervised sessions or home-based through the app), accessing educational resources about nutrition and other intervention components, receiving their own wellbeing support and peer connection opportunities, and

being included in progress discussions and goal setting where appropriate. These options are not mutually exclusive, and participation levels can be adjusted throughout the intervention as circumstances change. Some families may start with limited involvement and increase participation as they become more comfortable, whilst others may need to reduce involvement due to competing demands.

6.5.6.4. Respecting patient autonomy and privacy

The protocols explicitly respect patient autonomy regarding disclosure and involvement levels. Patients retain control over what information is shared with family members and can change their preferences at any time. For patients who prefer limited family involvement, or who do not have available support persons, the intervention remains fully functional through individual participation pathways. Communication support resources help families navigate conversations about diagnosis and treatment, particularly where privacy preferences create complexity. This acknowledges the finding that some family members experienced significant burden maintaining confidentiality whilst wanting to provide support, and that some patients chose to limit disclosure to protect family members from worring.

The protocols also address situations where patient and family member preferences may differ, guiding healthcare professionals on managing these conversations sensitively whilst maintaining the patient's right to determine their own care arrangements.

6.6. Programme theory

This section elaborates on the programme theory, explaining how the intervention components are expected to produce change through mechanisms at individual, family, and system levels. The intervention theory model (Figure 6) provides a visual overview; Table 6.5. (Section 6.6.2.) provides a detailed textual specification.

6.6.1. How change is expected to occur

The programme theory proposes that change occurs through three interconnected pathways operating at different levels.

6.6.1.1. Individual pathway

At the individual level, patients develop physical and psychological capability through structured instruction, practice, and self-monitoring. Technology-enhanced delivery provides efficient, accessible guidance whilst maintaining accountability relationships with healthcare professionals. This pathway builds on current intervention strengths (effective exercise instruction, valued monitoring) whilst addressing identified gaps in psychological capability, particularly nutritional knowledge. The COM-B model explains the mechanisms: enhanced capability and opportunity, combined with motivation support through monitoring and reminders, may produce behaviour change.

6.6.1.2. Family system pathway

At the family level, family members receive education and support, enabling them to provide more effective, practical and emotional assistance. Joint participation in appropriate activities creates shared health behaviour change and mutual accountability. Family-inclusive information sessions address knowledge gaps whilst respecting communication preferences. Family Systems Theory explains how changes in one family member's behaviour influence others, potentially catalysing broader family health improvements beyond the individual patient.

6.6.1.3. Healthcare system pathway

At the system level, the intervention design works within existing organisational constraints whilst providing healthcare professionals with efficient tools for patient support and monitoring. Flexible delivery mechanisms address scheduling and accessibility barriers. Technology integration supports rather than replaces healthcare provider expertise. CFIR principles ensure the intervention can be realistically delivered and sustained within NHS resource constraints.

6.6.1.4. Integration of pathways

These pathways interact interdependently, where enhanced family capability improves patient support quality, strengthening the individual pathway. Improved patient engagement reduces healthcare provider burden, enabling more comprehensive care within the system pathway. Efficient intervention delivery creates capacity for family involvement that might otherwise

be impossible within time constraints. Technology supports all pathways whilst accommodating diverse needs and preferences.

6.6.2. Intervention specification

Table 6.5. provides a detailed specification of the intervention elements, including preconditions, inputs, activities, mechanisms, outcomes, and contextual factors.

Table 6.5.: Intervention specification

Element	Description
Preconditions and assumptions	Patients are referred to prehabilitation with sufficient time before surgery (minimum 1-2 weeks); patients have access to smartphone or alternatives to technology support is available; family members are available and willing to participate where applicable; healthcare professionals have capacity for initial assessment and periodic monitoring; NHS infrastructure can support app integration and dashboard access
Inputs and resources	Healthcare professional time for assessment, supervision, and monitoring; mobile application with exercise guidance, reminders, and tracking; nutritional education materials in patient and family versions; psychological support resources with flexible format options; healthcare professional dashboard for remote patient monitoring; training materials for healthcare professionals and service providers on family-inclusive delivery approaches
Activities	Initial assessment and personalised intervention prescription; in-person supervised exercise sessions; app-based guided home exercises with reminders; structured nutritional education for patients and families; optional joint family participation in exercise activities; psychological support through integrated stress management and formal options; remote monitoring via healthcare professionals and service providers dashboard; automated progress tracking and feedback
Mechanisms of change	Individual level (COM-B): building physical capability through graded exercise; enhancing psychological capability through structured education; creating physical opportunity through flexible delivery; enabling social opportunity through family involvement; strengthening automatic motivation through monitoring and cues. Family level (Family Systems Theory): enabling interconnected health behaviours through joint participation; encouraging shared motivation and mutual accountability; improving family communication about health. System level (CFIR): amplifying healthcare professionals' and service providers' expertise through technology; reducing unnecessary workload through automation; enabling adaptation to local contexts
Intermediate outcomes	Increased intervention engagement and adherence; improved exercise adherence; better nutritional adherence; enhanced health literacy for patients and families; greater self-efficacy; improved physical capabilities; reduced patient anxiety; reduced family member distress; improved family functioning; increased confidence for surgery
Health impacts	Short-term: improved pre-surgery physical fitness; enhanced surgical resilience; reduced post-operative complications. Medium-term: faster recovery; greater functional independence; improved quality of life for patients and families. Long-term: sustained health behaviour change; broader family health behaviour improvements; appropriate healthcare utilisation; return to normal activities
Contextual factors	Patient level: time to surgery; cancer type and stage; age; baseline fitness; prior prehabilitation experience; technology literacy; preferences for family involvement. Family level: family structure and availability; communication patterns; privacy preferences; existing health behaviours. System level: NHS financial pressures; Healthcare professionals and service providers' workload and capacity; facility accessibility; organisational culture and support; local infrastructure constraints

6.7. Discussion

6.7.1. Summary of development process

This chapter presented the systematic development of an optimised family-inclusive prehabilitation intervention following the 6SQuID framework. The development process synthesised evidence from a systematic review, healthcare professional/service provider interviews, and patient/family interviews to identify four critical gaps: absence of social support behaviour change techniques, inadequate nutritional guidance, implementation barriers preventing effective delivery, and family member needs not being systematically addressed. COM-B analysis identified modifiable factors with the greatest scope for change, particularly social opportunity and psychological capability. Three complementary theoretical frameworks (COM-B, Family Systems Theory, and CFIR) informed the selection of behaviour change mechanisms and practical delivery approaches.

6.7.2. Contribution to the field

This study makes several contributions to the prehabilitation literature. First, to the best of the researchers' knowledge, it represents the first systematic integration of COM-B analysis with Family Systems Theory in the prehabilitation context. This approach moves beyond individual-focused intervention to recognise the interconnected nature of health behaviours within family systems. Second, the intervention addresses the absence of social support behaviour change techniques identified in the systematic review. Whilst research demonstrates that family caregivers are vital to cancer care, a systematic review by Griffin and colleagues (2014) found that most family interventions in cancer care lacked systematic integration, with insufficient evidence that they consistently improved patient outcomes. Research on prehabilitation specifically has shown that family involvement, when it occurs, is typically informal and unsystematic rather than evidence-based (Bolshinsky et al., 2018; Thomas et al., 2019). The optimised intervention provides guidelines for structured protocols for family inclusion whilst respecting privacy and autonomy preferences. Third, the technology integration approach demonstrates how digital tools can amplify healthcare professionals' expertise rather than replacing it or adding an administrative burden. Research shows mixed results regarding digital health's impact on healthcare professionals' workload; a scoping review of digital health in oncology found that whilst some tools were perceived as burdensome, others did not negatively impact working time (Aapro et al., 2020). The

optimised intervention addresses workload pressures identified by healthcare professionals whilst maintaining the human relationships that both patients and providers valued.

6.7.3. Strengths of the development approach

The development process has several strengths. It is triangulated data, grounded in evidence from multiple stakeholder groups and methodological approaches. This may offer a robust foundation for intervention design, ensuring the intervention addresses gaps identified in the literature whilst responding to real-world implementation challenges and patient/family needs.

The process was theoretically driven, integrating three frameworks rather than relying on a single theory, enabling systematic analysis across different domains such as individual behaviour change mechanisms, family system dynamics, and organisational implementation factors. The iterative mapping process aimed to provide clear justification for each design decision, allowing the reader to understand how specific intervention features address identified gaps. Implementation considerations were built into the intervention design by including healthcare professional/service providers perspectives on barriers and facilitators; therefore, the intervention should already address some of the real-world constraints such as time limitations, scheduling conflicts, and workload pressures, which may potentially increase the likelihood of successful implementation.

6.7.4. Limitations

Several limitations must be acknowledged. All primary qualitative data were collected from a single hospital site in Scotland. Whilst this provided an in-depth understanding of one context, it limits generalisability to other NHS settings with different organisational structures, staffing models, or patient populations. The specific implementation barriers identified may not reflect challenges in other healthcare contexts.

The development did not employ formal co-design or participatory design methods where patients, family members, and healthcare professionals actively collaborated in designing intervention components. Instead, the development followed a researcher-led approach where stakeholder perspectives informed but did not directly shape intervention design. Co-design approaches might have yielded different insights or identified additional priorities. It should also be noted that certain stakeholder groups may be underrepresented. The patient and

family samples may have limited diversity in terms of age, ethnicity, cancer types, and family structures. Perspectives from other relevant professionals, such as dietitians or physiotherapists, were not systematically incorporated.

The development process, however, resulted in a theoretically sound and stakeholder-informed intervention design, but its actual feasibility, acceptability, and preliminary effectiveness remain untested.

6.7.5. Implementation considerations and scalability

Implementing this intervention across different healthcare settings requires careful consideration of which components are essential for intervention integrity and which can be adapted to local circumstances. This distinction may be critical for enabling implementation in diverse contexts whilst preserving the intervention's theorised mechanisms of behaviour change.

6.7.5.1. Core components

Core components that should remain consistent across implementation sites include the behaviour change techniques employed (instruction, self-monitoring, social support, goal setting), as these are the active ingredients through which the intervention is theorised to enable behaviour change. Systematic family inclusion opportunities must be maintained, as addressing the social support gap is a primary aim of the optimised intervention. The four core domains of exercise, nutrition, psychological and family support should all be included, as multimodal prehabilitation has stronger evidence than single-component interventions. The dual-delivery model combining human contact with technology support should be preserved, as this addresses both the valued therapeutic relationship and the practical barriers identified. Removing or substantially modifying these core components would fundamentally alter the intervention and undermine the programme theory. Any implementation should therefore prioritise maintaining these elements even when adaptations are necessary in other areas.

6.7.5.2. Adaptable elements

Other intervention elements can be adapted to local circumstances without compromising intervention integrity. Delivery venues can vary between hospital-based, community, or home-based settings, depending on local accessibility and patient preferences. Some sites may have excellent hospital facilities, whilst others may find community venues more

accessible for their patient population. Session timing and frequency can be adjusted to accommodate different surgical timelines, organisational schedules, and patient availability. The specific app features and interface design can be modified whilst maintaining the core functionality of exercise guidance, reminders, and monitoring.

Staffing models can be adapted to local workforce arrangements. Whilst the intervention is designed to be delivered by healthcare professionals/service providers with relevant expertise, the specific professional groups involved (physiotherapists, nurses, exercise specialists) may vary between sites. Training ensures consistent delivery of core components regardless of which professional groups are involved. The intensity and duration of the intervention may need adjustment based on the typical time to surgery at different sites and for different cancer types.

6.7.5.3. Uncertainty about adaptation effects

However, it is currently uncertain which specific adaptations will preserve or enhance intervention effectiveness, and which might undermine it. The interaction between intervention components means that modifications to one element may have unintended consequences for others. For example, reducing in-person contact might be acceptable if app-based support is comprehensive, but the threshold at which reduced human contact undermines therapeutic relationships is unknown in this context. The intervention will therefore require phased implementation with systematic monitoring to determine acceptable adaptations. As Heil and colleagues (2022) note, prehabilitation implementation should include pre-planned process evaluation to assess fidelity and quality of implementation, clarify causal mechanisms, and identify contextual factors associated with variation in outcomes. This evaluation should examine which adaptations are made at different sites, how this effect implementation fidelity, and whether outcome variations are associated with specific adaptations.

6.7.5.4. Required resources

Successful implementation requires consideration of resource requirements. Staff time is needed for initial patient assessment, supervised sessions, and monitoring via the dashboard. Training is required for healthcare professionals and service providers delivering the optimised intervention, particularly regarding family-inclusive approaches, which may differ from standard practice. The app’s content must be introduced to staff thoroughly and

dashboard access and functions will need to be explained accordingly. Administrative systems need to accommodate family member registration and communication where relevant. The intervention is designed to be functional within existing NHS resource constraints rather than requiring substantial additional investment. Technology is used to amplify healthcare professionals' and service providers' expertise and automate routine monitoring, potentially offsetting some of the time constraints. However, initial implementation will require investment in training and system setup, and ongoing resource implications should be monitored as part of the feasibility evaluation.

6.7.6. Complexity and implementation tension

A fundamental tension exists in this intervention design; to address the gaps identified across the three studies, the intervention incorporates multiple new components: systematic family inclusion, digital tools with monitoring capabilities, and enhanced behaviour change techniques. However, this comprehensiveness creates inherent complexity that may create implementation challenges, and this is well-documented in implementation science literature (Skivington et al., 2021). Whilst simpler interventions often prove ineffective at achieving meaningful outcomes, more complex multilevel interventions frequently fail at implementation due to coordination demands and resource requirements (Moore et al., 2017). Research identifies complexity as a major barrier to implementing healthcare interventions, with multidisciplinary interventions requiring additional work on top of routine clinical responsibilities (Geerlings et al., 2018). Interventions are particularly difficult to sustain in resource-constrained settings (Chambers et al., 2013), precisely the NHS context in which this intervention would need to function. The features designed to enhance effectiveness (family involvement, addressing social support gaps, technology providing flexibility and accountability, personalisation accommodating individual differences) may prevent the intervention from reaching patients if implementation proves too complex or resource-intensive. Future feasibility testing must evaluate not only whether the intervention achieves intended outcomes when delivered, but whether it can realistically be delivered and sustained within existing NHS structures.

6.7.7. Future directions

The optimised intervention requires testing and refinement (6SQuID Step 5) before rigorous evaluation (Step 6). Study 5 presents focus group findings evaluating the optimised

intervention and its acceptability with patients, family members, and healthcare professionals. This provides initial stakeholder feedback, enabling refinement before more resource-intensive feasibility testing. Following refinement based on stakeholder feedback, a feasibility randomised controlled trial would assess recruitment rates, retention, adherence to intervention components, safety, and preliminary effectiveness through clinical and psychosocial outcomes for both patients and family members. Process evaluation would examine implementation fidelity, mechanisms of change, and contextual factors influencing outcomes. This phased approach aligns with the MRC framework for developing and evaluating complex interventions (Skivington et al., 2021).

6.8. Conclusion

This chapter has presented the systematic development of an optimised family-inclusive prehabilitation intervention following the 6SQuID framework and informed by the MRC guidance for complex intervention development. By synthesising evidence from a systematic review, healthcare professional perspectives, and patient/family experiences, the optimised intervention addresses critical gaps in current practice: the absence of social support behaviour change techniques, inadequate nutritional guidance, implementation barriers limiting intervention reach, and unmet family member needs. The integration of COM-B, Family Systems Theory, and CFIR provides a theoretical foundation for an intervention that recognises health behaviour change occurs within interconnected family systems and must be deliverable within real-world healthcare constraints. The programme theory articulates how intervention components are expected to produce change through mechanisms at individual, family, and system levels, providing a testable framework for future evaluation. The optimised intervention is grounded in evidence and theory, requiring testing and refinement through stakeholder evaluation and feasibility research. Study 5 presents the next stage of this development process in the form of a focus group evaluation of the proposed intervention with key stakeholders.

Chapter 7. Stakeholder focus group feedback and evaluation of acceptability of the optimised family-inclusive cancer surgery prehabilitation intervention (Study 5)

7.1. Introduction

Study 4 presented the development of an optimised, family-inclusive prehabilitation intervention, addressing gaps identified in earlier chapters (Studies 1-3) of this thesis. This chapter evaluates the views and perceptions of cancer patients, family members and service providers on the acceptability of the proposed intervention through a multi-stakeholder focus group. Stakeholder feedback represents a critical component of healthcare intervention development, enhancing intervention acceptability, feasibility, and implementation success (O'Cathain et al. 2019; Skivington et al., 2021). Implementation science frameworks, including the CFIR (Damschroder et al., 2009), emphasise that intervention characteristics, stakeholder perspectives, and organisational context interact to determine implementation outcomes. Multi-stakeholder input allows identification of potential implementation barriers and facilitators before full intervention development, reducing the risk of intervention failure due to poor stakeholder acceptance. This chapter applies these principles by gathering service provider, cancer patient and family member feedback on the proposed prehabilitation intervention to help identify refinements.

The theoretical frameworks underpinning the proposed intervention, outlined in Study 4, including the COM-B model for behaviour change (Michie et al., 2011) and Family Systems Theory (Bowen, 1978) for understanding family dynamics, require validation through stakeholder feedback. Stakeholder perspectives can guide whether theoretical predictions align with real-world experiences and identify refinements needed for the successful implementation within existing healthcare systems.

Focus groups provide an optimal method for exploring complex intervention components through interactive discussion and immediate feedback (Krueger et al., 2015; Nyumba et al., 2018). The multi-stakeholder composition enables triangulation of perspectives, revealing areas of convergence and divergence across different stakeholder groups. Visual presentation of intervention materials during the focus group allowed participants to provide concrete feedback on specific components rather than abstract concepts. The focus group approach aligns with the COM-B model (Michie et al., 2011) by enabling assessment of how

intervention components address capability, opportunity, and motivation domains from multiple stakeholder perspectives. Healthcare professionals can evaluate implementation components within organisational constraints, whilst patients and family members can assess the acceptability and usability of proposed interventions.

The primary aim of this study was to evaluate stakeholder acceptability of the proposed family-inclusive prehabilitation intervention (Study 4) through multi-stakeholder feedback. Secondary aims included identifying specific intervention refinements needed for successful implementation and validating the application of theoretical frameworks (COM-B model and Family Systems Theory) in predicting stakeholder needs and preferences.

This chapter provides validation of the intervention development work presented in Study 4, moving from stakeholder and theory-informed design to stakeholder-informed refinement. The findings contribute to the prehabilitation evidence base by demonstrating how systematic stakeholder engagement can enhance intervention design whilst identifying implementation considerations for family inclusive approaches in cancer care settings.

This study addresses Research Question 5: Is the optimised family inclusive prehabilitation/rehabilitation for cancer surgery intervention acceptable to cancer patients, family members, and service providers?

To address this overarching question, the following specific objectives were examined:

1. What are patient, family member and service providers' perspectives of the proposed family-inclusive prehabilitation intervention and its acceptability?

2. How do stakeholders evaluate the key intervention components (technology-enhanced delivery, nutrition support, and family inclusion)?

3. What intervention refinements are needed based on stakeholder feedback to support successful implementation of the intervention?

7.2. Methods

7.2.1. Study design

A single focus group using a structured approach was conducted via video call with cancer patients, family members, and healthcare professionals. All participants were recruited through a hospital in Scotland, located in the NHS Greater Glasgow and Clyde proximities, and had experience with prehabilitation interventions. The focus group was designed to evaluate the intervention components developed in Study 4 through interactive discussion and structured feedback.

7.2.2. Recruitment

Recruitment was facilitated by the healthcare team at a Hospital in Scotland, following NHS research governance protocols. As per NHS governance requirements, the healthcare team was responsible for identifying eligible participants and distributing postal invitations on behalf of the research team. The invitation letter (Appendix K) included a participant information sheet (cancer patients - Appendix L / family members - Appendix M) which provided details of the study aims and procedures, as well as the researcher's contact information. Those interested in taking part were asked to reach out to the researcher via email, text or call.

Eligibility criteria:

Participants were eligible if they met the following criteria:

For patients:

- participation in the prehabilitation intervention at the chosen hospital in Scotland within the last 12 months

- diagnosis of CRC or ovarian cancer

- no previous participation in earlier thesis studies (Study 2)

- above the age of 18

For family members:

- must have a family member who meets the criteria above

For healthcare professionals/service providers:

- direct involvement the prehabilitation intervention

- no participants from previous study (Study 1)

Three recruitment rounds were completed, with approximately 10 invitations being distributed per round to patients and their family members (n=10 letters per round, n=30 total). We opted for three smaller rounds of recruitment over two months as the number of patients participating in the prehabilitation clinic's intervention is limited. By staggering the invitations, it allowed newer patients to also be recruited. From these invitations, one patient-family member dyad agreed to participate.

Five healthcare professionals involved in delivering the prehabilitation intervention at chosen hospital in Scotland were invited; two expressed interest, but only one agreed to participate and was sent a participant information sheet (Appendix N).

Recruitment challenges:

There were several factors that contributed to the limited sample size. The eligible patient pool was restricted by the prehabilitation clinic's relatively small service with limited patients that fit the patient criteria. The HSC REC approval took approximately three months to obtain, which compressed the available recruitment window due to the thesis submission deadline. This process, though lengthy, did not require the researcher (CK) to respond to any queries. After three recruitment rounds, the healthcare team indicated that all eligible patients meeting the criteria had been reached. The final focus group comprised three participants: one cancer patient, one family member, and one healthcare professional, representing all three stakeholders. While the sample is smaller than anticipated, the participants provided multi-perspective feedback on the newly suggested intervention.

7.2.3. Participants

The cancer patient (FG-PT) was male, 18 months post-colorectal cancer diagnosis with stoma surgery experience and comorbid Type 2 diabetes. He was an active user of the prehabilitation clinic app. Their family member (FG-FM) was a female partner who was the

primary food preparer, had an extensive family cancer history and was involved in all appointments and care decisions. The service provider (FG-SP) was a physiotherapist with physical activity prehabilitation delivery experience and a group class facilitation background; they run the prehabilitation clinics physical activity group class on a weekly basis. As the prehabilitation clinic of the chosen hospital only constitutes of a small number of staff, the hospital name and location were redacted to insure the anonymity of the participants of this study.

7.2.4. Data collection

Interested participants who contacted the researcher were provided with the consent form via post, including a stamped return envelope. Written informed consent was obtained prior to the focus group, with participants returning the signed forms via post. At the beginning of the focus group, the researcher reiterated the study aims, procedure for the session and willingness to participate was verbally confirmed. Participants were reminded that the session was recorded and that they had the right to withdraw their participation at any point.

The focus group was conducted via Microsoft Teams and lasted around 60 minutes. It was a semi-structured discussion, which was based around understanding stakeholder input and their acceptability of the optimised intervention. It was explained to participants that after the evaluation of the findings from Studies 1-3, three main components emerged and were integrated into the new intervention development (Study 4): technology-enhanced delivery, nutrition support component and family inclusion. Intervention components were presented using PowerPoint slides (Appendix P) to participants during the focus group, allowing visual presentation with explanation and immediate feedback. The first visual aid slide showed a mock-up of the digital app, showing a dashboard page, exercise page, nutrition page, and a summary page. The second slide discussed family inclusion. The third slide focused specifically on the nutritional component of the intervention. The session was audio recorded with participant consent for anonymised verbatim transcription.

7.2.5. Data analysis and theoretical framework

A hybrid deductive-inductive thematic analysis combining framework-based analysis with emergent theme identification was employed (Fereday and Muir-Cochran, 2006). The analysis was conducted manually by the researcher.

The deductive analysis was structured along the intervention components developed in Study 4. The analysis mapped participants' responses to the three core intervention components: technology-enhanced delivery, nutritional support, and family inclusion. Additionally, the COM-B model was used as a theoretical component to validate whether stakeholders' responses aligned with predicted barriers and facilitators identified in earlier thesis chapters (Studies 2 and 3). This involved examining participants' feedback reflecting capability gaps in knowledge and skills, opportunity constraints such as time and resources, or motivational factors, including beliefs and goals. Therefore, the deductive analysis assessed the effectiveness of the theoretical framework developed in Study 4 to predict stakeholder needs and intervention acceptability.

The inductive approach involved identifying themes beyond the existing framework. Through carefully reading and re-reading the transcript, the researcher remained open to new barriers, facilitators, and implementation insights developing from the data. This approach helped to recognise unanticipated stakeholder priorities which had not become apparent in Studies 2 and 3.

The analysis progressed through three rounds, and the transcript was coded using the deductive framework. The second round involved refining both deductive and inductive codes, merging similar codes, and organising codes into broader themes. The third round focused on finalising themes and ensuring coherence and distinctiveness from one another. Representative quotations were selected to illustrate each theme. Through the process of moving between the data and the theoretical framework, the researcher ensured rigorous interpretation.

Please find the full reflexivity statement in Chapter 4, section 4.2.6. However, for this chapter in particular, a further reflexivity should be noted. As I designed the optimised intervention in Study 4, I might have carried some bias when introducing it to the focus group. It was always my intention to be open-minded to feedback and insights from the participants, as I viewed this process as informative and enriching the intervention components rather than as a threat to my own work. Nevertheless, I am not able to fully exclude the possibility of unconscious biases throughout the focus group discussions or the analysis.

7.2.6. Ethical Considerations

Ethical approval was obtained by the NHS GG&C Research and Innovation board (UGN23ON094), Health and Social Care Research Ethics Committee A (HSC REC A; 23/NI/0137) and the University of Glasgow's ethics committee through requesting amendments to the original submissions (Appendix J / Appendix I / Appendix D /Appendix Q). All participants received comprehensive written and verbal information about the study, emphasising voluntary participation and data anonymisation protocols. Written informed consent was obtained prior to recording. Anonymisation involved the removal of identifying contextual information from quotations whilst maintaining analytical integrity.

7.3. Results

7.3.1. Intervention component validation

7.3.1.1. Technology-enhanced delivery

All three stakeholders expressed support for technology-enhanced delivery, confirming the acceptability of this intervention component suggested in Study 4. As mentioned in Chapter 4 (Section 4.2.1.1.), some patients of the prehabilitation clinic were offered a simple exercise app, which is being referred to in this section. The optimised intervention will offer an enhanced version of this application, accessible by the entire clinical team and offered to all patients and encompassing other aspects of prehabilitation such as nutrition and psychological support.

The FG-PT described practical benefits, mentioning how the current app accompanied exercise intervention encouraged his sustained engagement: *"I thought that it was really good because it has a small sort of video of the exercise as well and a timer and so it's not just printed out sheet of exercises it's an actual, like I have to look at it on the iPad as I do it in real time."*. This addresses capability barriers by building exercise technique knowledge and confidence through visual demonstration of the exercise and structured time periods through the timing of the duration of each exercise and rest pattern. Though the instructional nature of the printed exercise plan patients received as part of the prehabilitation clinics' exercise component underlined motivational factors, the accountability mechanism through the app was also reported as motivating. Highlighting how the awareness of the healthcare

professional monitoring patients might create an incentive for more consistent engagement: *"And of course, SP-NI can see how I've been exercising, from his screen, I think, check if I do the exercises. It does incentivise it to do it, I think, to do the exercises a bit more than just having a sheet of paper to look at."*. This illustrates that the healthcare professional's dashboard, which would have insight into all patients' progress and adherence, aids motivational barriers through external accountability. Healthcare professionals monitoring patients creates incentives for motivation, such as goal-oriented engagement and habit formation. The FG-PT repeatedly demonstrated being open to new and enhanced technology integration, building on the external resources they have used (outside the prehabilitation clinics' exercise app). FG-PT described a positive experience with an external virtual resource he engaged with to address a specific information gap in his cancer care plan: *"We had a Zoom meeting yesterday with Maggie's about that. It's their introduction to chemotherapy... that was pretty good, that was helpful."*. He also emphasised the simplicity of accessing the service: *"The Maggie's meeting was a QR code on the appointment letter, and you just click on that, and it took you to the site, and you book, you were given some days for the Zoom meeting. It was very easy to do."*. This underlines that simple digital access works effectively and that these virtual delivery formats are perceived as helpful and acceptable.

The FG-FM explained their separate relationship with prehabilitation clinics' exercise facilitator staff and their own relationship with exercise: *"I've had a lot of back problems, and [SP-NI] did try to give me some exercises, but they didn't work. I practise Tai Chi, so sometimes I go downstairs and do that, and FG-PT comes upstairs, and you (FG-PT) have that time."* FG-PT confirmed this separation in their exercise routine: *"yea I tend to do that by myself with the iPad and just do that for half an hour by myself"* with FG-FM adding *"yeah, that's kind of your time."* FG-FM's physical limitations (back problems) and preference for alternative exercise (Tai Chi) meant she did not use the exercise app, nor necessarily worked out with her partner. The backpains mentioned by FG-FM represent physical capability constraints that prevented shared exercise participation. This shows how individual differences in capability can influence adaptation to exercise interventions. For both, exercise was a seemingly important part of their lives; however, their separate approaches to exercise revealed that even highly collaborative couples may hold individual preferences which could create natural boundaries around technology use for exercise habits.

The FG-SP was strongly in favour of technology integration and identified access as well as equity benefits which extend beyond the individual patients experience into a population-level consideration: *"I think it's a great idea I think for the number of folk who are going through it is great, with families other commitments or just even location like sometimes just travelling and if you are not close to the hospital, having to drive and you got all these other appointments."*. The FG-SP identified how technology could address physical opportunity barriers, such as travel due to geographical distances and scheduling because of competing commitments, which currently limit the intervention's access. Besides this acknowledgement for the app-based intervention, the FG-SP also pointed out current monitoring limitations of paper-based systems: *"It's not quite as interactive as an app, because we can't see if folk are doing it [the exercises]."*

Within the focus group, stakeholders supported expanding technology to include nutrition support aspects. The FG-PT expressed enthusiasm: *"definitely yeah because it (nutrition) seems to be such an important part of the prehabilitation treatments, you know, combined with the exercise"*. The FG-SP reinforced this from a clinical perspective and noted patients frequently return asking, *"Nutrition-wise, like that people will come back and they will say I don't really know what to take [in this context, eat or consume] or what not to take or how much am I taking."* This agreement on nutrition integration represented multi-stakeholder validation.

A critical implementation challenge was brought up regarding intervention adaptation over time, with the FG-PT identifying: *"The thing is, with the exercises on the app,* [*SP-NI] has changed them as I have gone through, you know, the stoma and then they came off, in stages, so he has changed the exercises. So how would that work with the individuals in the app?"*. The FG-SP confirmed their current manual process: *"So how we work it where I work, you will have to come back in, so we' see how far you have come for example after surgery, and then we would give you 6-8 weeks of different exercises."* The FG-SP continued: *"but sometimes we also do a phone call and check how you are getting on."*. This feedback from both the FG-PT and the FG-SP perspectives reveal a critical technical requirement of automated time-based progression, which is based on surgery dates and progresses through the varying recovery trajectories.

Both the FG-PT (from lived experience) and the FG-SP (from clinical practice) independently identified the same limitation, that the current paper-based as well as app-based approaches require manual healthcare professional adjustment as patients progress through surgical phases. This represented evidence of a genuine implementation barrier not addressed in the proposed intervention design in Study 4.

7.3.1.2. Nutrition support

All three stakeholders confirmed nutrition support as a critical intervention component, though significant comprehension and implementation barriers were identified.

The FG-PT confirmed the absence of nutrition guidance in existing technology: *"There is no nutritional guide on that app, I've got that [nutrition] from talking to SP-NI, we talk about nutrition, but the app itself is just mainly the exercises."* Despite this gap, FG-PT expressed support for integration: *"definitely yeah because it seems to be such an important part of the prehabilitation treatments, you know, combined with the exercise."*

Apart from information gaps, the FG-PT also articulated fundamental comprehension difficulties with nutritional terminology that was being introduced by the researcher. This demonstrated how nutritional concepts, such as dividing foods into carbohydrates, fats and proteins, fail to translate into practical guidance around food for lay people. When the focus group participants were shown an example of nutritional guidance for the app, the FG-PT identified this problem: *"protein, easy to digest food, well, that doesn't mean anything to most people."*. This was a hurdle the FG-PT observed previously too, with nutrition support they received at the point of diagnosis: *"Like they would say have one cup of Greek yoghurt, well what does that mean? Does that mean go to the supermarket and buy a big jar of strawberry-flavoured yoghurt, which is full of sugar? OK, but really it is natural yoghurt with no flavourings."* This comment discusses a psychological capability barrier which extends beyond a knowledge gap to a fundamental health literacy issue. The FG-PT noted that this confusion persisted throughout their cancer journey: *"You get this pre surgery information from the stoma nurse, you get a lot of information from them about diet, you know, soft diet for so many weeks after you first had the stoma but its very much like what is shown here, you know, just ingredients, yogurt, banana and what not, safe foods and what to avoid, but there*

isn't many things about recipes." This indicates that the descriptive information given is not sufficient and is often open to misinterpretation.

The FG-FM, despite managing Type 2 diabetes of their partner (FG-PT) for years, acknowledged nutritional challenges affect broader populations: *"yeah, I think we have got it well covered",* but recognised *"I can see some people really struggling."* The FG-FM contributed a practical consideration: *"I suppose portion control as well."* The FG-PT immediately confirmed: *"Yes, when talking to SP-NI, portion control was something that came up."* This practical skill offered by SP-NI addresses psychological capabilities in terms of understanding appropriate quantities of foods to consume and the practical implementation skills needed to apply this knowledge.

The FG-SP identified a critical educational gap from their broader clinical experience: *"I also think food that folk should avoid, just a bullet point on why, because folk don't understand it... So, you know some folks have always been told about high fibre foods, eat high fibre foods, but maybe a point on why you wouldn't want to eat that when you have a stoma would be good.".*

Agreement emerged favouring recipe-based approaches over abstract nutritional concepts (like nutrition information such as macros aka grams of fat/protein/carbohydrates), the FG-PT stated: *"I think as [FG-SP] said, that is maybe a better idea, instead of a list of safe food and what to eat and what not to eat, a recipe for a meal which has all the right things in it.".* This represented an interactive agreement between the FG-PT and the FG-SP during the discussion. The healthcare professional reinforced with practical considerations: *"And probably the recipes you want, you know, must be food that folk will eat. You can get fancy recipes, but folk want mashed potatoes, but it's about how you cook it that's important."*

The FG-PT preferred a written format: *"Yeah, a picture but also a written recipe would be better."* The FG-FM supported maintaining both recipes and safety lists: *"yeah, yeah"* when the researcher suggested integrating both approaches.

While the FG-SP suggested brief explanations for dietary restrictions, neither the FG-PT nor the FG-FM verbally responded to this specific suggestion during the discussion. However, the FG-PTs earlier expressed confusion about terminology, which supported the need for clearer explanations. The focus group revealed that nutritional support requires recipe-based

practical guidance with precise language (specifying "plain natural yoghurt with no added sugar" rather than "Greek yoghurt"), familiar culturally appropriate foods, portion control guidance, and brief explanatory notes for restrictions. The patient and family member did not verbally respond to some healthcare professional suggestions, indicating potential differences in perceived priorities between clinical and lived experience perspectives. The cancer patient noted the limitation of existing technology and therewith highlighting their acceptance of the newly proposed application which includes what is here described as lacking in the old app: *"There is no nutritional guide on that app, I've got that (nutrition) from talking to SP-NI, we talk about nutrition, but the app itself is just mainly the exercises."*

7.3.1.3. Psychological support

Confusion and slight resistance around psychological support and its terminology became apparent in the focus group. The discussion did not necessarily suggest unwillingness to engage with mental wellbeing exercises or monitoring of wellbeing but rather emphasised the need for varying conceptualisations of it as well as how it is communicated to patients and family members. Simplified assessment approaches of wellbeing (scale-based ratings) showed acceptability; however, the value of increased wellbeing through peer support through digital means, such as online or app-based chat rooms, was questioned.

The FG-PT acknowledged that the resistance towards psychological care might be generational or cultural: *"I think it's like a generational thing in a way as well."*. This demonstrated a psychological capability barrier where abstract psychological care concepts seem to be disregarded on the basis of generational differences. Despite struggling with terminology around psychological support, the FG-PT expressed willingness to engage with simplified scale-based assessments of their wellbeing: *"Yes I would, I would engage with that (scale-based rating). SP-NI will ask me how I feel from a scale, you know, and he marks it on my chart, it could also be done on an app."*. Applying visual approaches addresses psychological capability barriers by making psychological assessments more accessible.

However, the FG-PT identified a barrier to honest reporting: *"I think people might struggle with it you don't always want to tell somebody you aren't feeling that good. In the past, I have sometimes been trying to put on a brave face for other people. You know, when people ask you how you are getting on with the cancer, just say yea I am fine, getting on with it. Keep it*

inside a bit." The FG-PT tentatively suggested digital assessment might help: *"You could mark it in an app and look at yourself maybe, it would maybe help. I'm not sure."*

The FG-SP provided context from their clinical experience, describing how psychological support naturally develops in group settings through peer interaction: *"In the exercise classes, we have a break, so everyone comes in, all different types of cancers and stages, and in the break we talk about, not necessarily about how they are feeling but just talk about what is coming up for them and then it kind of naturally progresses in to talking about things more deeply."* They explained the mechanism: *"Someone would say they are struggling with sleeping and then someone else will say I am kind of the same, sharing their experience. So, it is just a natural conversation between folk, together."*

The FG-SP emphasised how valuable these conversations, which develop naturally, can be: *"A lot of people who say that that is actually, that's what they find to be the best part about the class."* They contrasted this with direct professional inquiry: *"Cause 9 out of 10 times, if I ask when someone comes in, 'how are you feeling', they will just say 'yea I am fine'. So, yea then talking to other folks, that when they talk about other stuff that maybe they weren't able to name or don't know how to talk about at first."* This suggests that peer interaction enables natural disclosure, which direct questioning by a healthcare professional may not. Creating space for patients to talk with one another demonstrates that social opportunity is being encouraged through peer interactions, therefore addressing motivation barriers by creating safe spaces for emotional expression.

The FG-SP acknowledged difficulty replicating organic peer support, which takes place in in-person exercise classes, for example, digitally: *"I don't know how you would capture that in an app."* When describing the natural progression from casual chat to deeper sharing, when engaging in face-to-face activities with other patients or healthcare professionals. The discussion did not resolve whether chat rooms or comment sections could create the same psychological safety as in-person peer interaction. The FG-SP suggested that signposting external resources (such as the closest cancer charity, walking groups in the area, online seminars on cancer treatment or life after cancer), in the app, could be a potential alternative.

However, FG-SP suggested potential digital approaches when asked about psychological support in the app: *"In terms of psychological support yeah, I think something like you know*

scale, just you know your face is how you feeling are you feeling, how you feeling today that you can just click and it keeps an eye on it."

The FG-SP proposed potential peer support mechanisms: *"And maybe a comment section with the most common side effects? Somethings for the people go through, so maybe they can chat in a chat room, so it's not necessarily help from professionals, but maybe more peer support, saying this is what you could do from other patients, to learn from other patients on how they coped with different things."* They elaborated: *"Maybe it's an option to almost signpost to some of these charities chat rooms or just particular questions to other patients or patients may answer."*

The FG-FM did not provide extensive input on psychological support approaches during the discussion. When asked about stress management resources, the FG-FM stated: *"I think sometimes I tend to, I keep a lot inside, I do have a friend that I can talk to, I mean I know I have family."* When the FG-PT asked, *"Would that help you in an app though?"* FG-FM responded: *"Well, probably not for me."*

Both the FG-PT and the FG-SP agreed that picture scale-based assessment was more acceptable than abstract wellbeing questionnaires. FG-PTs' willingness to engage with a scale rating matched the FG-SP suggestion that simple visual scales (*smiley faces indicating how you are feeling*) could work effectively.

The consensus of the focus group was that psychological support requires simplified terminology and assessment approaches (visual scales aka smiley faces, rather than "wellbeing" scales), acknowledgment of generational and cultural differences in engagement, integration with face-to-face peer support opportunities that cannot be fully replicated digitally, and signposting to external support resources with simple access methods. The optimal approach to digital peer support remained unresolved and is requiring further exploration and testing.

7.3.2. Family inclusion pathways

Throughout the discussion in the focus group, a variety of family involvement patterns emerged, and important distinctions between this couple's experience and broader patient populations were made, which suggested the need for flexible pathways.

The dyad mentioned their own way of managing and sharing information throughout the cancer journey and FG-PT explained: *"I talk to FM, and she always came with me to SP-NI and various things. There is nothing I know, and FG-FM doesn't know."*. FG-FM's extensive cancer experience through having had other family members affected by the disease influenced this openness: *"There has been cancer in my family for a long, literally years, most of my family has had cancer. So, for me, this, I don't know, it is not something I don't know about."*. This displays Family Systems Theory's principle of multigenerational patterns, where the FG-FM's extensive experience with cancer influenced her approach to FG-PT's diagnosis. It also suggests that the FG-FM might have a greater understanding of the disease, its terminology and how to manage it.

However, the FG-PT recognised this approach doesn't represent all patient experiences: *"Though that might not work for everybody. I imagine some people close down when they have got their cancer, and they don't want to talk about it with other people."*. This recognition aligns with Family Systems Theory's concepts of the emotional cut-off, where individuals experiencing high stress may distance themselves from family members, representing one end of a continuum from complete information sharing to protective distancing. The variation in family inclusion was further confirmed by the FG-SP who observed diverse family involvement patterns in their clinical experience: *"The family involvement, see we always say if folk want to bring someone along to the class they can."*, they then noted: *"Family members usual come along for the first few sessions"* but described how involvement patterns often change over time, suggesting families' needs differ and usually evolve throughout the cancer journey.

Out of the three prehabilitation components, nutrition management appeared to require the most family involvement, and FG-PT acknowledged the food-related dependence: *"I do need support from FG-FM with the food, definitely, otherwise I would easily just eat a McDonalds. I am easily led."*. This demonstrates that FG-FM provides essential social support opportunities for dietary adherence, creating accountability that enhances FG-PTs motivation to adhere to their diet. FG-FM then went on to describe how she manages their diet at home: *"For a while now, FG-PT had type two diabetes, so we have been careful for a while now. Certain things we just don't ever buy so they're not in the house as a temptation."*. FG-FMs strategy to manage their shared food addressed both physical opportunity through ensuring availability of appropriate food at the home, as well as social opportunity as she created a

food environment at the home which supported FG-CPs nutritional behaviour change. This further exemplifies Family Systems Theory's concept of interdependence, where FG-FM dietary management strategies and FG-CPs nutritional adherence exist in circular causality, FG-FMs control over food and cooking supports FG-CPs dietary goals, and FG-CPs needs shape FG-FMs shopping and food preparation decisions. This stood in contrast with their individual exercise approach, which demonstrates that different prehabilitation components may result in varied and flexible family involvement patterns. Here nutrition was required to be organised and managed by one person [family member] for the dyad, whilst exercise routines remained more self-orientated.

The FG-SP provided additional context about what family members typically seek from prehabilitation intervention and described family members' often practical-minded orientation: *"Basic kind of information to help support and to make life easier and to know what to expect so it is not as overwhelming."*. The FG-SP further noted that families frequently ask: *"Like what do they [the cancer patient] need to do"* looking for clarification so that they [family members] are able to provide appropriate support. This oftentimes includes correcting misconceptions regarding recovery, for example, around the patient's physical activity: *"Actually we want people to be moving and stuff because it's good for them."*. Throughout the conversation it became apparent that family members would benefit from care pathway guidance and practical support strategies rather than information only being focused on nutrition and inclusive physical activity components of prehabilitation The FG-SP also described how patients and family members: *"Start to just chat amongst themselves (in the exercise class)"* developing peer support networks separate from but complementary to the patient peer support.

FG-PT expressed openness to any features within the app that might help with information sharing, might that be through the family log in as well as the healthcare professional dashboard: *"Yeah yes there's no problem with that yeah anything that would help, would help people, our healthcare professionals."* However, FG-FM questioned the additional value of having her own log in/dashboard, given how they tend to manage sharing information around the FG-PTs cancer journey: *"Would I use an app... I don't know whether I would..."*.

FG-FM's extensive family cancer history *"There has been cancer in my family for a long, literally years, most of my family has had cancer",* which appeared to affect her receptiveness to additional support resources, suggesting she felt adequately informed. This contrasted with

the FG-SP description of family members seeking *"basic information"* and typically attending *"first few sessions"* to ask questions, before disengaging. This divergence suggested that families with extensive cancer experience may have different support needs than those encountering cancer for the first time, requiring tiered or more adaptable family support approaches.

Irreplaceable value of human interaction

Both FG-PT and FG-FM emphasised the emotional and relational aspects of healthcare professional interaction that cannot be replicated through digital means. FG-FM described the interactions she had with the healthcare professional who facilitated the prehabilitation exercise intervention for FG-PT and its impact as follows: *"[SP_NI] just has a calmness and he would tell you a little bit about his family and what he was doing at the weekend, and ask you about your plans and chat a little bit about your life and then brings you back up about talking about what you came for. And every time you left him, you felt like you are back here again (points high in the sky with her hand, suggesting heightened mood)."*. FG-PT reinforced this perceived value: *"Yea so just chatting to someone who is not a clinician, who is not a doctor, yea."*. This further highlights that the face-to-face connection with healthcare professionals extends beyond information delivery and includes emotional support and the development of trusted relationships which creates a feeling of normality.

7.4. Discussion

7.4.1. Validation of theoretical framework application

The focus group findings provided support for the COM-B model as a framework for understanding stakeholder needs and identifying relevant intervention components, which aligns with the literature (Willmott et al., 2021). The technology enhanced delivery component addressed all three COM-B domains effectively: building physical capability through structured exercise guidance, creating opportunities for consistent engagement despite scheduling barriers, and enhancing motivation through accountability mechanisms and progress tracking. Participants' responses confirmed the motivation domain predictions, with FG-PT explicitly stating that healthcare professional monitoring created incentives for exercise adherence. This is validated through theoretical foundations on digital health accountability. Mohr et al. (2011) developed the Supportive Accountability Model,

establishing that human support increased adherence through accountability. Building on this theoretical framework, Jakob et al.s' (2022) systematic review of 99 studies across eight health domains demonstrated that personal support from healthcare professionals during digital interventions significantly improved adherence across all health domains. In a meta-analysis of 27 RCTs, by Noah et al. (2018), 22 studies were identified incorporating feedback loops where care providers analysed patient data and communicated with patients to modify their treatment regimens and improve adherence. This is the mechanism FG-PT described when noting the awareness of SP-NI monitoring their exercise metrics creating incentives for their engagement. The convergence between theoretical predictions, empirical evidence, and stakeholder experience validates the interventions incorporation of healthcare professional monitoring as a core motivational component for health behaviour change.

The nutrition support findings validated the capability domain analysis from previous thesis phases, confirming significant gaps in psychological capability around nutritional knowledge. However, the focus group revealed that capability limitations extended beyond simple knowledge provision to include health literacy and practical implementation skills. FG-PTs confusion about "Greek yogurt" terminology exemplified how abstract nutritional concepts fail to translate into practical capability for food selection and preparation. This observation parallels with Zhang et al.'s (2025) cross-sectional study of factors influencing nutritional literacy in CRC patients. Findings of 245 CRC patients suggested that only 31.4% demonstrated adequate nutrition literacy and patients scored the lowest on identifying food groups. Similarly, Adamaczyk et al.'s (2024) qualitative study which assessed the role of food in oncological care, revealed that healthcare professionals focus on nutritional value when educating on nutrition while patients concentrate on qualitative food concepts when selecting foods, such as the use of phrases: "natural", "no added sugar". Therefore, nutritional education should offer more practical guidance which forgoes these capability barriers.

Family Systems Theory application received mixed validation. The focus group confirmed that family dynamics significantly influence health behaviour engagement, with FG-FM food preparation role proving to of importance for FG-PTs dietary adherence. This aligns with Faccio et al.'s (2018) integrative framework of family resilience in the oncology setting, establishing that family systems operate as units where members are inseparable and when one member receives a cancer diagnosis, the entire system experiences alterations. However, the Family Systems Theory's theory prediction that family inclusion would be universally

beneficial was challenged by the varied family involvement preferences demonstrated by participants. The interdependence observed between FG-PT and FG-FM regarding their physical activities exemplifies Rolland's (2005) Family System-Illness Model, which views families as interconnected systems where cancer diagnosis affects all members through bidirectional influences. This may suggest that the finalised optimised prehabilitation intervention needs to be flexible in terms of family involvement. Findings of a systematic review on the impact of family behaviours in a chronically ill patient cohort (Rosland et al., 2012) resonate with this conclusion. Rosland and colleagues (2012) identified that family behaviours which support patient autonomy are associated with better overall outcomes, while controlling or overprotective family responses can negatively impact illness self-management.

7.4.2. Intervention refinement implications

One of the refinement needs identified was an automated timeline-based exercise intervention progression. This requirement emerged from FG-PTs direct experience with manual intervention adjustments to his exercise routine and represents a fundamental technical specification not previously identified. Similarly, Lim et al.'s (2021) development study demonstrated the feasibility of algorithms that adjust personalised rehabilitation content throughout the breast cancer care continuum based on surgery type, treatment process, and chronic disease status. The modular mobile health app classified 34 user cases according to surgery information and treatment process to deliver personalised content appropriate to each patient's stage in the treatment continuum. The optimised app-based intervention should therefore incorporate surgery dates, post-surgical complications which may result in recovery delay, recovery progression including stoma placement and reversal, and individual circumstances to provide appropriate prehabilitation content along the recovery trajectory. This semi-automated adaptation to the intervention should alleviate healthcare professional workload pressures (which were identified in Study 2) as it will automate otherwise manual processes.

The focus group revealed that nutritional support requires re-conceptualisation from theoretical education to practical implementation guidance. The preference for recipe-based approaches over abstract nutritional concepts aligns with Gibbs et al.'s (2016) validation study of breast cancer survivors, which found that participants scored higher on most

nutrition assessment domains except food portion. This suggests a specific deficit in translating nutritional requirements into practical serving sizes which seems to persist despite educational interventions, as demonstrated by Parekh et al. (2018). Their HEAL-BCA pilot RCT with 59 breast cancer patients found that despite the patient's motivation to seek valid information about healthy food choices, their knowledge of nutrition was insufficient. Even after six nutrition education sessions, participants only showed minimal improvement and confusion around portion sizes persisted. The optimised prehabilitation intervention should therefore prioritise "how to" guidance over education which only addressed why to consume certain foods. However, the FG-SPs suggestion for brief explanations of dietary restrictions indicates that some educational content remains valuable when presented concisely and contextually.

The confusion around wellbeing terminology indicates that psychological support components require significant simplification and clarification. The preference for scale-based mood assessment over complex wellbeing concepts suggests that the intervention should focus on simple, quantifiable measures rather than subjective concepts that may be culturally or generationally challenging. FG-PTs' acknowledgement that resistance towards psychological care or terminology might be generational aligns with Pescosolido et al.'s (2021) nationally representative study findings; higher age emerged as a conservatising factor, while being in the millennial birth cohort was a progressive factor. The older cohort sought more distance from people with depression, demonstrating different comfort levels with mental health-related concepts. FG-PTs' preference for a simplified scale-based assessment is further supported by a scoping review conducted by Ahmad et al. (2014). The findings suggested that single-item self-rated mental health measures correlated moderately with multi-item mental health scales, whilst also being more accessible to patients.

The varied family involvement preferences confirmed the need for multiple integration pathways identified in the intervention development phase. However, the focus group suggested that shared nutrition access may be more valuable than shared exercise tracking, indicating component specific family involvement preferences rather than uniform integration approaches. This finding is supported by Albanese et al.'s (2019) narrative review findings of 28 studies examining Type 2 diabetes patients; positive spousal encouragement to consume healthy foods was linked with increased dietary adherence, while controlling spousal behaviours such as warnings, persuasion, and pressure were linked to poorer

adherence. Although the study was conducted around diabetes patients, the family dynamics around illness and food consumption might be similar to those of cancer patients. The literature suggests that dyadic interventions can be effective when adequately structured. Levoy et al.’s (2022) systematic review and meta-analysis of 54 RCTs with 31,291 participants found that 51% of transitional care interventions lacked caregiver engagement, yet caregiver engagement significantly moderated intervention effects, with interventions including caregiver engagement reducing re-hospitalisations by 17%. Furthermore, Li et al.’s (2025) meta-analysis of 13 RCTs with 1625 participants demonstrated that dyadic interventions enhanced quality of life for both cancer patients and family members.

7.4.3. Implementation considerations

The support for technology integration, combined with recognition of irreplaceable human elements, confirms that the intervention should enhance rather than replace existing healthcare professional relationships. The FG-SPs' description of organic peer support development in group settings highlights limitations of digital solutions for emotional support needs.

Severinsen et al.’s (2025) qualitative study with head and neck cancer patients suggested that the MyFood app, which was used in the study cohort, was considered intuitive and user-friendly and that this digital dietary recording was seen as more accessible than paper-based information. However, the study identified that family caregivers provided the majority of emotional support to patients through the treatment course. This draws on the balance and interconnectedness of digital applications for information and human interaction for psychological support needs, which was also identified in the focus group. This therefore acknowledges that the implementation of a digital prehabilitation app should maintain clear boundaries regarding technological capabilities whilst also preserving time for interpersonal interactions with peers, healthcare professionals, and aiding connection with family members.

The FG-SPs' recognition of current limitations regarding patient physical activity tracking made them show enthusiasm for technology integration. This might suggest a potential for health care professionals adapting to this technology component of the optimised prehabilitation intervention. However, implementation success will depend on training on the application and education on how to use monitoring data effectively to reduce administrative burden. In Severinsen et al.'s (2025) study, healthcare professionals expressed that training

and familiarity with the application were important prerequisites for carrying out the digital intervention; they also desired reminders about ongoing implementation and feedback on progression. Furthermore, the study also emphasised that the project team must be available to answer questions and solve potential problems to increase the likelihood of successful implementation.

The FG-SPs' identification of access barriers for patients with transportation limitations or multiple appointments validates the intervention's potential for addressing healthcare equity issues. Transportation emerges as the single most consistent and significant barrier to prehabilitation participation across multiple systematic reviews. Sontag et al.'s (2024) realist review of 34 documents examining prehabilitation for frail patients identified transportation as the most significant barrier, with transportation dependency on others making patients feel burdensome and preventing regular attendance. Watts et al.'s (2024) mixed-methods systematic review of 56 studies on cancer prehabilitation access identified limited access to facilities, long travel distances, lack of time, parking difficulties, and scheduling conflicts as major structural barriers, with socioeconomically deprived communities particularly underserved. Barnes et al.'s (2023) qualitative study nested within the PREHAB trial with 15 older frail adults undergoing elective cancer surgery found that the home-based format overcame transportation barriers, with participants reporting the intervention was "manageable and suitable" specifically because it eliminated travel requirements. However, the technology accessibility concerns raised in previous phases require continued attention to ensure that digital solutions do not create new barriers for vulnerable populations. Kerstiens et al.'s (2024) qualitative study of 29 thoracic surgery patients found that technology itself could become a barrier, with 5 of 29 participants identifying technology as a barrier to smartwatch-based intervention participation, and participants expressing a need for additional support, as not all patients have family support or technology access. Digital prehabilitation interventions may reduce healthcare inequities by freeing up resources for those who need them most. While the optimised intervention may initially seem to exclude people without technology access or digital literacy, it may allow healthcare professionals to redirect their time and attention toward these individuals. Since around 94% of people in the UK have at-home internet access (Ofcom, 2025), most will be able to access the digital app, suggesting that the majority of patients would benefit from scalable digital prehabilitation interventions. However, there are age-related disparities, where approximately one in three people over 65 lacks the basic skills to use the internet successfully (AgeUK, 2024); within these

populations, a session on how to use the app needs to be delivered, and continued support needs to be offered. The smaller subset of patients facing multiple barriers, such as being frail, living far from healthcare facilities that offer prehabilitation services, and struggling with technology, can receive personalised, one-to-one support from healthcare professionals who, due to the optimised intervention, should have more capacity. Rather than all patients facing equal barriers to in-person interventions (like transportation), digital solutions create a more efficient system where those with the greatest needs receive targeted support.

7.4.4. Study limitations

Several limitations must be acknowledged in interpreting these findings. The small sample size (n=3) limits generalisability, though the multi-stakeholder composition provided valuable triangulated perspectives. The recruitment challenges encountered suggest potential selection bias toward participants who were particularly engaged with existing services or comfortable with research participation.

The single focus group design prevented exploration of divergent views that might emerge across multiple sessions. The participants represented a specific demographic profile (older adults, long-term partnership, extensive cancer experience) that will not reflect the diversity of cancer patient populations requiring prehabilitation.

The online format, whilst necessary for accessibility, may have affected group dynamics and limited nonverbal communication that could provide additional insights. The presentation-based approach, whilst enabling concrete feedback, may have constrained discussion of alternative approaches or novel suggestions from participants.

The focus on stakeholder input and acceptability assessment did not include implementation outcome measures or clinical effectiveness evaluation. Future research must examine whether stakeholder-validated intervention refinements are feasible and translate into improved clinical outcomes and sustainable implementation within healthcare systems.

7.4.5. Multi-level influences: a social ecological perspective

The focus group findings, combined with evidence from previous thesis studies, align with the Social Ecological Model's multi-level framework for understanding health behaviour change (Bronfenbrenner, 2005). This mapping demonstrates that effective prehabilitation

requires intervention across multiple ecological levels rather than focusing solely on individual behaviour change.

Individual level: Technology preferences, health literacy challenges, and personal motivation patterns developed as key individual-level factors. FG-PTs' confusion about nutritional terminology ("protein, easy to digest food, well, that doesn't mean anything to most people") exemplifies individual-level capability barriers that require targeted intervention.

Interpersonal level: Family dynamics proved to be of importance across all studies. The focus group confirmed varied family involvement preferences, from complete information sharing (CP/FM dyad) to privacy-maintaining approaches identified in patient interviews. FG-FM food preparation role and diabetes management experience demonstrated how interpersonal resources can enhance or constrain intervention effectiveness.

Organisational level: Healthcare professional constraints dominated organisational level influences. Time pressures, scheduling conflicts, and resource limitations identified in healthcare professionals' and service providers' interviews required intervention design solutions rather than system-wide changes. The FG-SP enthusiasm for technology-enhanced monitoring illustrated how organisational efficiency needs can align with patient care goals.

Policy level: NHS waiting time standards, care pathway requirements, and resource allocation decisions created the structural context within which prehabilitation operates.

This multi-level analysis reinforces that the family inclusive intervention addresses a critical gap in current approaches, which predominantly target individual level behaviour change whilst neglecting interpersonal and organisational influences essential for sustainable behaviour changes as well as real-world implementation.

7.5. Conclusion

This focus group evaluation provided validation of the proposed family-inclusive prehabilitation intervention whilst identifying refinements for successful implementation. Technology-enhanced delivery received enthusiastic support from all stakeholder groups, with particular appreciation for accountability mechanisms and comprehensive content

integration. However, the need for automated timeline-based intervention progression emerged as a critical technical requirement.

Nutrition support validation confirmed the systematic gaps identified in previous thesis phases, whilst revealing the need for practical, recipe-based approaches rather than theoretical education. The confusion around wellbeing terminology highlighted the importance of simplified psychological support approaches that accommodate cultural and generational differences.

Family inclusion feedback confirmed the need for flexible involvement pathways whilst emphasising the particular importance of nutrition-related family support. The irreplaceable value of human connection emerged as an important consideration for maintaining healthcare professional relationships whilst leveraging technology benefits.

7.5.1. Intervention development implications

The findings necessitate several intervention design modifications. Technical specifications must include automated progression algorithms based on surgery dates and recovery milestones. Nutrition content requires reconceptualisation around practical implementation rather than education on nutritional concepts of macronutrients. Psychological support components need simplification.

Implementation planning should balance technology efficiency with preservation of valued human interactions. Healthcare professional training requirements include both technical system use and integration of monitoring data into patient-centred care approaches. Quality assurance protocols must ensure that technology enhancement does not compromise the interpersonal elements that participants identified as irreplaceable.

7.5.2. Future research directions

Future research should focus on further focus groups, with a larger and broader sample size to receive more diverse feedback across a variety of patient populations and healthcare settings. Those outcomes should then be used to revise the intervention and programme theory, which will then need to be further developed with the help of feasibility testing to refine the intervention before effectiveness testing. Longitudinal studies can then investigate sustained engagement, and clinical outcomes will determine whether stakeholder validated refinements

translate into improved patient outcomes. Implementation research should explore healthcare professional training requirements and organisational factors affecting successful intervention adoption.

The automated progression algorithms identified as important for implementation success require development and testing. Research examining optimal approaches to nutrition education delivery could inform broader health literacy initiatives beyond the prehabilitation context. Investigation of digital peer support mechanisms may identify approaches to replicate the organic support development observed in face-to-face settings.

This stakeholder validation process demonstrates the value of multi-perspective intervention evaluation in healthcare intervention development. The refinements identified through the focus group feedback could improve the optimised interventions' acceptability, feasibility, and ultimately effectiveness in supporting cancer patients and their families through the prehabilitation process and beyond.

Chapter 8. Discussion

8.1. Introduction to the discussion chapter

This chapter synthesises the findings of four interconnected studies that collectively demonstrate which aspect of prehabilitation should be optimised for cancer surgery patients and the role of family inclusion within it. The systematic review (Study 1) showed critical gaps in current evidence-based practices, particularly regarding behaviour change techniques and social support integration. The interviews with healthcare professionals and service providers (Study 2) identified implementation barriers whilst simultaneously discussing the opportunities for intervention enhancements. Patient and family interviews (Study 3) disclosed unmet needs and preferences, highlighting the disconnect between current intervention standards and actual stakeholder requirements. Synthesising the first three study's findings informed the composition of the optimised semi-digital prehabilitation intervention (Study 4). The final focus group (Study 5) evaluated the proposed intervention components whilst identifying refinements for successful implementation.

The synthesis of the findings across this thesis acknowledges that stakeholder perspectives may hold individual-based disagreements and that theoretical frameworks, whilst useful, may oversimplify the real-world implementation in clinical practice as well as family dynamics.

8.2. Addressing research questions and thesis aims

Research Question 1: What behaviour change techniques are employed in prehabilitation interventions for colorectal and ovarian cancer surgery, and which techniques are associated with intervention effectiveness?

The systematic review demonstrated that behaviour change techniques, though employed across prehabilitation interventions, lacked theoretical sophistication and systematic integration within prehabilitation interventions. All sixteen reviewed studies incorporated behaviour change mechanisms, though the intentional use of BCTs was not discussed. The most prevalent BCT was "Provide instructions" (used in 16 studies), followed by "Prompt self-monitoring of behaviours" (10 studies and "Prompt practice" (9 studies). This emphasis on instruction-based and self-monitoring approaches aligns with prehabilitation's aim to empower patients with skills and knowledge for treatment preparation but represents a relatively narrow application of available behaviour change strategies.

Most significantly, the absence of social support BCTs across all sixteen reviewed studies suggests a fundamental conceptual gap in how prehabilitation is understood and implemented. This finding is particularly notable given substantial evidence that social support enhances adherence to lifestyle changes. Barnes et al.'s (2023) mixed-methods systematic review of barriers and facilitators to prehabilitation found that social support was widely reported as a facilitator of intervention adherence, whilst its absence acted as a barrier. Similarly, Ormel et al. (2018) and Beck et al. (2021) have demonstrated that support from family members and peers increases adherence to health behaviour change interventions. The omission of social support from current prehabilitation interventions, therefore represents not merely a gap but a contradiction of available evidence.

No clear patterns emerged between specific behaviour change techniques and intervention effectiveness. Nine studies demonstrated effectiveness, whilst five showed no significant differences, suggesting that implementation quality, contextual factors, and individual patient characteristics may be more important determinants of success than BCT selection alone. This interpretation stands in contrast with Copeland et al.'s (2020) consensus guidance, emphasising the need for behavioural science integration in prehabilitation interventions. This is further supported by Grimmett et al.'s (2021) observation that prehabilitation interventions developed without explicit behavioural science expertise show limited attention to behaviour change techniques and their underlying determinants. Broader behaviour change literature indicates that how techniques are delivered matters as much as which techniques are chosen (Michie et al., 2011). The limited use of goal setting (six studies) and demonstration of behaviour (four studies) represents additional missed opportunities, given evidence from musculoskeletal rehabilitation that these techniques improve exercise adherence (Meade et al., 2019).

Research question 2: How can the existing patient focused prehabilitation/rehabilitation for cancer surgery intervention be optimised to support cancer preventive behaviour change in cancer patients and their family members? A healthcare professionals' and service providers' perspective

Healthcare professionals articulated that systematic family integration would optimise care for patients and may help with prehabilitation engagement and adherence. They consistently described family members' value in supporting information retention during consultations, with one healthcare professional noting that consultations covering anatomy, surgical procedures, and stoma care lasted approximately an hour, acknowledging "*it is quite a lot for*

them to take in." This recognition of cognitive burden aligns with broader oncology literature as cancer patients frequently experience information overload during the diagnostic and pre-treatment period, with family presence improving recall and comprehension (Laidsaar-Powell et al., 2013).

Healthcare professionals also identified family members' motivational impact, observing that patients attending with family had better engagement with physical activity components and that family involvement could create positive cycles of shared activity extending beyond clinical sessions. However, they cautioned against making family involvement appear mandatory, recognising that *"it might be a barrier to some people"* who lack available support. This nuanced perspective reflects findings from Rosland et al.'s (2012) systematic review, which found that whilst supportive family behaviours improved chronic illness self-management, the absence of such support should not preclude intervention participation.

Technology-enhanced efficiency emerged as essential for managing workload constraints whilst maintaining quality care. Healthcare professionals expressed frustration with current paper-based systems that prevented monitoring of patient engagement between sessions, seeing digital solutions as a means to extend their reach without requiring additional resources. This aligns with Barberan-Garcia et al.'s (2021) argument that digital support for prehabilitation can optimise health value generation within resource-constrained healthcare systems.

Structural barriers including scheduling conflicts (with prehabilitation clinics and classes occurring on the same day, creating week-long gaps), limited staff resources (*"there is only me here"*), and accessibility issues (parking, location) emerged as significant impediments requiring systematic address rather than individual workarounds. These barriers mirror those identified in Powell et al.'s (2023) multi-perspective investigation of prehabilitation acceptability, which found that compressed timelines and logistical challenges significantly affected intervention feasibility. The tension between healthcare professionals' recognition of family value and their inability to systematically include families within existing workflow constraints reveals implementation challenges that transcend individual motivation or skill, requiring organisational and policy-level solutions.

Research question Study 3: How can the existing patient-focused prehabilitation/rehabilitation for cancer surgery intervention be optimised to support

cancer preventive behaviour change in cancer patients and their family members? A cancer patient and family members perspective

Patients and family members identified technology-enhanced accountability as valuable when implemented thoughtfully. Patients appreciated that healthcare professionals could monitor their app-based exercise engagement, describing this awareness as *"an incentive… to do the exercises a bit more than just having a sheet of paper to look at."* This finding supports the Supportive Accountability Model (Mohr et al., 2011), which proposes that human oversight of digital interventions enhances adherence through accountability relationships. However, concerns about accessibility for older adults persist, with participants noting uncertainty about whether app-based approaches *"would work for somebody older"*, a concern validated by evidence that approximately one in three UK adults over 65 lack basic internet skills (Age UK, 2024).

The nutritional support component requires complete reconceptualisation, moving from abstract guidance to practical, culturally appropriate implementation of support. Patients consistently reported inadequate dietary guidance, with one participant stating they *"weren't sent away with a nutrition sheet"* and had to independently seek information online. When guidance was provided, patients struggled with terminology, confusion about what *"Greek yogurt"* or *"easily digestible protein*" meant in practice exemplified health literacy barriers that extended beyond simple knowledge gaps. This finding aligns with Gillis et al.'s (2021) scoping review, which found that nutrition interventions in prehabilitation frequently lack attention to patients' food knowledge and health literacy, and with Adamczyk et al.'s (2024) observation that healthcare professionals focus on nutritional value whilst patients concentrate on qualitative food concepts like *"natural"* or *"no added sugar."*

Family involvement showed potential for enhancing intervention effectiveness. Patients valued having two people in the room during consultations, noting that family members understand things differently or remember things differently. Family members who attended exercise sessions described mutual benefits, with joint participation encouraging caring for one another on a different level and extending into shared activities beyond the clinical intervention. These findings align with Li et al.'s (2025) meta-analysis demonstrating that dyadic interventions enhance quality of life for both cancer patients and family members.

However, family involvement faces significant challenges related to privacy preferences, communication patterns, and the burden placed on family members who receive little formal support themselves. Some patients preferred to shield family members from the full extent of their condition, whilst family members (e.g. FM2) whose partners chose not to disclose their diagnosis to others experienced isolation: *"the toughest thing for me was because [PT2] didn't want anybody to know. So, I had to keep it a secret."* Family members also reported feeling overlooked by healthcare services focused exclusively on patients, with one describing frustration that *"all you ever get was a phone call saying how is she?"* These findings resonate with the National Cancer Institute's (2024) recognition that caregivers often feel unprepared, receive inadequate guidance, and may neglect their own health needs whilst supporting cancer patients.

Research Question 4: How can evidence from healthcare professionals and service providers, patients and family members be synthesised to develop an optimised family-inclusive prehabilitation intervention?

The synthesis of stakeholder evidence enabled development of a family-inclusive prehabilitation intervention grounded in both theoretical frameworks and lived experience. This approach aligns with MRC framework guidance on complex intervention development, which emphasizes that stakeholder perspectives should inform intervention design to enhance acceptability, feasibility, and implementation success (Skivington et al., 2021).

The intervention integrates three core components identified through stakeholder consultation: technology-enhanced delivery with healthcare professional monitoring, comprehensive nutritional support, and flexible family integration pathways. The COM-B model provided the theoretical structure for addressing capability gaps (particularly nutritional knowledge), opportunity barriers (scheduling, accessibility, family involvement), and motivation factors (accountability, goal setting) (Michie et al., 2011). Family Systems Theory (Bowen, 1978; Rolland, 2005) informed the approach to family integration, recognising that health behaviours exist within relational contexts where family members' actions and patients' needs are interdependent.

A critical finding from the synthesis was that family involvement should be component-specific rather than applied as a blanket approach across all intervention elements. Nutrition emerged as requiring the highest level of family integration; family members who prepare

food need comprehensive guidance to support dietary adherence, and patients acknowledged dependence on family support for maintaining dietary changes. Exercise, by contrast, often remained an individual activity even within highly collaborative couples, with partners preferring separate routines that respected personal preferences and physical capabilities. This differentiated approach extends beyond existing prehabilitation literature, which has largely overlooked family integration. The systematic review conducted for this thesis (Study 1) found a complete absence of social support behaviour change techniques across all sixteen reviewed studies, despite evidence that social support enhances intervention adherence (Shen et al., 2024; van der Velde et al., 2023).

The intervention design also addressed the tension between standardisation and personalisation identified across stakeholder groups. Whilst core intervention elements (exercise guidance, nutritional support, progress monitoring) remain consistent, the intervention accommodates varying family involvement preferences, technology comfort levels, and psychological support needs. This flexibility aligns with Sekhon et al.'s (2017) Theoretical Framework of Acceptability, which identifies fit with individual values and lifestyle as a key determinant of healthcare intervention acceptability.

Research Question 5: Is the optimised family inclusive prehabilitation/rehabilitation for cancer surgery intervention acceptable to cancer patients, family members, and service providers?

The focus group evaluation provided qualified endorsement of the proposed intervention whilst identifying implementation-critical refinements that extend beyond the preferences identified in earlier studies. Whilst Study 3 explored what patients and families wanted from prehabilitation, Study 5 specifically tested whether the synthesised intervention design (developed in Study 4) would be workable in practice. This distinction between expressed preferences and implementation feasibility is recognised as essential in complex intervention development (Skivington et al., 2021).

An important contribution from Study 5 was the identification of automated progression systems as part of the app-based intervention. This finding moves beyond Study 3's general appreciation of technology-enhanced accountability to specify a concrete implementation requirement: that exercise interventions must automatically adapt to surgical scheduling changes, treatment delays, and recovery trajectories. This aligns with emerging evidence on

digital prehabilitation, which emphasises that technology must accommodate the 'short window of opportunity' characteristic of cancer surgery pathways and provide real-time adaptation rather than static programming (Barberan-Garcia et al., 2021; Powell et al., 2023).

Regarding psychological support, Study 5 identified that approaches require simplification and cultural adaptation to be acceptable across diverse patient populations. This extends Study 3's finding of varied receptiveness to psychological support by specifying that the intervention design itself requires modification, rather than simply offering optional components. The focus group participants identified specific barriers regarding engagement with psychological support, where the necessity of mindfulness-based approaches was questioned. This echoes broader literature highlighting the need for tailored psychological interventions that account for demographic differences in preferences and acceptability. Meta-analytic evidence demonstrates that mindfulness-based interventions show larger effects in younger cancer patients compared to older adults (Cillessen et al., 2019), while population-based studies indicate that when experiencing psychological distress, younger cancer survivors are significantly more likely to engage with mindfulness practices than older adults aged 65 and over (Zhang et al., 2020). These findings have led to calls for psychosocial interventions to be rigorously adapted for older adults with cancer, informed by stakeholder perspectives rather than assuming standardised approaches will be equally effective across age groups (Trevino et al., 2020). Gender also influences engagement with psychological support, with systematic reviews identifying conformity to masculine gender role norms as a significant barrier to men's help-seeking behaviour (Fish et al., 2015). Men with cancer frequently perceive formal psychological support as misaligned with their needs and preferences (Montiel et al., 2023), and those who adopt traditionally masculine coping styles such as optimistic action may be paradoxically less likely to seek help even when experiencing unmet psychological needs (Goodwin et al., 2019). The participants' questioning of mindfulness approaches in the present study may therefore reflect these broader demographic variations in intervention acceptability.

The small sample size (n=3), resulting from recruitment challenges common in cancer populations (Bower et al., 2014), limits the breadth of perspectives captured. However, small samples in feasibility research are recognised as appropriate when the purpose is to identify critical uncertainties and refine intervention components rather than establish generalisability (Eldridge et al., 2016). The depth of the discussion in the focus group offered detailed

feedback consistent with the goals of early-stage intervention development outlined in MRC framework guidance (Skivington et al., 2021).

8.2.2. Thesis aims achievement

The primary aim of exploring how to optimise prehabilitation interventions for cancer surgery patients and how family members can be included has been partially achieved through the development of a comprehensive intervention design incorporating systematic family integration, evidence-based behaviour change techniques, and practical implementation solutions. The ecological framework analysis (Study 5) demonstrates that the intervention acts across multiple levels of influence, including the family level, from individual preferences through to organisational and policy contexts.

However, this achievement must be qualified by recognition that 'optimisation' itself is a contested concept, implying that there exists an ideal intervention that could work across diverse contexts and populations. The findings suggest instead that effective prehabilitation requires continuous adaptation to local contexts, available resources, and stakeholder characteristics.

The secondary aims of identifying long-lasting behaviour change mechanisms and developing family member engagement protocols have been addressed through COM-B analysis and family systems integration. The COM-B analysis identified patterns consistent with recent prehabilitation literature. Capability gaps were most pronounced in nutritional knowledge, where patients struggled to translate abstract dietary concepts into practical food choices. A finding that aligns with Gillis et al.'s (2021) scoping review, which found that nutrition interventions in prehabilitation are frequently conducted without reference to best practice guidelines and lack attention to patients' food and nutrition knowledge and health literacy. Opportunity barriers included scheduling conflicts, transportation limitations, and the absence of systematic family integration within existing services. These barriers mirror those identified in Shen et al.'s (2024) thematic synthesis of 26 prehabilitation studies, which mapped patient and healthcare provider perspectives onto the COM-B Model and found that lack of reflective motivation and physical opportunity were among the most significant barriers to prehabilitation engagement. The review found that motivation was supported through two distinct mechanisms: supervision and feedback from healthcare professionals, and self-monitoring through activity trackers and apps, which patients described as creating

incentives for sustained engagement. This aligns with both the Supportive Accountability Model (Mohr et al., 2011) and recent co-design work by Edbrooke et al. (2025), whose COM-B-informed development of lung cancer prehabilitation found that patients require specific "enablement and incentivisation" beyond simply being told to exercise.

In regards to family engagement, the research identified that family involvement patterns vary considerably across prehabilitation components. Nutrition emerged as requiring the highest level of family integration, with family members who prepare food needing comprehensive guidance to support dietary adherence. This component-specific pattern suggests that effective family engagement protocols should offer flexible pathways rather than uniform integration, accommodating preferences ranging from complete information sharing to privacy-maintaining approaches. Family members consistently sought practical care guidance, rather than clinical education, indicating that protocols should priorities actionable support strategies.

However, whether these behaviour change mechanisms are sustained beyond the immediate prehabilitation period remains unknown. It should also be noted that engagement protocols developed may privilege certain family constellations, particularly those with stable partnerships and functional communication, whilst potentially excluding patients without supportive family structures or those preferring individual coping approaches.

8.3. Synthesis of key findings across studies

8.3.1. Evidence for family integration

The evidence supporting family integration across the first 4 studies appears compelling at first examination. The systematic review's identification of completely absent social support behaviour change techniques across sixteen interventions suggests a significant missed opportunity. Healthcare professionals (Study 2) recognised family members' important roles in information processing, motivation, and practical support. Patient and family interviews (Study 3) showed family members already undertaking substantial responsibilities for nutrition, motivation, and care coordination, albeit without adequate support. However, once the optimised intervention was developed (Study 4) and discussed in the focus group (Study 5), mixed feelings arose about purpose-driven app-based family member inclusion; a more flexible approach was preferred. This evidence operates across multiple ecological levels,

from individual preferences for family involvement through interpersonal dynamics affecting intervention engagement, to organisational constraints limiting systematic integration and policy contexts that fail to recognise family-inclusive care benefits. The multi-level validation strengthens the argument for family-inclusive approaches whilst simultaneously highlighting the implementation complexity involved. However, this apparent conclusion should be viewed critically. The systematic review's finding of absent social support BCTs may not necessarily indicate that family integration would improve outcomes; the absence might reflect deliberate exclusion based on implementation challenges that proved overwhelmingly complex, or recognition that family dynamics can complicate as well as support health behaviour change. Rosland et al.'s (2012) systematic review found that whilst supportive family behaviours improved chronic illness self-management, controlling or overprotective family responses were associated with poorer outcomes. Healthcare professionals' recognition of family value, whilst consistent and articulate, is based primarily on subjective observations and memorable cases rather than systematic outcome measurement. Their perspectives may be disproportionately influenced by particularly positive or negative cases that stand out in memory, rather than representing the full spectrum of family involvement experiences. The practical challenges they face in implementing family integration may lead them to idealise its potential benefits whilst underestimating its complications.

The patient and family interviews predominantly captured the experiences of families who chose high levels of engagement with prehabilitation and maintained relatively functional communication between each other. Powell et al.'s (2023) multi-perspective investigation of prehabilitation acceptability specifically recruited "non-engagers" alongside engagers and found distinct barriers among those who declined participation, perspectives largely absent from this thesis. The perspectives of those who experienced family conflict around cancer diagnosis were rare among interview participants, and those who declined participation in this study or preferred individual coping strategies, so excluded themselves from prehabilitation altogether, remain unheard in this analysis. The apparent benefits of family involvement may not extend to all family units, and for some patients, family involvement might increase stress, complicate decision making, or undermine autonomy.

The focus group's findings must be interpreted cautiously, representing the views of only three participants from a single site who were willing and able to participate in research. This self-selection likely biases toward those with positive intervention experiences and stable

family relationships, a limitation acknowledged in feasibility research guidance, which nonetheless recognises the value of small samples for identifying critical uncertainties and refining intervention components (Eldridge et al., 2016). The enthusiasm for family integration may not reflect the views of the broader patient population, particularly those from different cultural backgrounds, non-traditional family structures, or complex family dynamics.

8.3.2. Technology as an implementation solution

Technology was identified as a theme across studies as a potential solution to multiple implementation challenges. Healthcare professionals saw digital tools as a means to manage time constraints and workload pressures whilst maintaining patient contact, one participant noting that current paper-based systems meant *"we can't see if folk are doing it,"* limiting their ability to support patients between sessions. Patients appreciated app-based accountability and structure, finding the monitoring connection to healthcare professionals motivating: *"he was monitoring it so… that was an incentive."* This accountability mechanism aligns with the Supportive Accountability Model (Mohr et al., 2011), which proposes that human oversight of digital interventions enhances adherence through accountability relationships. The focus group endorsed technology enhancement whilst identifying needs for automated progression systems that could adapt exercise prescriptions based on surgery dates and recovery milestones. These findings resonate with growing evidence for digital prehabilitation. Barberan-Garcia et al. (2021) argued that digital support can optimise resource-constrained prehabilitation systems and has demonstrated feasibility across multiple cancer types (Moyen et al., 2025). The automated progression requirement identified in the focus group mirrors developments of Kim et al. (2023) who designed a treatment stage-adjusted digital intervention for gastric cancer that modified content based on surgery type, treatment process, and postoperative days.

However, the technology solution narrative requires critical examination. The enthusiasm for digital approaches may reflect a contemporary bias toward technological solutions for complex healthcare problems, potentially overlooking the digital divide that could exacerbate health inequalities. Participants raised concerns about whether app-based approaches "would work for somebody older", a concern validated by evidence that approximately one in three UK adults over 65 lacks basic internet skills (Age UK, 2024). Kerstiens et al.'s (2024)

qualitative study of thoracic surgery patients found that technology itself could become a barrier, with participants expressing a need for additional support when they lacked family assistance or technology access.

The accountability mechanism that some patients found motivating might be experienced as surveillance by others, potentially undermining the therapeutic relationship or creating performance anxiety around health behaviours. The efficiency gains for healthcare professionals might come at the cost of reduced interpersonal connection, a concern reflected in the focus group's emphasis on the "irreplaceable value of human interaction," with participants describing how face-to-face contact with healthcare professionals provided emotional support and relationship-building that technology could not replicate. Furthermore, the sustainability of technology engagement remains uncertain. Initial enthusiasm for digital tools often wanes over time, and the long-term adherence to app-based interventions is typically lower than initial uptake suggests (Barberan-Garcia et al., 2021). The resource requirements for maintaining and updating digital platforms, providing technical support, and ensuring data security may ultimately exceed the efficiency savings they promise to deliver.

8.3.3. Nutritional support

The inadequacy of nutritional support was brought up consistently across Studies 2, 3, 5, representing perhaps the clearest area requiring improvement. The systematic review found limited integration of nutritional BCTs within multimodal interventions, a finding consistent with Gillis et al.'s (2021) scoping review, which concluded that nutrition interventions in prehabilitation are frequently conducted without reference to best practice guidelines and lack standardised approaches. Healthcare professionals recognised patient needs but lacked resources for comprehensive nutritional support, with one noting that patients frequently return asking *"nutrition wise… I don't really know what to take or what not to take or how much."* Patients and families reported confusion, inadequate guidance, and resort to independent information seeking, one family member stating, "we did feel that there wasn't enough information, and we had to go online and look." The focus group confirmed preferences for practical, recipe-based approaches over theoretical education.

This persistent gap reveals systemic issues beyond simple resource allocation, reflecting broader challenges in translating nutritional science into practical patient guidance. Gillis et al. (2021) emphasised that effective nutritional prehabilitation must consider patients' food

preferences, capacity to prepare meals, food and nutrition knowledge, health literacy, and motivation to change, factors rarely addressed in current interventions. The disconnect between what healthcare professionals and service providers believe they are offering and what patients experience receiving suggests fundamental communication failures. Adamczyk et al.'s (2024) qualitative study found that healthcare professionals focus on nutritional value (macronutrients, calories) when educating patients, whilst patients concentrate on qualitative food concepts such as natural or no added sugar, a mismatch evident in this thesis when participants expressed confusion about abstract dietary guidance.

The complexity of nutritional needs across the cancer journey, from pre-surgical optimisation through post-operative recovery with potential stoma management, may exceed what standardised interventions can address. As one participant noted, guidance received from stoma nurses was *"very much like… just ingredients, yoghurt, banana and whatnot, safe foods and what to avoid, but there isn't many things about recipes."* The preference for practical over theoretical approaches highlights health literacy challenges that extend beyond simple information provision. The confusion around terms like Greek yoghurt or easily digestible protein reveals assumptions about shared understanding that may not hold across diverse populations. Zhang et al.'s (2025) study of nutritional literacy in colorectal cancer patients found that only 31.4% demonstrated adequate nutrition literacy, with patients scoring lowest on identifying food groups (such as fats, carbohydrates, proteins).

The focus group consensus that nutritional support requires recipe-based, practical guidance with familiar, culturally appropriate foods aligns with emerging recognition in prehabilitation literature. Yaceczko et al.'s (2024) evaluation of nutrition components within gastrointestinal cancer prehabilitation found that only 38% of reviewed studies included nutrition education from a registered dietitian, with specific details on counselling strategies rarely described. The ESPEN guidelines on clinical nutrition in surgery (Weimann et al., 2021) emphasise individualised nutritional care, but implementation remains inconsistent. Cultural food preferences, economic constraints on food choices, and family food cultures all complicate the delivery of effective nutritional support, challenges that family integration may help address, given that family members who prepare food require comprehensive guidance to support dietary adherence.

8.4. Theoretical contributions

8.4.1. COM-B Model application in prehabilitation context

The systematic application of the COM-B Model reveals specific patterns whilst also questioning the model's limitations. Physical capability is generally well addressed through structured exercise interventions, but psychological capability shows significant gaps, particularly around nutritional knowledge and understanding of recovery processes. Physical opportunity is generally adequate when interventions are accessible, but social opportunity remains severely underdeveloped despite its recognised importance. Motivation shows complex patterns, with reflective motivation often undermined by inadequate automatic motivation support and environmental cues.

The model's compartmentalisation of behaviour into capability, opportunity, and motivation domains, whilst useful for analysis, may artificially separate interconnected phenomena. Family involvement, for instance, simultaneously affects all three domains in ways that resist unambiguous categorisation. The model's individual focus sits uncomfortably with the relational nature of health behaviours within family systems, suggesting the need for theoretical frameworks that better capture interpersonal dynamics, which are discussed next.

8.4.2. Family systems theory in healthcare intervention design

The patient and family interviews confirmed that health behaviours ripple through family units, with changes in one member affecting others. Information processing benefits from multiple family members' involvement were clearly demonstrated. Communication patterns within families significantly affected intervention engagement, and privacy preferences created subsystems that complicated support provision.

However, Family Systems Theory assumes relatively stable and functional family structures that may not reflect contemporary family diversity. Single-person households, chosen families, long-distance family relationships, and dysfunctional family dynamics are poorly accommodated within the theory's framework. The theory's emphasis on system equilibrium may not capture the disruption that a cancer diagnosis creates, which possibly fundamentally alters family dynamics in ways that resist systematic prediction.

The integration of Family Systems Theory with COM-B and implementation science theoretical frameworks represents a valuable theoretical contribution of this thesis. Whilst COM-B has been increasingly applied to identify prehabilitation intervention design, as demonstrated by Shen et al.'s (2024) thematic synthesis and Whish-Wilson et al.'s (2025) co-design study with lung cancer patients, its application has remained focused on individual patients. Family Systems Theory, meanwhile, has informed family-centred care approaches in oncology but has not been systematically applied to prehabilitation intervention development (Rolland, 2005; Faccio et al., 2018). This thesis proposes that combining these frameworks addresses a fundamental limitation acknowledged in prehabilitation literature: that social support and family involvement, whilst recognised as important facilitators of behaviour change, have not been systematically integrated into intervention design (Shen et al., 2024).

Integration may be productive in several ways. COM-B's structured analysis of capability, opportunity, and motivation domains was enriched by Family Systems Theory's attention to interdependence, revealing how family members provide social opportunity for dietary adherence whilst patients' needs shape family members' food preparation decisions. This circular causality aligns with Rolland's (2005) Family Systems-Illness Model, which views families as interconnected systems where cancer diagnosis affects all members through bidirectional influences. The concept of interdependence helped explain findings such as why nutrition support required higher family involvement than exercise, and family members who control food purchasing and preparation become integral to patients' capability to implement dietary changes.

However, there might also be tensions between the combined approaches, which should be acknowledged. The individualistic assumptions underlying the COM-B Model sit in contrast with Family Systems Theory's emphasis on individuals being part of relational units. COM-B's categorisation of behaviour into capability, opportunity, and motivation domains may artificially separate phenomena that Family Systems Theory views as inherently interconnected. For instance, family involvement simultaneously affects all three COM-B domains in ways that resist unambiguous classification. Future theoretical development should address these tensions, potentially generating frameworks specifically designed for family-inclusive health interventions rather than adapting individually-focused models.

The integration of Family Systems Theory with COM-B and implementation science frameworks represents an inclusive theoretical framework; however, tensions between the combined approaches should be investigated. The individualistic assumptions of behaviour change theory conflict with the systemic perspective of family theories, whilst implementation science's organisational focus may overlook the interpersonal dynamics that ultimately determine intervention success.

8.5. Practical contributions to prehabilitation practice

8.5.1. Evidence-based intervention components

The intervention design (Study 4) provides a systematic integration of evidence-based behaviour change techniques with family involvement approaches, addressing the complete absence of social support in current evidence-based practice observed in Study 1. This integration is grounded in stakeholder experiences (Studies 2 and 3) rather than theoretical assumptions, providing practical guidance for implementation. However, these practical contributions must be viewed critically due to their potential limitations. The developed intervention components assume a level of health literacy, family stability, and technological access that may not reflect the full spectrum of cancer patients. The technology-enhanced delivery method offers a solution to resource constraints. Healthcare professionals/service providers (Study 2) identified that current paper-based systems limit their ability to monitor patient engagement ("*we can't see if folk are doing it*"), whilst patients valued the accountability created by knowing their exercise data was visible to clinicians. This aligns with the overall literature, which demonstrates that telehealth-based prehabilitation is feasible and can improve physical outcomes for cancer surgery patients (Tay et al., 2024). A joined system of digital interventions with human support, like it is developed in study 4, is thought to further enhance adherence (Mohr et al., 20211). However, technology solution risks creating new barriers for digitally excluded populations. Concerns raised by participants about accessibility for older adults reflect broader evidence. Kerstiens et al.'s (2024) qualitative study of thoracic surgery patients found that technology itself could become a barrier, with patients expressing need for additional support when they lacked family assistance or technology access. In the UK, whilst approximately 94% of people have home internet access, around one in three people over 65 lack basic skills to use the internet successfully (Age UK, 2024). The focus group (Study 5) validation suggested that digital

prehabilitation may nonetheless improve healthcare equity by enabling healthcare professionals to redirect time toward patients facing multiple barriers who require personalised, face-to-face support. The need for automated timeline-based progression, identified through focus group (Study 5) feedback, represents a critical technical requirement, which, to the best of my knowledge, has not previously been addressed in prehabilitation literature. Current digital interventions require manual adjustment from healthcare professionals as patients progress through clinical phases. Automated systems that adapt exercise prescriptions based on surgery dates, recovery progression, and individual complications could address this gap, similar to the treatment stage-adjusted digital intervention developed by Kim et al. (2023) for gastric cancer rehabilitation.

8.5.2. Family integration protocols

The research demonstrates that family integration must accommodate varying preferences and circumstances, providing structured approaches that respect autonomy whilst maximising support benefits. The identification and systematic approach to addressing patients' privacy preferences represents a contribution to family-inclusive prehabilitation design. Patient and family interviews revealed that privacy preferences significantly shaped family involvement patterns as some patients chose not to disclose their diagnosis to wider networks, which isolated family members who needed emotional support themselves. As one family member described, *"the toughest thing for me was because [PT2] didn't want anybody to know. So, I had to keep it a secret. And I'm somebody who needs to share my burdens."* (FM2). This finding aligns with oncology literature on information management within families. The National Cancer Institute's (2024) review of informal caregivers notes that keeping a cancer diagnosis secret from others can add to caregivers' sense of burden and responsibility, whilst cultural factors influence disclosure preferences. Faccio et al.'s (2018) integrative framework of family resilience in oncology similarly recognises that families develop varied communication patterns in response to cancer, ranging from open discussion to protective buffering. The intervention design addresses this by offering flexible family integration pathways rather than assuming uniform preferences. Family members can be involved in specific components (such as nutrition support, where involvement was consistently valued) whilst respecting boundaries around others. This component-specific approach acknowledges that, as FG-SP noted, *"that might not work for everybody. I imagine some people close down when they have got their cancer, and they don't want to talk about it with other people."*

However, this flexibility requires healthcare professionals to navigate complex conversations about family involvement preferences, a skill that may require specific training not currently standard in prehabilitation delivery. Yet these protocols may privilege certain family units whilst marginalising others. Nuclear family assumptions may not accommodate single individuals, chosen families, or culturally diverse structures. The emphasis on family involvement might inadvertently pressure patients who prefer individual coping or whose family relationships are sources of stress rather than support.

8.5.3. Implementation solutions

The intervention design works within existing healthcare/service providers' constraints whilst providing efficiency improvements, taking a pragmatic approach that may increase implementation feasibility. The solutions address challenges across multiple ecological levels, from individual technology preferences through organisational workflow integration to policy-level resource considerations. Nevertheless, working within system constraints may perpetuate systemic inequities rather than challenging them. The acceptance of limited resources as given may inadvertently endorse underfunding of cancer care services. The efficiency focus might prioritise measurable outcomes over harder-to-quantify benefits like emotional support or dignity preservation.

8.6. Methodological contributions

8.6.1. Multi-stakeholder research design

The combination of a literature review, healthcare professional/service providers perspectives, patient and family experiences, and stakeholder focus groups for validation provides suggestions, strengthened by their sequential findings. The progression from systematic review methodology through qualitative interviews to focus group validation may demonstrate an effective integration for intervention development. However, this multi-stakeholder approach may create a misunderstanding of comprehensiveness as it maintains significant blind spots.

The participants who contributed to this research, engaged healthcare professionals, participating patients, and involved family members, may not represent those most in need of support. The perspectives of those not included in the research might fundamentally

challenge the intervention developed in several ways. First, patients who declined prehabilitation or disengaged early may have identified barriers that participating patients did not experience or could overcome. Powell et al.’s (2023) multi-perspective investigation of prehabilitation acceptability specifically recruited non-engagers alongside those who did engage and found that non-engagers faced distinct barriers, including feeling overwhelmed by their diagnosis and needing more time before considering participation. The current research captured only one perspective on this spectrum, which is of those sufficiently engaged in prehabilitation to participate in interviews and focus groups.

Second, family members who were absent from the prehabilitation process, whether due to patient preference, geographical distance, or strained relationships, might challenge the assumption that family involvement is beneficial. Rosland et al.’s (2011) systematic review of family behaviours in chronic illness management found that whilst supportive family behaviours improved outcomes, controlling or overprotective family responses were associated with poorer illness self-management. The intervention developed here may have inadvertently assumed functional family dynamics that do not exist for all patients. These gaps are acknowledged in prehabilitation literature more broadly, as studies on prehabilitation predominantly capture the perspective of patients who engage with the intervention.

Third, healthcare professionals and service providers expressed enthusiasm for family involvement; however, they mentioned facing time pressures, which may increase if formal family inclusion is integrated and would therefore be an additional burden. Research on implementing supportive cancer care interventions has identified that healthcare professionals and service providers face significant challenges, including time constraints to promote or deliver supportive care, conflicting schedules, and limited resources (Calvo-Schimmel et al., 2022). These systemic barriers, combined with insufficient administrative support and staff shortages, restrict clinicians' ability to provide comprehensive supportive services within the constraints of routine clinical practice (Walsh et al., 2010). It should also be noted that only some healthcare professionals and service providers who facilitate prehabilitation were interviewed and included in the focus group, and clinicians may hold other views on the topic of family integration. Wu et al. (2022) found that participants self-selected into their tele-prehabilitation intervention, suggesting they may have already possessed higher self-efficacy and motivation, and recommended that future studies interview patients who declined to participate. Similarly, Casanovas-Alvarez et al. (2024) acknowledged that their findings were

limited to participants randomised to their intervention arm, emphasising the need to incorporate the perspectives of those who decided not to participate to better understand barriers and improve intervention design. Barnes et al. (2023) emphasised that their qualitative study of prehabilitation barriers primarily captured perspectives of participants with high adherence rates (>75%), meaning those with lower adherence were inadequately represented. The intervention developed through this research should therefore potentially be understood as optimised for patients with supportive family structures, sufficient health literacy to engage with technology, and openness to participate in behaviour change interventions. Patients who fall outside these parameters may require different approaches that this research did not identify.

8.6.2. Participatory intervention development

The approach demonstrates how stakeholder input can systematically inform intervention design whilst maintaining evidence-based foundations, representing advancement in participatory research methodology. The incorporation of multi-stakeholders ensures that the intervention reflects real-world needs rather than researcher assumptions. Yet participatory approaches risk privileging articulate, engaged stakeholders whilst marginalising those less able or willing to participate. The power dynamics inherent in researcher participant relationships may shape what participants feel able to express. The synthesis of diverse stakeholder views into a single intervention may satisfy no party fully, whilst claiming to represent everyone.

8.7. Implications for policy and practice

8.7.1. Healthcare policy implications

The findings support policy development around systematic family integration in cancer care, moving beyond individual-focused approaches to recognise family units as the appropriate intervention target. The ecological framework demonstrates that policy implications operate across organisational, community, and system levels, requiring coordinated policy development rather than isolated initiatives. However, policy promotion of family integration must carefully consider unintended consequences. Mandating family involvement might violate patient autonomy or create additional burdens for already-stressed family systems. Policy frameworks must accommodate diverse family structures and cultural perspectives on

family involvement in healthcare. Technology integration in healthcare, whilst showing promise, requires careful policy guidance to prevent digital solutions from exacerbating health inequalities. Policy must ensure that efficiency gains from technology do not come at the expense of therapeutic relationships or exclude digitally disadvantaged populations.

8.7.2. Clinical practice implications

This work provides a framework for standardising prehabilitation approaches whilst maintaining flexibility for local adaptation. The systematic BCT integration offers practical guidance for future intervention development, whilst the family integration protocols and communication strategies may inform training for healthcare professionals. However, standardisation risks imposing uniform approaches on diverse populations with varying needs. The tension between evidence-based standardisation and person-centred flexibility remains unresolved. Clinical practice must navigate between protocol adherence and responsive adaptation to individual circumstances.

8.7.3. Healthcare system organisation

The intervention design demonstrates how technology can amplify healthcare professionals' expertise rather than requiring additional resources, providing a model for sustainable service enhancement. This efficiency-focused approach aligns with health system pressures for cost-effective service delivery. Yet the emphasis on doing more with existing resources may inadvertently endorse chronic underfunding of cancer services. The risk exists that efficiency innovations become excuses for further resource reduction rather than quality enhancement. Healthcare systems must resist the temptation to use technology as a substitute for adequate human resources.

8.8. Study limitations and critical evaluation

8.8.1. Methodological limitation

The sample limitations significantly constrain the generalisability of the findings. The systematic review’s restriction to colorectal and ovarian cancers may not capture patterns relevant to other cancer types. Healthcare professional interviews from a single hospital site in Scotland reflect local organisational culture and resources. Patient and family interviews showed suspected limited demographic diversity, with predominantly male patients

potentially missing gendered experiences of prehabilitation. The focus group's small sample size (n=3) limits the breadth of perspectives captured. However, in early-stage intervention development, small-scale qualitative work serves to identify critical uncertainties and refine intervention components rather than establish generalisability, with concepts such as information power suggesting that even small samples can be sufficient when engagement is deep and focused (O'Cathain et al., 2019).

Geographical and cultural constraints may further limit the optimised interventions transferability. As the research was conducted entirely within one hospital site in Scotland, it reflects specific health system characteristics which may be typical for this specific location. Future research should incorporate a comprehensive demographic assessment to enable analysis of how socioeconomic factors influence prehabilitation engagement and family involvement preferences. It should also purposefully incorporate a more diverse participant pool, as cultural and linguistic homogeneity fails to capture the experiences of ethnic minority populations who may face additional barriers to prehabilitation engagement.

8.8.2. Theoretical limitations

The BCT coding process, whilst systematic, involved interpretation where techniques were not explicitly described in interventions. The absence of named BCTs in most interventions required inferential coding that may have introduced error. The limitation of the 26-item taxonomy, whilst pragmatic, may have missed nuanced behaviour change strategies.

The COM-B model application, whilst providing useful structure, sometimes forces complex phenomena into restrictive categories. Some findings resisted neat classification into capability, opportunity, or motivation domains. The interaction between domains appears more complex and dynamic than the model suggests, with changes in one domain affecting others in unpredictable ways.

Family Systems Theory integration provided valuable insights, but may oversimplify the complexity of family dynamics in crisis situations. The theory's assumptions about family structure and function may not accommodate contemporary family diversity. Cultural variations in family involvement preferences and practices were inadequately addressed.

8.8.3. Implementation limitations

Despite efforts to address digital divides, the intervention design still assumes basic technology access and literacy that may not be universal. This challenge at the individual ecological level requires community-level solutions that may not be available. The technology requirements may systematically exclude vulnerable populations, most in need of support. Development within the NHS context may limit transferability to other healthcare systems with different resource allocation and organisational structures. The intervention's assumptions about healthcare professional/service provider roles, referral pathways, and service organisation reflect specific policy-level ecological constraints that vary across global healthcare systems.

8.8.4. Epistemological limitations

The pragmatic, solution-focused approach adopted throughout this thesis, whilst valuable for intervention development, may have constrained deeper critical analysis of why these gaps exist. The focus on 'optimising' prehabilitation assumes the fundamental validity of the prehabilitation concept itself, potentially overlooking questions about whether intensive pre-surgical behaviour change interventions represent appropriate use of the limited time between diagnosis and surgery. The reliance on stakeholder perspectives, whilst providing rich insights, privileges certain participants and experiences. Patients who dropped out of prehabilitation, declined participation, or were never referred remain unheard, yet their perspectives might fundamentally challenge the intervention assumptions developed here. The absence of these individuals represents not just a methodological limitation but an epistemological blind spot that may perpetuate inequities. The theoretical frameworks employed, whilst useful, shape what can be seen and said about prehabilitation. Alternative theoretical lenses might reveal different problems and solutions.

8.9. Future research directions

8.9.1. Effectiveness research

As suggested in Study 5 (Section 7.5.2), Future research should focus on further focus groups, with a larger and broader sample size to receive more diverse feedback across a variety of patient populations and healthcare settings. Those outcomes should then be used to revise the intervention theory, which will then need to be further developed with the help of

feasibility testing to refine the intervention before effectiveness testing. Longitudinal studies can then investigate sustained engagement, and clinical outcomes will determine whether stakeholder-validated refinements translate into improved patient outcomes; as well as family member engagement and sustained behaviour change. Implementation research should explore healthcare professional training requirements and organisational factors affecting successful intervention adoption.

8.9.2. Implementation research

Multi-site implementation studies across diverse healthcare settings would determine transferability and identify essential adaptation requirements. Research should examine how intervention components perform across different organisational contexts, resource levels, and patient populations. Particular attention should focus on implementation in resource-constrained settings where the full intervention may be unfeasible. Healthcare professional training evaluation should examine not just skill acquisition, but attitude change toward family-inclusive care. Research must investigate whether training can overcome individual-focused practice patterns and whether organisational culture supports or undermines family integration efforts.

8.9.3. Technology development

Development and testing of automated progression algorithms, identified as important in the focus group, requires careful attention to clinical safety and appropriate adaptation triggers. Research should examine how to balance standardised progression with individual variation in recovery trajectories. Digital accessibility solutions require investigation beyond simple interface modifications. Research should explore hybrid models that combine digital and non-digital elements, ensuring that technology enhancement does not become technology dependence. Studies should examine whether digital tools complement or replace human support and what this means for therapeutic relationships with healthcare professionals/service providers and/or clinical team.

8.9.4. Health economics

A comprehensive economic evaluation should examine intervention costs against multiple outcome domains. Beyond clinical outcomes, analysis should consider family wellbeing

benefits, informal care provision, and broader health system impacts. The economic implications of preventing family member burnout or promoting their health behaviours may justify intervention costs even without dramatic clinical improvements. Research should examine whether initial investment in family-inclusive prehabilitation reduces longer-term healthcare utilisation through better family-supported recovery and sustained behaviour change. The economic value should include, but is not limited to, prevented complications, reduced re-admissions, and improved self-management.

8.9.5. Critical and theoretical research

Future research should critically examine the assumptions underlying prehabilitation itself. Studies might investigate whether the imperative to 'optimise' patients for surgery represents a form of responsibility that shifts burden from healthcare systems to individuals and families. Research could explore how prehabilitation narratives of preparation and improvement interact with patient experiences of vulnerability and loss of control. Theoretical development should move beyond applying existing frameworks to generating new theories specific to family-inclusive health interventions. Research might develop frameworks that better capture the dynamic, reciprocal nature of family health behaviours and the tension between individual autonomy and relational embeddedness in healthcare decision making.

8.10. Personal and professional development reflections

8.10.1. Research skills development

This doctoral journey has developed sophisticated mixed methods research expertise, from systematic review through qualitative interviews to intervention development and stakeholder validation. The intervention, through different methodological approaches, has built an appreciation for how different methods reveal different aspects of the complexity of people and the healthcare system. The challenges encountered, particularly recruitment difficulties for the focus group, have taught valuable lessons about the realities of health services research. The need to work within NHS governance frameworks whilst maintaining research rigour has developed skills in navigating institutional requirements and protecting scientific integrity.

8.10.2. Clinical understanding

The multi-stakeholder perspective gained through this research has fundamentally shifted my understanding of healthcare interventions. The recognition that interventions are experienced differently by patients, families, and healthcare professionals has developed a more nuanced appreciation of implementation complexity. The exploration of family dynamics in healthcare contexts has shown the artificial nature of treating patients as isolated individuals. Understanding how health behaviours are embedded in relational contexts has implications extending far beyond prehabilitation to health promotion generally.

8.10.3. Critical reflexivity

The research process has developed a critical awareness in me of how a researcher's positionality shapes inquiry and findings. My position as a doctoral researcher within the academic system, whilst providing certain privileges and perspectives, may have constrained what participants felt able to share and how I interpreted their experiences. On the latter, my own cancer diagnosis and the cancer care I received, which was ongoing throughout this PhD journey, might have impacted my interpretations more drastically. The tension between producing 'useful' research that offers solutions and maintaining critical distance that questions assumptions has been constantly present. The pressure to demonstrate impact and relevance may have led to overstating intervention potential whilst understating fundamental challenges.

8.11. Conclusion

8.11.1. Summary of contributions

This thesis offers several contributions to prehabilitation science and implementation research. The identification of systematic gaps in current evidence-based practice, such as the absence of social support components, underlines fundamental conceptualisation problems in how behaviour change interventions often approach relational beings as isolated individuals. The development of a comprehensive theoretical framework integrating the COM-B model, Family Systems Theory, and implementation science acknowledges the tensions between these approaches. The framework is supposed to provide practical guidance whilst acknowledging the complexity that may ultimately limit this intervention's feasibility.

The evidence-based intervention developed through stakeholder consultation offers a concrete contribution to practice whilst recognising its limitations. The intervention represents one possible concept shaped by specific contexts, stakeholders, and theoretical lenses rather than an optimal solution applicable across all settings. The methodological contribution of systematic stakeholder integration in intervention development provides a replicable approach whilst acknowledging the individuals excluded from this process. The demonstration of how multiple perspectives can inform intervention design must be balanced with recognition of whose perspectives remain marginalised.

8.11.2. Advancing the field

This work represents a shift from individual-focused to family-inclusive prehabilitation approaches, though this shift remains partial and contested. The evidence supporting family integration must be balanced with recognition of the diversity of family structures, dynamics, and preferences that complicate universal application.

The integration of behaviour change with family systems approaches and implementation science creates a framework that nonetheless struggles with internal tensions and contradictions. This intervention design tries to provide a starting point for a more concrete model, acknowledging the compromises required for its implementation. The technology integration framework may offer solutions to resource constraints, but it also risks creating new barriers for vulnerable populations. The balance between efficiency and equity remains problematic, with technologies potentials beige able to serve some populations, but also risking excluding others.

8.11.3. Final reflection

This thesis demonstrates the potential and limitations to optimise healthcare interventions through stakeholder engagement and theoretical integration. The family inclusive prehabilitation intervention developed (Study 4) may represent insights whilst acknowledging the complexity and contradictions inherent in such undertakings.

The findings across all four studies provide compelling support for family-inclusive approaches. However, the convergence of findings across studies may partly reflect shared characteristics of participants rather than universally applicable conclusions. Healthcare professionals who volunteered for interviews may have been those already favourably

disposed toward family involvement; patients and family members who participated were those with sufficiently functional relationships to engage jointly in research; and focus group participants represented those willing and able to attend. Those with different perspectives, healthcare professionals sceptical of family integration, patients preferring individual approaches, or families experiencing conflict, are underrepresented, meaning the apparent consensus may not extend to the broader population.

The evidence presented makes a case for moving beyond individual-focused prehabilitation toward approaches that recognise the relational nature of health behaviours. Yet it must be proceeded with caution, acknowledging the diversity of family set-ups, the potential for harm through forced inclusion, and the risk of further burdening already stressed family systems.

This work contributes to a growing recognition that effective healthcare interventions must address multiple ecological components whilst acknowledging the practical constraints that limit comprehensive intervention. The theoretical optimality and the real-world implementation feasibility remain a central challenge for this type of research. Ultimately, this thesis suggests an optimised prehabilitation intervention that recognises real-world application, embedded in relationships and constrained by resources. This represents advancement toward more effective, equitable, and sustainable approaches to cancer care that leverage rather than ignore the support systems that patients value most highly.

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Appendices

Appendix A – Participant information sheet for HCP/SP interview

PARTICIPANT INFORMATION SHEET – HEALTHCARE PROFESSIONALS

Study Name
How can the existing patient-focused prehab/rehab for cancer surgery programme be optimized to support cancer preventive behaviour change in cancer patients and their family members?

Introduction
We would like to invite you to take part in a research study. Before you decide you need to understand why the research is being done and what it would involve for you. Please take time to read the following information carefully. Talk to others about the study if you wish. Ask us if there is anything that is not clear or if you would like more information.

Who is conducting the research?
This study is being led by Miss Clara Kurtidu, a Public Health PhD student, from the Institute of Health and Wellbeing at the University of Glasgow. Ms Clara Kurtidu specialises in prehabilitation for cancer surgery patients and started this study to see how prehabilitation programmes can be changed to better engage patients in the process. We appreciate your taking the time to read about our study.

The purpose of the study
We want to hear about the prehabilitation programme, from the perspective of a healthcare professional, and find out how we can improve the current system.

What is the study about?
There is published research stating that individuals with cancer may improve their general health and their long-term outcomes by following prehabilitation programmes before cancer surgery.
We want to recruit healthcare professionals who are part of the "Apple Clinic" at the Royal Alexandra Hospital in Paisley. We aim to interview individuals to investigate how we can improve the current programme.

Why have I been invited?
You have been invited to this study as a professional who is involved in the 'Apple Clinic' working with people who have been diagnosed with intra-abdominal and/or gastrointestinal cancer as part of the prehabilitation service offered at the Royal Alexandra Hospital. Therefore, we would like to explore your views on the current prehabilitation programme and how it can be optimised.

Do I have to travel to the Royal Alexandra Hospital?
We would prefer an interview at the Royal Alexandra Hospital, and therefore would need you to travel to the hospital for your interview. Therefor interviews could be arranged on a day where you will be at the hospital for work purposes.

If travelling to the hospital is not an option for you, we can also arrange an interview via Zoom call or a regular phone call.
Please let us know which suits you best when you agree to partake.

College of MVLS Ethics Participant Information Sheet 1 version 2.0 11.01.2023

Do I have to take part?

No. Participation in this study is voluntary and it is up to you to decide whether to take part. If you decide to take part, you are still free to withdraw at any time and without giving a reason.

What will happen if I agree to partake?

If you agree to participate you will be invited to partake in a 30–60-minute interview with the researcher, Clara Kurtidu. The researcher will ask you questions about your experience with the prehabilitation programme offered at the Apple Clinic at the Royal Alexandra Hospital, Paisley. If you wish not to answer certain questions or if you would like to terminate the interview, you can do so without having to provide a justification.

What will happen if I don't want to carry on with the study?

At any time during the study you may withdraw, without giving any reason. Any information collected will not be included in the study and will be destroyed.

Will my participation in this study be kept confidential?

Yes. The only people who know will be the research team and if you agree, your oncologist, surgeon and nurse specialist from your hospital. If you agree to participate, your data will immediately be anonymised and coded so you cannot be identified. All coded data will be stored on password protected, secure computer systems that are maintained in a locked office.

As the researcher, it is my legal and moral responsibility to report and therefore breach confidentiality if professional misconduct is mentioned by the participant. In this case, a report of the misconduct will be passed onto the participant's department lead or wider organization's HR officer.

Your consent to the use of project data does not have a specific expiration date, but you may withdraw your consent at any time by notifying the study team. If you withdraw your consent the study team will discard any data collected from you.

In addition, by consenting you are agreeing to the study team securely storing your contact details. This allows the study team to approach you in the future for any follow up work to this study. You will not be approached by any other researchers, only this team and for information directly related to this trial.

What will happen to my personal data?

We will treat your personal data (including your names and contact details) as set out in the General Data Protection Regulation 2018 (GDPR). We need to collect and temporarily store information like your names and contact details, so our researcher can arrange to meet with you and send you the final report if you wish.

The University of Glasgow is the data controller for this study and all associated personal data collected. For more information about your rights in relation to your personal data you may contact the University of Glasgow's Data Protection & FOI Office: https://www.gla.ac.uk/myglasgow/dpfoioffice/contact/, or visit the website of the Information Commissioner's Office: www.ioc.org.uk

What happens to the information that is collected?
It is intended that the results of the research will be published in a research journal. The information collected should help to improve the current prehabilitation programme run by "The Apple Clinic" at the Royal Alexandra Hospital, Paisley. It is important to point out that no volunteers included in the research will be able to be identified from any report or publication. If you would like a copy of the published results of the research let the researcher know during the interview or please contact us at the address given below and we will be happy to send them to you.

The information collected may also help us or our colleagues answer new research questions related to prehabilitation for cancer surgery patients. We will remove all information from the written records of the interviews that could identify you and store them with the participant questionnaires for 10 years. Your name will not be held with the information.

What are the possible disadvantages of taking part?
The study may take 30-60 minutes of your time. There are no right or wrong answers to the questions and you can talk about anything that you feel is relevant. It is possible that during the interview you may find a topic sensitive and you are free to ask the interviewer to move on to another subject or stop the session altogether. It is important for you to understand that you are not required to discuss anything that you do not want to and you should discuss only the things which you feel are relevant. If you have concerns you can discuss them fully with the research team.

What are the possible benefits of taking part?
We cannot promise the study will help you directly, but its findings may be useful in informing the design and delivery of the current or future prehabilitation programmes.

Will I receive payment or expenses?
No.

Who is funding the study?
This study has been reviewed and approved for funding by the Scottish Cancer Foundation. Their website for more information is http://scottishcancerfoundation.org.uk

What do I do now?
If you have voiced your interest to Prof Susan Moug, then the researcher, Clara Kurtidu, will contact you by telephone and if you agree to partake, you will arrange a time and day to meet at the Royal Alexandra Hospital for an hour-long interview.
If you have not voiced your interest in partaking in the study, you can either reach out to Prof Susan Moug via email susan.moug@ggc.scot.nhs.uk. Or you can reach out to Ms Clara Kurtidu directly via email: c.kurtidu.1@research.gla.ac.uk

What if I have any questions?
We encourage you to contact the research team. This study is being led by Ms Clara Kurtidu and she can be contacted via email: c.kurtidu.1@research.gla.ac.uk

Who has reviewed the study?
This study was reviewed by the University of Glasgow, College of Medical, Veterinary, and Life Sciences Ethics Committee.

If you have a complaint about any aspect of the study

If you are unhappy about any aspect of the study and wish to make a complaint, please contact, Ms Marie Kotzur via email Marie.Kotzur@glasgow.ac.uk

If you are unhappy with the handling of your personal data, please let our researcher know. You can also make a complaint directly to the Information Commissioner's Office, either online: https://ico.org.uk/concerns/ or by phone: 0303 123 1113.

Further information and contact details

If you wish to obtain further information about this research, please do not hesitate to email Ms Clara Kurtidu c.kurtidu.1@research.gla.ac.uk

Thank you very much for considering taking part in our research.

Appendix B – Consent form for HCP/SP interview

Prehabilitation for cancer surgery patience

Consent Form

Please initial the box

I confirm that I have read and understand the information sheet dated 11/01/2023 (version 2) for the above study and have had the opportunity to ask questions ☐

I agree to take part in the above study ☐

I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected. ☐

I consent for this interview being recorded and for quotations of the interview to be published if they will be anonymised ☐

I allow for my anonymised data to be shared in the future ☐

I understand that if I disclose of professional misconduct, the researcher has a legal and moral obligation to breach confidentiality and report the misconduct ☐

-- ---------------- ----------------------------------
Name of Participant Date Signature

-- ---------------- ----------------------------------
Name of Researcher Date Signature

1 copy to the patient, 1 copy to the researcher, 1 Original for the patients' notes

College of MVLS Consent Form 1 version 2.0 11.01.2023

Appendix C – Topic guide for HCP/SP interviews

Interview Schedule

Introduction

– Thank you for seeing me today and offering to take part in this study

– I would like first to outline the study so that you are able to decide whether you wish to proceed further (present participant information sheet)

– Sign consent form × 2 (one for participant and information sheet, one for the interviewer)

– I have a list of topics that I want to address

– Feel free to ask questions at any stage during the interview

– I might make a few notes in case I want to come back to something later

– Please remember that you are allowed to stop the interview at any point, might that be to take a break or to terminate the interview

– You are also allowed not to answer certain questions

Questions

1. Experience of prehabilitation programme The Apple Clinic at the Royal Alexandra Hospital

- How do you feel about being part of the Apple Clinic?
- What parts do you particularly enjoy being part of?
- Could any of these systems be improved?
- What aspects of the programme do you think need to be tweaked?
- Do you feel there is anything missing from the programme?
- How do you feel about an integrated programme including physical activity, nutrition, and psychological well-being?
- What could this look like?
- Which part of the three pillars (PA, nutrition, PW) do you believe to be most important from a physician's perspective?
- Which part of the three pillars (PA, nutrition, PW) do you believe to be most important from a patient's perspective?
- What are your views on including family members in the progress?
- How do you think family members could support cancer patients?
- Do you think that family member inclusion could hinder the cancer patient in any way?
- How would family members best be integrated?
- Do you have any other things you want to discuss or add?

Exit

-Thank you for taking the time to participate in my research

-If there is anything else that comes up for you in regards to the research please feel free to contact me (mention that contact details can be found on PIS)

Appendix D – Ethics approval - Glasgow University – 200220027

From: ResearchEthicsSystem@glasgow.ac.uk
Date: 24 January 2023 at 17:46:19 GMT
To: "Clara Kurtidu (PGR)" <c.kurtidu.1@research.gla.ac.uk>
Subject: Research Ethics Application Approved [How can the existing patient-focused prehab/rehab for cancer surgery programme be optimised to support cancer preventive behaviour change in cancer patients and their family members?]-[200220027]

Dear Clara Kurtidu (PGR),

The following research ethics application has been approved:

Project Title	How can the existing patient-focused prehab/rehab for cancer surgery programme be optimised to support cancer preventive behaviour change in cancer patients and their family members?
Application Number	200220027
Committee	College of Medical Veterinary and Life Sciences
Submitted By	Professor Kathryn Robb

Appendix E - Invitation letter for cancer patient and family members – dyad interviews

Dear Patient and family member/friend,

24.04.2024

Re: Invitation to participate in a research project about optimising the prehab/rehab for cancer surgery programme at the Apple Clinic at the Royal Alexandra Hospital

The purpose of this letter is to invite you to participate in a research study.
This invitation goes out to patients who have been part of the Apple Clinics exercise programme as well as their family members/friends/carers.

The participant information sheets attached provides details of the purpose of the study, which you need to consider before deciding whether you would be willing to take part.

We would like to interview you for 60-90 minutes to get your feedback on the prehabilitation programme at the Apple Clinic you and/or your family member has been offered as part of your preparation for your surgery at the Royal Alexandra Hospital. We can offer you a £20 gift card each as a thank you for taking part in the interview.

We want to get your input on how we could improve the programme.

You do not have to take part in this study. If you do agree to participate, you remain free to withdraw from the study at any time and do so without any disadvantage to yourself and without giving a reason.

If you decide that you would like to take part in the study once you have considered the information provided, or if have further questions, please contact me through the details below.

Many thanks for taking the time to read this information.

Yours sincerely,

Professor Susan Moug
Consultant General and Colorectal Surgeon,
Royal Alexandra Hospital, Paisley and
Golden Jubilee University National Hospital.
Honorary Professor, University of Glasgow.

and **Clara Kurtidu**
PhD Student at the University of Glasgow
Email: c.kurtidu.1@research.gla.ac.uk
Phone:

Appendix F – Participant information sheet for cancer patients – dyad interview

PARTICIPANT INFORMATION SHEET – Cancer Patients

Optimising the prehab for cancer surgery programme

Study Name

How can the existing patient-focused prehab for cancer surgery programme be optimised to support cancer preventive behaviour change in cancer patients and their family members?

Introduction

We would like to invite you to take part in a research study. Before you decide you need to understand why the research is being done and what it would involve for you. Please take time to read the following information carefully. Talk to others about the study if you wish. Ask us if there is anything that is not clear or if you would like more information.

Who is conducting the research?

This study is being led by Miss Clara Kurtidu, a Public Health PhD student, from the School of Health and Wellbeing at the University of Glasgow. Ms Clara Kurtidu specialises in prehabilitation for cancer surgery patients and started this study to see how prehabilitation programmes can be changed to better engage patients in the process. Prehabilitation means getting ready for surgery in whatever time you have before surgery, utilising physical activity, healthy eating and any psychological support that might be helpful. We appreciate your taking the time to read about our study.

What is the purpose of the study?

We want to hear about the patients' opinions on the prehabilitation programme and find out how we can improve the current programme. We are also interested in patients' views on the inclusion of family members in the prehabilitation programme, as well as family members' views on the prehabilitation programme and how they could become more involved.

What is the study about?

There is published research stating that individuals with cancer may improve their general health, and possibly their long-term health, by following prehabilitation programmes before cancer surgery.

We want to recruit volunteers who are going to have surgery (or already had surgery) with the intention to cure by removing the tumour from the body and are currently part of the Apple Clinics prehabilitation programme. We aim to interview individuals to investigate how we can improve the current programme, as well as views of both cancer patients and family member, on how to engage family members in the process.

<u>What is the Apple Clinic?</u>

The Apple Clinic at the Royal Alexandra Hospital, Paisley, is a prehabilitation service where lifestyle changes are discussed and physical activity is promoted. Prehabilitation is introduced to patients after diagnosis but before surgery with the aim to improve cancer preventative behaviour and surgery outcomes.

Why have I been invited?
You have recently had surgery for your cancer diagnosis, or you are currently waiting to have surgery for your cancer and took part in the prehabilitation programme. Your specialist doctors have decided that the surgery will have the intention to cure and will not be followed by chemo- or radiotherapy.

Do I have to travel to the Royal Alexandra Hospital?
We would prefer an interview at the Royal Alexandra Hospital, and therefore would need you to travel to the hospital for your interview.
If travelling is not an option for you, we can also arrange an interview online via Microsoft Teams.
Please let us know which suits you best if you decide to take part.

Do I have to take part?
No. Participation in this study is voluntary and it is up to you to decide whether to take part. If you decide to take part, you are still free to leave at any time and without giving a reason. This will not affect the standard of care you may receive now or in the future.

What will happen if I agree to participate?
If you agree to participate you will be invited to take part in an interview with the researcher, Clara Kurtidu, as well as one of your family member/friend/carer. The interview will last approximately 60 to 90 minutes and will be audio recorded. The researcher will ask you questions about your experience with cancer and the prehabilitation services you were offered at the Apple Clinic at the Royal Alexandra Hospital, Paisley. If you wish not to answer certain questions or if you would like to stop the interview, you can do so without having to provide a reason, and this will not affect your rights or healthcare in any way.

Will my participation in this study be kept confidential?
Yes. The only people who know will be the research team and representatives of the study sponsor, NHS GG&C, to check that the study is being conducted properly. The NHS GG&C is the data controller of this study, they have a responsibility to keep your information for 10 years. They are a health board in Scotland and are responsible for providing and managing health services such as hospitals and general practice, and work alongside partnership organisations including local authorities and the voluntary sector.

If you agree to participate, your data will immediately be anonymised (that is, your name will be removed and replaced with a number or code) so you cannot be identified.
Additionally, all pseudonymised data will be securely stored on the University of Glasgow network data. Documents such as your signed consent form will be kept at a research dedicated locked and restricted access room at the Royal Alexandra Hospital.

Your consent to the use of project data does not have a specific expiration date, but you may withdraw your consent at any time by notifying the study team. If you withdraw your consent the study team will use the information collected up to that point in the study.

By consenting you are agreeing to the study team securely storing your contact details. This allows the study team to approach you in the future for any follow up work to this study. You will not be approached by any other researchers, only this team and for information directly related to this trial.

How will we (the NHS GG&C) use information about you?

We will need to use information from you for this research project. This information will include your name and contact details. People will use this information to do the research or to check your records to make sure that the research is being done properly.We will keep all information about you safe and secure.

Once we have finished the study, we will keep some of the data so we can check the results. We will write our reports in a way that no-one can work out that you took part in the study.

What are your choices about how your information is used?

You can stop being part of the study at any time, without giving a reason, but the NHS GG&C will keep information about you that we already have. Any information collected will also be included in the study. The NHS GG&C have a responsibility to keep your information for 10 years. They need to manage your records in specific ways for the research to be reliable. This means that we won't be able to let you see or change the data we hold about you.
To safeguard your rights, we will use the minimum personally identifiable information possible. You can find out more about how we use your information at: https://www.nhsggc.scot/patient-visitor-faqs/data-protection-privacy/

What will happen to my personal data?

We will treat your personal data (including your names and contact details) as set out in the General Data Protection Regulation 2018 (GDPR). However, if you would like us to contact you with the findings of the study, which we will ask you about then we conduct the interview, we may store your name and contact details at a research dedicated locked and restricted access room at the Royal Alexandra Hospital. So we have your details on hand once the findings have been summarised. Once the findings have been passed on to you, the information will be destroyed.

What happens to the information that is collected?

It is intended that the results of the research will be published in a research journal. The information collected should help to improve the current prehabilitation programme run by "The Apple Clinic" at the Royal Alexandra Hospital, Paisley. To be able to do so, the audio recordings of the interview will be transcribed by Clara Kurtidu and then analysed by her. Some of the things you discuss with the interviewer might be put in quotations and be used in the published findings of the study – however, all identifying features will be removed and anonymised so it cannot be traced back to you. It is important to point out that no volunteers

included in the research will be able to be identified from any report or publication. If you would like to be informed of the study results let the researcher know during the interview or please contact us at the email address given below and we will be happy to send you a PDF that concludes all important findings.

The anonymised information collected may also be used by us or our colleagues at the University of Glasgow to answer new research questions related to prehabilitation for cancer surgery patients. We will remove all information from the written records of the interviews that could identify you and store them for 10 years. Your name will not be held with the information.

What are the possible disadvantages of taking part?
The study may take about an hour to 90 minutes of your time. There are no right or wrong answers to the questions, and you can talk about anything that you feel is relevant. It is possible that during the interview you may find a topic sensitive or upsetting, and you are free to ask the interviewer to move on to another subject or stop the session altogether. It is important for you to understand that you are not required to discuss anything that you do not want to, and you should discuss only the things which you feel are relevant. If you have concerns, you can discuss them fully with the research team.

What are the possible benefits of taking part?
We cannot promise the study will help you, although in previous studies participants have commented that they have enjoyed the opportunity to think about their health and express their views. Additionally, our findings may help improve the delivery of future healthcare services and therefore, may benefit people diagnosed with cancer in the future.

Will I receive payment or expenses?
Yes. You will be given a gift card worth £20 as a token of appreciation for your participation, after the interview is conducted.

Who is funding the study?
This study has been reviewed and approved for funding by the Scottish Cancer Foundation. Their website for more information is: https://scottishcancerfoundation.org.uk

What do I do now?
If you have voiced your interest to the physical activity lead and the physical activity facilitator, then the researcher, Clara Kurtidu, will contact you by telephone and if you agree to take part, you will arrange a time and day to meet at the Royal Alexandra Hospital for the interview. It is also possible to arrange the interview as a phone or online Teams call if that works better for you.
If you have not voiced your interest in taking part in the study, you can either reach out to Ms Clara Kurtidu directly via email: c.kurtidu.1@research.gla.ac.uk or call her on:

What if I have any questions?
We encourage you to contact the research team. This study is being led by Ms Clara Kurtidu and she can be contacted via email: c.kurtidu.1@research.gla.ac.uk or phone: 07977535765
Or you can contact Dr. Marie Kotzur who is not involved in the research but able to answer questions and queries around the research: Marie.Kotzur@glasgow.ac.uk

Who has reviewed the study?
The study was reviewed and approved by an NHS Research Ethics Committee.

If you have a complaint about this research study

You can email: complaints@ggc.scot.nhs.uk

Write to: Complaints Department
North East Sector Offices,
Stobhill Hospital
300 Balgrayhill Road
Glasgow
G21 3UR

Or call: 0141 201 4500

If you have a complaint about the way your data is being handled

If you are unhappy about how your data is being handled and wish to make a complaint, the NHS GG&C complaints procedure is available to you.
You can write to: Stewart Whyte
Data Protection Officer
NHS Greater Glasgow and Clyde
1 Smithhills Street
Level 2
Paisley PA1 1EB

Email: Data.Protection@ggc.scot.nhs.uk
Call: 0141 278 4774

If you are unhappy with the handling of your personal data, please let our researcher know in the first instance. You can also make a complaint directly to the Information Commissioner's Office, either online: https://ico.org.uk/concerns/ or by phone: 0303 123 1113.

Further information and contact details
If you wish to obtain further information about this research, please do not hesitate to email Ms Clara Kurtidu **c.kurtidu.1@research.gla.ac.uk** or call her on:
You can also contact Clara Kurtidu's supervisor and the chief investigator of this study under: katie.robb@glasgow.ac.uk

If you need support that reaches beyond the abilities of the research team and is related to your cancer diagnosis, please contact the following helplines.
Macmillan helpline, which is open 7 days a week from 8am-8pm under: 0808 8080000
Maggie's helpline, which is open Monday-Friday from 10am-4pm under: 0300 1231801

Thank you very much for considering taking part in our research. Please discuss this information with your friends, family, or doctor if you wish.

Appendix G – Participant information sheet for family members – dyad interview

PARTICIPANT INFORMATION SHEET – Family Members

Optimising the prehab for cancer surgery programme

Study Name
How can the existing patient-focused prehab for cancer surgery programme be optimised to support cancer preventive behaviour change in cancer patients and their family members?

Introduction
We would like to invite you to take part in a research study. Before you decide you need to understand why the research is being done and what it would involve for you. Please take time to read the following information carefully. Talk to others about the study if you wish. Ask us if there is anything that is not clear or if you would like more information.

Who is conducting the research?
This study is being led by Miss Clara Kurtidu, a Public Health PhD student, from the School of Health and Wellbeing at the University of Glasgow. Ms Clara Kurtidu specialises in prehabilitation for cancer surgery patients and started this study to see how prehabilitation programmes can be changed to better engage patients in the process. Prehabilitation means getting ready for surgery in whatever time there is before surgery, utilising physical activity, healthy eating and any psychological support that might be helpful. We appreciate your taking the time to read about our study.

The purpose of the study
We want to hear about the patients' opinions on the prehabilitation programme and find out how we can improve the current programme. We are also interested in patients' views on the inclusion of family members in the prehabilitation programme, as well as family members' views on the prehabilitation programme and how they could become more involved.

What is the study about?
There is published research stating that individuals with cancer may improve their general health, and possibly their long-term health, by following prehabilitation programmes before cancer surgery.
We want to recruit volunteers who are going to have surgery (or already had surgery) with the intention to cure by removing the tumour from the body and are currently part of the Apple Clinics prehabilitation programme. We aim to interview individuals to investigate how we can improve the current programme, as well as views of both cancer patients and family members, on how to engage family members in the process.

What is the Apple Clinic?

The Apple Clinic at the Royal Alexandra Hospital, Paisley, is a prehabilitation service where lifestyle changes are discussed and physical activity is promoted. Prehabilitation is introduced to patients after diagnosis but before surgery with the aim to improve cancer preventative behaviour and surgery outcomes.

Why have I been invited?
One of your family members has recently been diagnosed with cancer and had surgery for their cancer diagnosis or is currently waiting to have surgery for their cancer.

Do I have to travel to the Royal Alexandra Hospital?
We would prefer an interview at the Royal Alexandra Hospital, and therefore would need you to travel to the hospital for your interview.

If travelling is not an option for you, we can also arrange an interview online via Microsoft Teams. Please let us know which suits you best if you decide to take part.

Do I have to take part?
No. Participation in this study is voluntary and it is up to you to decide whether to take part. If you decide to take part, you are still free to leave at any time and without giving a reason. This will not affect any standard of your care in the future.

What will happen if I agree to participate?
If you agree to participate you will be invited to take part in an interview with the researcher, Clara Kurtidu and your family member/friend who has cancer and is taking part at the Apple Clinic. The interview will last approximately 60 to 90 minutes and will be audio recorded. The researcher will ask you questions about how you perceived the prehabilitation services offered to your family member with cancer. If you wish not to answer certain questions or if you would like to stop the interview, you can do so without having to provide a reason, and this will not affect your rights or your family member's healthcare in any way.

Will my participation in this study be kept confidential?
Yes. The only people who know will be the research team and representatives of the study sponsor, NHS GG&C, to check that the study is being conducted properly. The NHS GG&C is the data controller of this study, they have a responsibility to keep your information for 10 years. They are a health board in Scotland and are responsible for providing and managing health services such as hospitals and general practice, and work alongside partnership organisations including local authorities and the voluntary sector.

If you agree to participate, your data will immediately be anonymised (that is, your name will be removed and replaced with a number or code) so you cannot be identified.
Additionally, all pseudonymised data will be securely stored on the University of Glasgow network data. Documents such as your signed consent form will be kept at a research dedicated locked and restricted access room at the Royal Alexandra Hospital.

Your consent to the use of project data does not have a specific expiration date, but you may withdraw your consent at any time by notifying the study team. If you withdraw your consent the study team will use the information collected up to that point in the study.

By consenting you are agreeing to the study team securely storing your contact details. This allows the study team to approach you in the future for any follow up work to this study. You will not be approached by any other researchers, only this team and for information directly related to this trial.

How will the NHS GG&C use information about you?

We will need to use information from you for this research project. This information will include your name and contact details. People will use this information to do the research or to check your records to make sure that the research is being done properly.We will keep all information about you safe and secure.

Once we have finished the study, we will keep some of the data so we can check the results. We will write our reports in a way that no-one can work out that you took part in the study.

What are your choices about how your information is used?

You can stop being part of the study at any time, without giving a reason, but the NHS GG&C will keep information about you that we already have. Any information collected will also be included in the study. The NHS GG&C have a responsibility to keep your information for 10 years. They need to manage your records in specific ways for the research to be reliable. This means that we won't be able to let you see or change the data we hold about you.
To safeguard your rights, we will use the minimum personally identifiable information possible. You can find out more about how we use your information at: https://www.nhsggc.scot/patient-visitor-faqs/data-protection-privacy/

What will happen to my personal data?

We will treat your personal data (including your names and contact details) as set out in the General Data Protection Regulation 2018 (GDPR). However, if you would like us to contact you with the findings of the study, which we will ask you about then we conduct the interview, we may store your name and contact details at a research dedicated locked and restricted access room at the Royal Alexandra Hospital. So we have your details on hand once the findings have been summarised. Once the findings have been passed on to you, the information will be destroyed.

What happens to the information that is collected?

It is intended that the results of the research will be published in a research journal. The information collected should help to improve the current prehabilitation programme run by "The Apple Clinic" at the Royal Alexandra Hospital, Paisley. To be able to do so, the audio recordings of the interview will be transcribed by Clara Kurtidu and then analysed by her. Some of the things you discuss with the interviewer might be put in quotations and be used

in the published findings of the study – however, all identifying features will be removed and anonymised so it cannot be traced back to you. It is important to point out that no volunteers included in the research will be able to be identified from any report or publication. If you would like to be informed of the study results let the researcher know during the interview or please contact us at the email address given below and we will be happy to send you a PDF that concludes all important findings.
The anonymised information collected may also be used by us or our colleagues at the University of Glasgow to answer new research questions related to prehabilitation for cancer surgery patients. We will remove all information from the written records of the interviews that could identify you and store them for 10 years. Your name will not be held with the information.

What are the possible disadvantages of taking part?
The study may take about an hour to 90 minutes of your time. There are no right or wrong answers to the questions, and you can talk about anything that you feel is relevant. It is possible that during the interview you may find a topic sensitive or upsetting, and you are free to ask the interviewer to move on to another subject or stop the session altogether. It is important for you to understand that you are not required to discuss anything that you do not want to, and you should discuss only the things which you feel are relevant. If you have concerns, you can discuss them fully with the research team.

What are the possible benefits of taking part?
We cannot promise the study will help you, although in previous studies participants have commented that they have enjoyed the opportunity to think about their health and express their views. Additionally, our findings may help improve the delivery of future healthcare services and therefore, may benefit people diagnosed with cancer in the future.

Will I receive payment or expenses?
Yes. You will be given a gift card worth £20 as a token of appreciation for your participation, after the interview is conducted.

Who is funding the study?
This study has been reviewed and approved for funding by the Scottish Cancer Foundation. Their website for more information is http://scottishcancerfoundation.org.uk

What do I do now?
If you have voiced your interest to the physical activity lead and the physical activity facilitator, then the researcher, Clara Kurtidu, will contact you by telephone and if you agree to take part, you will arrange a time and day to meet at the Royal Alexandra Hospital for the interview. It is also possible to arrange the interview as a phone or online Teams call if that works better for you.
If you have not voiced your interest in taking part in the study, you can either reach out to Ms Clara Kurtidu directly via email: c.kurtidu.1@research.gla.ac.uk or call her on:

What if I have any questions?
We encourage you to contact the research team. This study is being led by Ms Clara Kurtidu and she can be contacted via email: c.kurtidu.1@research.gla.ac.uk or phone: _________
Or you can contact Dr. Marie Kotzur who is not involved in the research but able to answer questions and queries around the research: Marie.Kotzur@glasgow.ac.uk

Who has reviewed the study?
The study was reviewed and approved by an NHS Research Ethics Committee.

If you have a complaint about this research study
You can email: complaints@ggc.scot.nhs.uk

Write to: Complaints Department
North East Sector Offices,
Stobhill Hospital
300 Balgrayhill Road
Glasgow
G21 3UR

Or call: 0141 201 4500

If you have a complaint about the way your data is being handled

If you are unhappy about how your data is being handled and wish to make a complaint, the NHS GG&C complaints procedure is available to you.
You can write to: Stewart Whyte
Data Protection Officer
NHS Greater Glasgow and Clyde
1 Smithhills Street
Level 2
Paisley PA1 1EB

Email: Data.Protection@ggc.scot.nhs.uk
Call: **0141 278 4774**

If you are unhappy with the handling of your personal data, please let our researcher know in the first instance. You can also make a complaint directly to the Information Commissioner's Office, either online: https://ico.org.uk/concerns/ or by phone: 0303 123 1113.

Further information and contact details
If you wish to obtain further information about this research, please do not hesitate to email Ms Clara Kurtidu **c.kurtidu.1@research.gla.ac.uk** or call her on:
You can also contact Clara Kurtidu's supervisor and the chief investigator of this study under: katie.robb@glasgow.ac.uk

If you need support that reaches beyond the abilities of the research team and is related to your family members cancer diagnosis, please contact the following helplines.
Macmillan helpline, which is open 7 days a week from 8am-8pm under: 0808 8080000
Maggie's helpline, which is open Monday-Friday from 10am-4pm under: 0300 1231801

Thank you very much for considering taking part in our research. Please discuss this information with your friends, family, or doctor if you wish.

Appendix H – Topic guide for cancer patient and family member dyad interviews

Interview Schedule

Dyad Interviews

Introduction

- Thank you both for seeing me today and offering to take part in this study
- I would like to outline the study so that you are able to decide whether you wish to proceed further *(present participant information sheet)*
- Sign consent form × 4 (one for each participant—cancer patient and family member/friend—plus one information sheet each, and one copy for the interviewer)
- I have a list of topics that I want to address
- Feel free to ask questions at any stage during the interview
- I might make a few notes in case I want to come back to something later
- Please remember that either of you may stop the interview at any point, whether to take a break or to terminate the interview
- You are also welcome not to answer certain questions
- I am interested in hearing from both of you throughout this interview, so please feel free to share your perspectives at any time

Questions

Section 1: Experience of the Prehabilitation Programme

[Joint questions for cancer patient and family member]

1. What was your first impression of The Apple Clinic's process for getting you/your family member engaged in the programme?
2. How do you feel about being part of The Apple Clinic?
3. What parts do you particularly enjoy being part of?
4. What aspects of the programme do you think need to be tweaked?
5. Do you feel there is anything missing from the programme?
6. *[To family member]* Do you join some of the classes? If so, how many do you attend together?

Section 2: Understanding Current Perceptions and Experiences

[Primarily directed at cancer patient, but family member insights welcome]

1. Can you share your experience with the current patient-focused prehabilitation programme for cancer surgery? How did you feel when it was suggested that you participate in the programme?
2. How do you perceive the importance of lifestyle changes in relation to cancer?
3. What challenges do you face in adopting a cancer-preventive lifestyle?
4. How motivated are you to make lifestyle changes following a cancer diagnosis?

Section 3: Optimal Prehabilitation Programme

[Joint questions for both participants]

1. In your opinion, how can the existing prehabilitation programme/Apple Clinic be improved to better support cancer-preventive behaviour change?
2. What specific aspects of the programme do you find most beneficial or challenging?
3. Are there other aspects you can think of that might be beneficial, perhaps including nutritional support or psychological support?
4. How do you think individual assessment can help highlight key lifestyle areas for improvement? Are there any assessments that were not done when you were enrolled that would have been helpful?
5. How do you feel about an integrated programme including physical activity, nutrition, and psychological well-being? *[Explain the three pillars!]*
6. What could this look like?
7. Which part of the three pillars (physical activity, nutrition, psychological well-being) do you believe to be most important from a physician's perspective?
8. Which part of the three pillars do you believe to be most important from a patient's perspective?

Section 4: Role of Family Support

[Joint questions, particularly interested in both perspectives]

1. How important is family support in making lifestyle changes for cancer prevention?
2. *[To cancer patient]* In what ways do you think engaging a close family member can support your efforts in adopting a cancer-preventive lifestyle?

3. *[To family member]* How do you see your role in supporting lifestyle changes?
4. Do you believe family support can enhance the effectiveness of the prehabilitation programme?
5. What are your views on including family members in the programme?
6. How do you think family members could best support cancer patients?
7. Do you think that family member inclusion could hinder the cancer patient in any way?
8. How would family members best be integrated into the programme?

Section 5: Additional Comments

Do you have any other things you want to discuss or add?

Exit

1. Is there anything else you would like to share about your experience or suggestions for optimising the prehabilitation programme?
2. Thank you both for taking the time to participate in my research and for sharing your valuable insights
3. Provide information on the next steps in the research process *(ask if they would like to hear about the research once it is published)*
4. If there is anything else that comes up for you in regards to the research, please feel free to contact me *(mention that contact details can be found on the Participant Information Sheet)*

Appendix I – Health and Social Care Research Ethics Committee A; reference 23/NI/0137 approval

Health and Social Care Research Ethics Committee A (HSC REC A)
Email: reca@hscni.net

17 November 2023

Professor Kathryn Robb
Clarice Pears Building
School of Health and Wellbeing
90 Byres Road
G12 8TB

Dear Professor Robb,

Study title:	**How can the existing patient-focused prehab/rehab for cancer surgery programme be optimized to support cancer preventive behaviour change in cancer patients and their family members?**
REC reference:	**23/NI/0137**
Protocol number:	**NA**
IRAS project ID:	**312935**

Thank you for your letter of 09 November 2023, responding to the Proportionate Review Sub-Committee's request for changes to the documentation for the above study.

The revised documentation has been reviewed and approved on behalf of the PR sub-committee.

Confirmation of ethical opinion

On behalf of the Research Ethics Committee REC A, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised.

Good practice principles and responsibilities

The UK Policy Framework for Health and Social Care Research sets out principles of good practice in the management and conduct of health and social care research. It also outlines the responsibilities of individuals and organisations, including those related to the four elements of research transparency:

1. registering research studies
2. reporting results
3. informing participants
4. sharing study data and tissue

Conditions of the favourable opinion

The REC favourable opinion is subject to the following conditions being met prior to the start of the study.

Office for Research Ethics Committees Northern Ireland (ORECNI)
Lissue Industrial Estate West, 5 Rathdown Walk, LISBURN, BT28 2RF
Tel: (028) 95 361400 **General Email:** info.orecni@hscni.net

Confirmation of Capacity and Capability (in England, Northern Ireland and Wales) or NHS management permission (in Scotland) should be sought from all NHS organisations involved in the study in accordance with NHS research governance arrangements. Each NHS organisation must confirm through the signing of agreements and/or other documents that it has given permission for the research to proceed (except where explicitly specified otherwise).

Guidance on applying for HRA and HCRW Approval (England and Wales)/ NHS permission for research is available in the Integrated Research Application System.

For non-NHS sites, site management permission should be obtained in accordance with the procedures of the relevant host organisation.

Sponsors are not required to notify the Committee of management permissions from host organisations.

Registration of Clinical Trials

All research should be registered in a publicly accessible database and we expect all researchers, research sponsors and others to meet this fundamental best practice standard.

It is a condition of the REC favourable opinion that **all clinical trials are registered** on a publicly accessible database within six weeks of recruiting the first research participant. For this purpose, 'clinical trials' are defined as:

- clinical trial of an investigational medicinal product
- clinical investigation or other study of a medical device
- combined trial of an investigational medicinal product and an investigational medical device
- other clinical trial to study a novel intervention or randomised clinical trial to compare interventions in clinical practice.

Failure to register a clinical trial is a breach of these approval conditions, unless a deferral has been agreed by the HRA (for more information on registration and requesting a deferral see: Research registration and research project identifiers).

If you have not already included registration details in your IRAS application form you should notify the REC of the registration details as soon as possible.

Publication of Your Research Summary

We will publish your research summary for the above study on the research summaries section of our website, together with your contact details, no earlier than three months from the date of this favourable opinion letter.

Should you wish to provide a substitute contact point, make a request to defer, or require further information, please visit: https://www.hra.nhs.uk/planning-and-improving-research/application-summaries/research-summaries/

N.B. If your study is related to COVID-19 we will aim to publish your research summary within 3 days rather than three months.

During this public health emergency, it is vital that everyone can promptly identify all relevant research related to COVID-19 that is taking place globally. If you haven't already done so,

please register your study on a public registry as soon as possible and provide the REC with the registration detail, which will be posted alongside other information relating to your project. We are also asking sponsors not to request deferral of publication of research summary for any projects relating to COVID-19. In addition, to facilitate finding and extracting studies related to COVID-19 from public databases, please enter the WHO official acronym for the coronavirus disease (COVID-19) in the full title of your study. Approved COVID-19 studies can be found at: https://www.hra.nhs.uk/covid-19-research/approved-covid-19-research/

It is the responsibility of the sponsor to ensure that all the conditions are complied with before the start of the study or its initiation at a particular site (as applicable).

After ethical review: Reporting requirements

The attached document "After ethical review – guidance for researchers" gives detailed guidance on reporting requirements for studies with a favourable opinion, including:

- Notifying substantial amendments
- Adding new sites and investigators
- Notification of serious breaches of the protocol
- Progress and safety reports
- Notifying the end of the study, including early termination of the study
- Final report
- Reporting results

The latest guidance on these topics can be found at https://www.hra.nhs.uk/approvals-amendments/managing-your-approval/.

Ethical review of research sites

The favourable opinion applies to all NHS/HSC sites taking part in the study, subject to management permission being obtained from the NHS/HSC R&D office prior to the start of the study (see "Conditions of the favourable opinion" above).

Approved documents

The documents reviewed and approved by the Committee are:

Document	*Version*	*Date*
Evidence of Sponsor insurance or indemnity (non NHS Sponsors only) [UoG - Clinical Trials - 2023-2024 Client Information Letter.pdf]		14 July 2023
GP/consultant information sheets or letters [CNS info sheet.docx]	4	08 August 2023
GP/consultant information sheets or letters [CNS info sheet.docx]	version 5	03 November 2023
Interview schedules or topic guides for participants [Interview Schedule2.docx]	1	08 August 2023
IRAS Application Form [IRAS_Form_21092023]		21 September 2023
IRAS Checklist XML [Checklist_16112023]		16 November 2023
Letters of invitation to participant [Invitation Letter.docx]	2.0	08 August 2023
Letters of invitation to participant [Invitation Letter.docx]	version 3	09 November 2023
Other [Rec reply]	1	09 November 2023
Participant consent form [Consent Form CP_v4.docx]	4.0	08 August 2023
Participant consent form [Consent Form FM_v4.docx]	4.0	08 August 2023

Participant consent form [Consent Form CP_v5.docx]	version 6	10 November 2023
Participant consent form [Consent Form FM_v4.docx]	version 6	10 November 2023
Participant information sheet (PIS) [PIS CP_v4.docx]	v4	08 August 2023
Participant information sheet (PIS) [PIS FM_v4.docx]	4	08 August 2023
Participant information sheet (PIS) [PIS CP_v5.docx]	version 6	10 November 2023
Participant information sheet (PIS) [PIS FM_v5.docx]	version 6	10 November 2023
Research protocol or project proposal [Study Protocol]	4.0	08 August 2023
Research protocol or project proposal [Study Protocol version 5]	version 5	07 November 2023
Summary CV for Chief Investigator (CI) [CV_Nov2022_KARobb_2 pages.docx]		
Summary CV for student [cv clara.docx]		08 August 2023
Summary CV for supervisor (student research)		20 April 2023
Summary CV for supervisor (student research) [Dr Christos Theodorakopoulos CV (2 page).docx]		08 August 2023
Summary CV for supervisor (student research) [CV_2 page_SS.docx]		08 August 2023

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

User Feedback

The Health Research Authority is continually striving to provide a high quality service to all applicants and sponsors. You are invited to give your view of the service you have received and the application procedure. If you wish to make your views known please use the feedback form available on the HRA website: http://www.hra.nhs.uk/about-the-hra/governance/quality-assurance/

HRA Learning

We are pleased to welcome researchers and research staff to our HRA Learning Events and online learning opportunities– see details at: https://www.hra.nhs.uk/planning-and-improving-research/learning/

IRAS project ID: 312935	**Please quote this number on all correspondence**

With the Committee's best wishes for the success of this project.

Yours sincerely

pp Mr Barry Mimnagh **Chair of meeting**

Email: RECA@hscni.net

Enclosures: "After ethical review – guidance for researchers"

Copy to: Ms Emma-Jane Gault

Lead Nation Scotland: gram.nrspcc@nhs.scot

Appendix J – GGC R+I UGN23ON094 approval letter

Coordinator/administrator: Rozanne Suarez
Telephone Number: NA
E-Mail: Rozanne.Suarez2@ggc.scot.nhs.uk
Website: https://www.nhsggc.org.uk/about-us/professional-support-sites/research-innovation

Research & Innovation
Dykebar Hospital, Ward 11
Grahamston Road
Paisley, PA2 7DE
Scotland, UK

22/01/2024

Miss Clara Kurtidu
University of Glasgow
Institute of Health and Wellbeing
Gartnavel Royal Hospital
Glasgow

NHS GG&C Board Approval

Dear Miss Kurtidu

Study Title:	How can the existing patient-focused prehab/rehab for cancer surgery programme be optimized to support cancer preventive behaviour change in cancer patients and their family members?
Principal Investigator:	Miss Clara Kurtidu
GG&C HB site	Royal Alexandra Hospital
Sponsor	NHS Greater Glasgow and Clyde
R&I reference:	UGN23ON094
REC reference:	23/NI/0137
Protocol no: (including version and date)	V5.0 – 07.11.2023

I am pleased to confirm that Greater Glasgow & Clyde Health Board is now able to grant **Approval** for the above study.

Conditions of Approval

1. **For Clinical Trials** as defined by the Medicines for Human Use Clinical Trial Regulations, 2004
   a. During the life span of the study GGHB requires the following information relating to this site
      i. Notification of any potential serious breaches.
      ii. Notification of any regulatory inspections.

It is your responsibility to ensure that all staff involved in the study at this site have the appropriate GCP training according to the GGHB GCP policy (www.nhsggc.org.uk/content/default.asp?page=s1411), evidence of such training to be filed in the site file. Researchers must follow NHS GG&C local policies, including incident reporting.

2. **For all studies** the following information is required during their lifespan.
   a. First study participant should be recruited within 30 days of approval date.
   b. Recruitment Numbers on a monthly basis

c. Any change to local research team staff should be notified to R&I team
d. Any amendments – Substantial or Non Substantial
e. Notification of Trial/study end including final recruitment figures
f. Final Report & Copies of Publications/Abstracts
g. You must work in accordance with the current NHS GG&C COVID19 guidelines and principles.

Please add this approval to your study file as this letter may be subject to audit and monitoring.

Your personal information will be held on a secure national web-based NHS database.

I wish you every success with this research study

Yours sincerely,

Rozanne Suarez
Research Administrator

CC: **Professor Katie Robb, University of Glasgow**
Emma-Jane Gault, University of Glasgow

Appendix K – Invitation letter to focus group

Dear Patient and family member/friend, 10.12.2024

Re: Invitation to participate in a research project about optimising the prehab/rehab for cancer surgery programme at the Apple Clinic at the Royal Alexandra Hospital

The purpose of this letter is to invite you to participate in a research study.
This invitation goes out to patients who have been part of the Apple Clinics exercise programme as well as their family members/friends/carers.

The participant information sheets attached provides details of the purpose of the study, which you need to consider before deciding whether you would be willing to take part.

We would like to invite you to take part in a focus group to get your feedback on the prehabilitation programme at the Apple Clinic you and/or your family member has been offered as part of your preparation for your surgery at the Royal Alexandra Hospital. The focus group will last around 2 hours, and we can offer you a £20 gift card each as a thank you for taking part in the interview.

We want to get your input on how we could improve the programme.

You do not have to take part in this study. If you do agree to participate, you remain free to withdraw from the study at any time and do so without any disadvantage to yourself and without giving a reason.

If you decide that you would like to take part in the study once you have considered the information provided, or if have further questions, please contact me through the details below.

Many thanks for taking the time to read this information.

Yours sincerely,

Clara Kurtidu, PhD Student at the University of Glasgow
Email: c.kurtidu.1@research.gla.ac.uk
Phone:

Appendix L – Participant information sheet for cancer patient – focus group

PARTICIPANT INFORMATION SHEET – Cancer Patients

Optimising the prehab for cancer surgery programme

Study Name
How can the existing patient-focused prehab for cancer surgery programme be optimised to support cancer preventive behaviour change in cancer patients and their family members?

Introduction
We would like to invite you to take part in a research study. Before you decide you need to understand why the research is being done and what it would involve for you. Please take time to read the following information carefully. Talk to others about the study if you wish. Ask us if there is anything that is not clear or if you would like more information.

Who is conducting the research?
This study is being led by Miss Clara Kurtidu, a Public Health PhD student, from the School of Health and Wellbeing at the University of Glasgow. Ms Clara Kurtidu specialises in prehabilitation for cancer surgery patients and started this study to see how prehabilitation programmes can be changed to better engage patients in the process. Prehabilitation means getting ready for surgery in whatever time you have before surgery, utilising physical activity, healthy eating and any psychological support that might be helpful. We appreciate your taking the time to read about our study.

What is the purpose of the study?
We want to hear about the patients' opinions on the prehabilitation programme and find out how we can improve the current programme. We are also interested in patients' views on the inclusion of family members in the prehabilitation programme, as well as family members' views on the prehabilitation programme and how they could become more involved.

What is the study about?
There is published research stating that individuals with cancer may improve their general health, and possibly their long-term health, by following prehabilitation programmes before cancer surgery.
We want to recruit volunteers who are going to have surgery (or already had surgery) with the intention to cure by removing the tumour from the body and are currently part of the Apple Clinics prehabilitation programme. We aim to establish a focus group to investigate how we can improve the current programme, as well as views of both cancer patients and family member, on how to engage family members in the process.

Participant Information Sheet IRAS 312936 1 version 7.0 19.04.2024

What is the Apple Clinic?

The Apple Clinic at the Royal Alexandra Hospital, Paisley, is a prehabilitation service where lifestyle changes are discussed and physical activity is promoted. Prehabilitation is introduced to patients after diagnosis but before surgery with the aim to improve cancer preventative behaviour and surgery outcomes.

Why have I been invited?
You have recently had surgery for your cancer diagnosis, or you are currently waiting to have surgery for your cancer and took part in the prehabilitation programme. Your specialist doctors have decided that the surgery will have the intention to cure and will not be followed by chemo- or radiotherapy.

Do I have to travel to the Royal Alexandra Hospital?
No, the focus group will be held online.

Do I have to take part?
No. Participation in this study is voluntary and it is up to you to decide whether to take part. If you decide to take part, you are still free to leave at any time and without giving a reason. This will not affect the standard of care you may receive now or in the future.

What will happen if I agree to participate?
If you agree to participate you will be invited to take part in a focus group, preferably with a family member/friend/career. Other patients and their family members will also be there. The researcher Clara Kurtidu will also attend to guide the focus group. The focus group will last approximately 2 hours, with structured breaks and will be audio recorded. The researcher will ask you questions about your experience with cancer and the prehabilitation services you were offered at the Apple Clinic at the Royal Alexandra Hospital, Paisley. If you wish not to answer certain questions or if you would like to stop participating, you can do so without having to provide a reason, and this will not affect your rights or healthcare in any way.

Will my participation in this study be kept confidential?
The only people who know will be the persons attending, research team and representatives of the study sponsor, NHS GG&C, to check that the study is being conducted properly. The NHS GG&C is the data controller of this study, they have a responsibility to keep your information for 10 years. They are a health board in Scotland and are responsible for providing and managing health services such as hospitals and general practice, and work alongside partnership organisations including local authorities and the voluntary sector.

If you agree to participate, your data will immediately be de-identified (that is, your name will be removed and replaced with a number or code) so you cannot be identified.
Additionally, all pseudonymised data will be securely stored on the University of Glasgow network data. Documents such as your signed consent form will be kept at a research dedicated locked and restricted access room at the Royal Alexandra Hospital.
Your consent to the use of project data does not have a specific expiration date, but you may withdraw your consent at any time by notifying the study team. If you withdraw your consent the study team will destroy any personal information collected from you.

included in the research will be able to be identified from any report or publication. If you would like to be informed of the study results let the researcher know during the focus group or please contact us at the email address given below and we will be happy to send you a PDF that concludes all important findings.

The de-identified information collected may also be used by us or our colleagues at the University of Glasgow to answer new research questions related to prehabilitation for cancer surgery patients. We will remove all information from the written records of the focus group that could identify you and store them for 10 years. Your name will not be held with the information.

What are the possible disadvantages of taking part?

The study may take about 2 hours of your time. There are no right or wrong answers to the questions, and you can talk about anything that you feel is relevant. It is possible that during the focus group you may find a topic sensitive or upsetting, and you are free to ask the interviewer to move on to another subject or stop the session altogether. It is important for you to understand that you are not required to discuss anything that you do not want to, and you should discuss only the things which you feel are relevant. If you have concerns, you can discuss them fully with the research team.

What are the possible benefits of taking part?

We cannot promise the study will help you, although in previous studies participants have commented that they have enjoyed the opportunity to think about their health and express their views. Additionally, our findings may help improve the delivery of future healthcare services and therefore, may benefit people diagnosed with cancer in the future.

Will I receive payment or expenses?

Yes. You will be given a gift card worth £20 as a token of appreciation for your participation, after the focus group is conducted.

Who is funding the study?

This study has been reviewed and approved for funding by the Scottish Cancer Foundation. Their website for more information is: https://scottishcancerfoundation.org.uk

What do I do now?

If you have decided to take part, you can either reach out to Ms Clara Kurtidu directly via email: c.kurtidu.1@research.gla.ac.uk or call her on:

What if I have any questions?

We encourage you to contact the research team. This study is being led by Ms Clara Kurtidu and she can be contacted via email: c.kurtidu.1@research.gla.ac.uk or phone:
Or you can contact Dr. Marie Kotzur who is not involved in the research but able to answer questions and queries around the research: Marie.Kotzur@glasgow.ac.uk

Who has reviewed the study?

The study was reviewed and approved by an NHS Research Ethics Committee.

If you have a complaint about this research study

You can email: complaints@ggc.scot.nhs.uk

Write to: Complaints Department
North East Sector Offices,
Stobhill Hospital
300 Balgrayhill Road
Glasgow
G21 3UR

Or call: 0141 201 4500

If you have a complaint about the way your data is being handled

If you are unhappy about how your data is being handled and wish to make a complaint, the NHS GG&C complaints procedure is available to you.
You can write to: Stewart Whyte
Data Protection Officer
NHS Greater Glasgow and Clyde
1 Smithhills Street
Level 2
Paisley PA1 1EB

Email: Data.Protection@ggc.scot.nhs.uk
Call: 0141 278 4774

If you are unhappy with the handling of your personal data, please let our researcher know in the first instance. You can also make a complaint directly to the Information Commissioner's Office, either online: https://ico.org.uk/concerns/ or by phone: 0303 123 1113.

Further information and contact details
If you wish to obtain further information about this research, please do not hesitate to email Ms Clara Kurtidu **c.kurtidu.1@research.gla.ac.uk** or call her on:
You can also contact Clara Kurtidu's supervisor and the chief investigator of this study under: katie.robb@glasgow.ac.uk

If you need support that reaches beyond the abilities of the research team and is related to your cancer diagnosis, please contact the following helplines.
Macmillan helpline, which is open 7 days a week from 8am-8pm under: 0808 8080000
Maggie's helpline, which is open Monday-Friday from 10am-4pm under: 0300 1231801

Thank you very much for considering taking part in our research. Please discuss this information with your friends, family, or doctor if you wish.

If you disclose information during the focus group that indicates a risk of harm to yourself or others, please be aware that we may need to breach confidentiality to ensure your safety or the safety of others by contacting appropriate authorities such as your GP or the police.

By consenting you are agreeing to the study team securely storing your contact details. This allows the study team to approach you in the future for any follow up work to this study. You will not be approached by any other researchers, only this team and for information directly related to this trial.

How will we (the NHS GG&C) use information about you?

We will need to use information from you for this research project. This information will include your name and contact details. People will use this information to do the research or to check your records to make sure that the research is being done properly.We will keep all information about you safe and secure.

Once we have finished the study, we will keep some of the data so we can check the results. We will write our reports in a way that no-one can work out that you took part in the study.

What are your choices about how your information is used?

You can stop being part of the study at any time, without giving a reason, but the NHS GG&C will keep information about you that we already have. Any information collected will also be included in the study. The NHS GG&C have a responsibility to keep your information for 10 years. They need to manage your records in specific ways for the research to be reliable. This means that we won't be able to let you see or change the data we hold about you.
To safeguard your rights, we will use the minimum personally identifiable information possible. You can find out more about how we use your information at: https://www.nhsggc.scot/patient-visitor-faqs/data-protection-privacy/

What will happen to my personal data?
We will treat your personal data (including your names and contact details) as set out in the General Data Protection Regulation 2018 (GDPR). However, if you would like us to contact you with the findings of the study, which we will ask you about then we conduct the focus group, we may store your name and contact details at a research dedicated locked and restricted access room at the Royal Alexandra Hospital. So we have your details on hand once the findings have been summarised. Once the findings have been passed on to you, the information will be destroyed.

What happens to the information that is collected?
It is intended that the results of the research will be published in a research journal. The information collected should help to improve the current prehabilitation programme run by "The Apple Clinic" at the Royal Alexandra Hospital, Paisley. To be able to do so, the audio recordings of the focus group will be transcribed by Clara Kurtidu and then analysed by her. Some of the things we discuss within the focus group might be put in quotations and be used in the published findings of the study – however, all identifying features will be removed and de-identified so it cannot be traced back to you. It is important to point out that no volunteers

Appendix M – Participant information sheet for family members – focus group

PARTICIPANT INFORMATION SHEET – Family Members

Optimising the prehab for cancer surgery programme

Study Name
How can the existing patient-focused prehab for cancer surgery programme be optimised to support cancer preventive behaviour change in cancer patients and their family members?

Introduction
We would like to invite you to take part in a research study. Before you decide you need to understand why the research is being done and what it would involve for you. Please take time to read the following information carefully. Talk to others about the study if you wish. Ask us if there is anything that is not clear or if you would like more information.

Who is conducting the research?
This study is being led by Miss Clara Kurtidu, a Public Health PhD student, from the School of Health and Wellbeing at the University of Glasgow. Ms Clara Kurtidu specialises in prehabilitation for cancer surgery patients and started this study to see how prehabilitation programmes can be changed to better engage patients in the process. Prehabilitation means getting ready for surgery in whatever time there is before surgery, utilising physical activity, healthy eating and any psychological support that might be helpful. We appreciate your taking the time to read about our study.

The purpose of the study
We want to hear about the patients' opinions on the prehabilitation programme and find out how we can improve the current programme. We are also interested in patients' views on the inclusion of family members in the prehabilitation programme, as well as family members' views on the prehabilitation programme and how they could become more involved.

What is the study about?
There is published research stating that individuals with cancer may improve their general health, and possibly their long-term health, by following prehabilitation programmes before cancer surgery.
We want to recruit volunteers who are going to have surgery (or already had surgery) with the intention to cure by removing the tumour from the body and are currently part of the Apple Clinics prehabilitation programme. We aim to establish a focus group to investigate how we can improve the current programme, as well as views of both cancer patients and family members, on how to engage family members in the process.

What is the Apple Clinic?

The Apple Clinic at the Royal Alexandra Hospital, Paisley, is a prehabilitation service where lifestyle changes are discussed and physical activity is promoted. Prehabilitation is introduced to patients after diagnosis but before surgery with the aim to improve cancer preventative behaviour and surgery outcomes.

Why have I been invited?

One of your family members has recently been diagnosed with cancer and had surgery for their cancer diagnosis or is currently waiting to have surgery for their cancer.

Do I have to travel to the Royal Alexandra Hospital?

No, the focus group will be held online.

Do I have to take part?

No. Participation in this study is voluntary and it is up to you to decide whether to take part. If you decide to take part, you are still free to leave at any time and without giving a reason. This will not affect any standard of your care in the future.

What will happen if I agree to participate?

If you agree to participate you will be invited to take part in a focus group, preferably with a family member/friend/career. Other patients and their family members will also be there. The researcher Clara Kurtidu will also attend to guide the focus group. The focus group will last approximately 2 hours, with structured breaks and will be audio recorded. The researcher will ask you questions about how you perceived the prehabilitation services offered to your family member with cancer. If you wish not to answer certain questions or if you would like to stop participating, you can do so without having to provide a reason, and this will not affect your rights or your family member's healthcare in any way.

Will my participation in this study be kept confidential?

Yes. The only people who know will be the persons attending, research team and representatives of the study sponsor, NHS GG&C, to check that the study is being conducted properly. The NHS GG&C is the data controller of this study, they have a responsibility to keep your information for 10 years. They are a health board in Scotland and are responsible for providing and managing health services such as hospitals and general practice, and work alongside partnership organisations including local authorities and the voluntary sector.

If you disclose information during the focus group that indicates a risk of harm to yourself or others, please be aware that we may need to breach confidentiality to ensure your safety or the safety of others by contacting appropriate authorities such as your GP or the police.

If you agree to participate, your data will immediately be de-identified (that is, your name will be removed and replaced with a number or code) so you cannot be identified.
Additionally, all pseudonymised data will be securely stored on the University of Glasgow network data. Documents such as your signed consent form will be kept at a research dedicated locked and restricted access room at the Royal Alexandra Hospital.

Your consent to the use of project data does not have a specific expiration date, but you may withdraw your consent at any time by notifying the study team. If you withdraw your consent the study team will destroy any personal information collected for the purpose of this study.

By consenting you are agreeing to the study team securely storing your contact details. This allows the study team to approach you in the future for any follow up work to this study. You will not be approached by any other researchers, only this team and for information directly related to this trial.

How will the NHS GG&C use information about you?
We will need to use information from you for this research project. This information will include your name and contact details. People will use this information to do the research or to check your records to make sure that the research is being done properly. We will keep all information about you safe and secure.

Once we have finished the study, we will keep some of the data so we can check the results. We will write our reports in a way that no-one can work out that you took part in the study.

What are your choices about how your information is used?
You can stop being part of the study at any time, without giving a reason, but the NHS GG&C will keep information about you that we already have. Any information collected will also be included in the study. The NHS GG&C have a responsibility to keep your information for 10 years. They need to manage your records in specific ways for the research to be reliable. This means that we won't be able to let you see or change the data we hold about you.
To safeguard your rights, we will use the minimum personally identifiable information possible. You can find out more about how we use your information at: https://www.nhsggc.scot/patient-visitor-faqs/data-protection-privacy/

What will happen to my personal data?
We will treat your personal data (including your names and contact details) as set out in the General Data Protection Regulation 2018 (GDPR). However, if you would like us to contact you with the findings of the study, which we will ask you about then we conduct the focus group, we may store your name and contact details at a research dedicated locked and restricted access room at the Royal Alexandra Hospital. So we have your details on hand once the findings have been summarised. Once the findings have been passed on to you, the information will be destroyed.

What happens to the information that is collected?
It is intended that the results of the research will be published in a research journal. The information collected should help to improve the current prehabilitation programme run by "The Apple Clinic" at the Royal Alexandra Hospital, Paisley. To be able to do so, the audio recordings of the focus group will be transcribed by Clara Kurtidu and then analysed by her. Some of the things you discuss with the interviewer might be put in quotations and be used in the published findings of the study – however, all identifying features will be removed and de-identified so it cannot be traced back to you. It is important to point out that no volunteers included in the research will be able to be identified from any report or publication. If you

would like to be informed of the study results let the researcher know during the focus group or please contact us at the email address given below and we will be happy to send you a PDF that concludes all important findings.
The de-identified information collected may also be used by us or our colleagues at the University of Glasgow to answer new research questions related to prehabilitation for cancer surgery patients. We will remove all information from the written records of the focus group that could identify you and store them for 10 years. Your name will not be held with the information.

What are the possible disadvantages of taking part?
The study may take about 2 hours of your time. There are no right or wrong answers to the questions, and you can talk about anything that you feel is relevant. It is possible that during the focus group you may find a topic sensitive or upsetting, and you are free to ask the interviewer to move on to another subject or stop the session altogether. It is important for you to understand that you are not required to discuss anything that you do not want to, and you should discuss only the things which you feel are relevant. If you have concerns, you can discuss them fully with the research team.

What are the possible benefits of taking part?
We cannot promise the study will help you, although in previous studies participants have commented that they have enjoyed the opportunity to think about their health and express their views. Additionally, our findings may help improve the delivery of future healthcare services and therefore, may benefit people diagnosed with cancer in the future.

Will I receive payment or expenses?
Yes. You will be given a gift card worth £20 as a token of appreciation for your participation, after the focus group is conducted.

Who is funding the study?
This study has been reviewed and approved for funding by the Scottish Cancer Foundation. Their website for more information is http://scottishcancerfoundation.org.uk

What do I do now?
If you have decided to take part, you can either reach out to Ms Clara Kurtidu directly via email: c.kurtidu.1@research.gla.ac.uk or call her on:

What if I have any questions?
We encourage you to contact the research team. This study is being led by Ms Clara Kurtidu and she can be contacted via email: c.kurtidu.1@research.gla.ac.uk or phone:
Or you can contact Dr. Marie Kotzur who is not involved in the research but able to answer questions and queries around the research: Marie.Kotzur@glasgow.ac.uk

Who has reviewed the study?
The study was reviewed and approved by an NHS Research Ethics Committee.

If you have a complaint about this research study
You can email: complaints@ggc.scot.nhs.uk

Write to: Complaints Department
North East Sector Offices,
Stobhill Hospital
300 Balgrayhill Road
Glasgow
G21 3UR

Or call: 0141 201 4500

If you have a complaint about the way your data is being handled

If you are unhappy about how your data is being handled and wish to make a complaint, the NHS GG&C complaints procedure is available to you.

You can write to: Stewart Whyte
Data Protection Officer
NHS Greater Glasgow and Clyde
1 Smithhills Street
Level 2
Paisley PA1 1EB

Email: Data.Protection@ggc.scot.nhs.uk
Call: **0141 278 4774**

If you are unhappy with the handling of your personal data, please let our researcher know in the first instance. You can also make a complaint directly to the Information Commissioner's Office, either online: https://ico.org.uk/concerns/ or by phone: 0303 123 1113.

Further information and contact details

If you wish to obtain further information about this research, please do not hesitate to email Ms Clara Kurtidu **c.kurtidu.1@research.gla.ac.uk** or call her on:
You can also contact Clara Kurtidu's supervisor and the chief investigator of this study under: katie.robb@glasgow.ac.uk

If you need support that reaches beyond the abilities of the research team and is related to your family members cancer diagnosis, please contact the following helplines.
Macmillan helpline, which is open 7 days a week from 8am-8pm under: 0808 8080000
Maggie's helpline, which is open Monday-Friday from 10am-4pm under: 0300 1231801

Thank you very much for considering taking part in our research. Please discuss this information with your friends, family, or doctor if you wish.

Appendix N – Participant information sheet for HCP/SP – focus group

PARTICIPANT INFORMATION SHEET – HEALTHCARE PROFESSIONALS

Study Name
How can the existing patient-focused prehab/rehab for cancer surgery programme be optimized to support cancer preventive behaviour change in cancer patients and their family members?

Introduction
We would like to invite you to take part in a research study that involves a focus group discussion via a Team video call. Before you decide you need to understand why the research is being done and what it would involve for you. Please take time to read the following information carefully. Talk to others about the study if you wish. Ask us if there is anything that is not clear or if you would like more information.

Who is conducting the research?
This study is being led by Miss Clara Kurtidu, a Public Health PhD student, from the Institute of Health and Wellbeing at the University of Glasgow. Ms Clara Kurtidu specialises in prehabilitation for cancer surgery patients and started this study to see how prehabilitation programmes can be changed to better engage patients in the process. We appreciate your taking the time to read about our study.

The purpose of the study
We want to hear about the prehabilitation programme, from the perspective of a healthcare professional, and find out how we can improve the current system.

What is the study about?
There is published research stating that individuals with cancer may improve their general health and their long-term outcomes by following prehabilitation programmes before cancer surgery.
We want to recruit healthcare professionals who are part of the "Apple Clinic" at the Royal Alexandra Hospital in Paisley. We aim to create a discussion within the focus group to investigate how we can improve the current programme.

Why have I been invited?
You have been invited to this study as a professional who is involved in the 'Apple Clinic' working with people who have been diagnosed with intra-abdominal and/or gastrointestinal cancer as part of the prehabilitation service offered at the Royal Alexandra Hospital. Therefore, we would like to explore your views on the current prehabilitation programme and how it can be optimised.

Do I have to travel to the Royal Alexandra Hospital?
No.

Do I have to take part?

No. Participation in this study is voluntary and it is up to you to decide whether to take part. If you decide to take part, you are still free to withdraw at any time and without giving a reason.

What will happen if I agree to partake?

If you agree to participate you will be invited to partake in a 60-90 minute focus group with other participants and the researcher, Clara Kurtidu. The researcher will ask you questions about your experience with the prehabilitation programme offered at the Apple Clinic at the Royal Alexandra Hospital, Paisley. If you wish not to answer certain questions or if you would like to exit the focus group, you can do so without having to provide a justification.

What will happen if I don't want to carry on with the study?

At any time during the study you may withdraw, without giving any reason. Any personal information and identifiable data collected from you for the purposes of this study will be destroyed.

Will my participation in this study be kept confidential?

Yes. If you agree to participate, your data will immediately be de-identified and coded so you cannot be identified. All coded data will be stored on password protected, secure computer systems that are maintained in a locked office.

As the researcher, it is my legal and moral responsibility to report and therefore breach confidentiality if professional misconduct is mentioned by the participant. In this case, a report of the misconduct will be passed onto the participant's department lead or wider organization's HR officer.

Your consent to the use of project data does not have a specific expiration date, but you may withdraw your consent at any time by notifying the study team. If you withdraw your consent the study team will destroy any personal information collected from you.

In addition, by consenting you are agreeing to the study team securely storing your contact details. This allows the study team to approach you in the future for any follow up work to this study. You will not be approached by any other researchers, only this team and for information directly related to this trial.

What will happen to my personal data?

We will treat your personal data (including your names and contact details) as set out in the General Data Protection Regulation 2018 (GDPR). We need to collect and temporarily store information like your names and contact details, so our researcher can arrange to meet with you and send you the final report if you wish.

The University of Glasgow is the data controller for this study and all associated personal data collected. For more information about your rights in relation to your personal data you may contact the University of Glasgow's Data Protection & FOI Office: https://www.gla.ac.uk/myglasgow/dpfoioffice/contact/, or visit the website of the Information Commissioner's Office: www.ioc.org.uk

What happens to the information that is collected?

It is intended that the results of the research will be published in a research journal. The information collected should help to improve the current prehabilitation programme run by "The Apple Clinic" at the Royal Alexandra Hospital, Paisley. It is important to point out that no participants included in the research will be able to be identified from any report or publication. If you would like a copy of the published results of the research let the researcher know during the focus group or please contact us at the address given below and we will be happy to send them to you.

The information collected may also help us or our colleagues answer new research questions related to prehabilitation for cancer surgery patients. We will remove all information from the written records of the focus group that could identify you and store them with the participant questionnaires for 10 years. Your name will not be held with the information.

What are the possible disadvantages of taking part?
The study may take 60-90 minutes of your time. There are no right or wrong answers to the questions and you can talk about anything that you feel is relevant. It is important for you to understand that you are not required to discuss anything that you do not want to, and you should discuss only the things which you feel are relevant. If you have concerns you can discuss them fully with the research team.

What are the possible benefits of taking part?
We cannot promise the study will help you directly, but its findings may be useful in informing the design and delivery of the current or future prehabilitation programmes.

Will I receive payment or expenses?
No.

Who is funding the study?
This study has been reviewed and approved for funding by the Scottish Cancer Foundation. Their website for more information is http://scottishcancerfoundation.org.uk

What do I do now?
If you have voiced your interest to Prof Susan Moug, then the researcher, Clara Kurtidu, will contact you by telephone and if you agree to partake, propose different times and dates for the focus group, the date with the most votes will go forward.
If you have not voiced your interest in partaking in the study, you can either reach out to Prof Susan Moug via email susan.moug@ggc.scot.nhs.uk. Or you can reach out to Ms Clara Kurtidu directly via email: c.kurtidu.1@research.gla.ac.uk

What if I have any questions?
We encourage you to contact the research team. This study is being led by Ms Clara Kurtidu and she can be contacted via email: c.kurtidu.1@research.gla.ac.uk

Who has reviewed the study?
This study was reviewed by the University of Glasgow, College of Medical, Veterinary, and Life Sciences Ethics Committee.

If you have a complaint about any aspect of the study

If you are unhappy about any aspect of the study and wish to make a complaint, please contact, Ms Marie Kotzur via email Marie.Kotzur@glasgow.ac.uk

If you are unhappy with the handling of your personal data, please let our researcher know. You can also make a complaint directly to the Information Commissioner's Office, either online: https://ico.org.uk/concerns/ or by phone: 0303 123 1113.

Further information and contact details
If you wish to obtain further information about this research, please do not hesitate to email Ms Clara Kurtidu c.kurtidu.1@research.gla.ac.uk

Thank you very much for considering taking part in our research.

Appendix O – Topic guide for focus group

1. Introduction and Icebreaker

- Welcome participants and explain the purpose of the focus group *(mention the workshop)*

- Introduce the topic of prehabilitation and its relevance to cancer surgery patients, in Apple Clinic terms – just to make sure we all have the same understanding *(short and snappy)*

- Icebreaker question to help participants feel comfortable: **favourite daily movement or favourite food and their name**

2. Workshop activity

I would like you to think about your own experience with the prehab sessions and work together, as a group on making it work better.

Key things to think about: your first appointment with Ludo or Lauren, the physical activities you are learning about, food, emotional support

What did you particularly like and dislike about prehab?

- Think about what you would like to see changed.
- What could a prehab setting look like that makes you want to take part?
- What would make you feel supported enough to attend and stick to the exercises before and after surgery?
- How about support after surgery? What would you need to feel supported und encourage you to keep up the exercises and changes in eating habits?

Some of you I had the delight to interview previously - of the following issues came up:

1. Making time for prehab sessions *(following are prompts to discuss)*
- Timing of Prehab Assessment but also sessions at the Leisure centre.
- Impact of Ludo-led Sessions.
- What would you like communication to be like with the prehabilitation services? Weekly check ins?
- Explore preferences for prehab sessions, what could the structure (more classes a week), content (what do these classes look like), and delivery (how would you like them to be delivered? In person, doing them by yourself at home, group, one-to-one?) look like?

2.Importance of Family Members in Prehab Assessments *(following are prompts to discuss) - feedback on this in 1:1 interviews was very mixed*

- - Would you like family members to be included in the assessment part? And if so, what is the best way for family member to be part of the prehab process? Would you enjoy if your partner joined you doing the exercises? Or would you rather keep this separate from your partner?

- If you want your partner to take part with prehab exercises, how can the involvement of family members be increased? Is there anything Ludo and your healthcare team can do to support this?

3. Prompts for the workshop (in case participants get stuck in their discussion)

Physical Activity

- Exploring more ways to be active - community lead (so that could be a group of patients organising something amongst themselves. For example, walking groups etc)?

- Introduction of a mobile app with exercises on it? Do we like a digital version?

- Group exercise classes at different times? Or do we prefer 1:1s?

Would you like more face to face sessions? Would a phone application (app) be useful to track progress?

Nutrition aka Foods

- Would it help to have more education on what foods are good to eat before and after surgery?

- How about information on foods for those with stomas?

- What about long-term diet needs and supports?

- How would you like to receive this information? Seeing a dietician one on one? Leaflets?

- How would you feel best supported with sticking to the dietary changes? What can your healthcare team do for you to keep up a good diet and make smart choices?

Emotional Support

- Exploring alternative forms of emotional support / mental health support.

- Community based activities? does social connection at group events aid as mental health support?
- What are our thoughts on tea afternoons for partners of those effected with cancer? To connect and share experiences?

Strategies

- What are some things that could be changed to make sure you are taking part in your prehab sessions as well as your sessions at the lagoon, after surgery?

- Discuss potential ways to overcome barriers and improve support for prehabilitation

- What would motivate cancer patients and family members to engage in prehabilitation activities.

- How can we enhance support and communication around prehabilitation for cancer surgery patients?

7. Feedback and Suggestions

- Gather final thoughts and reflections on the topic of prehabilitation for cancer patients.

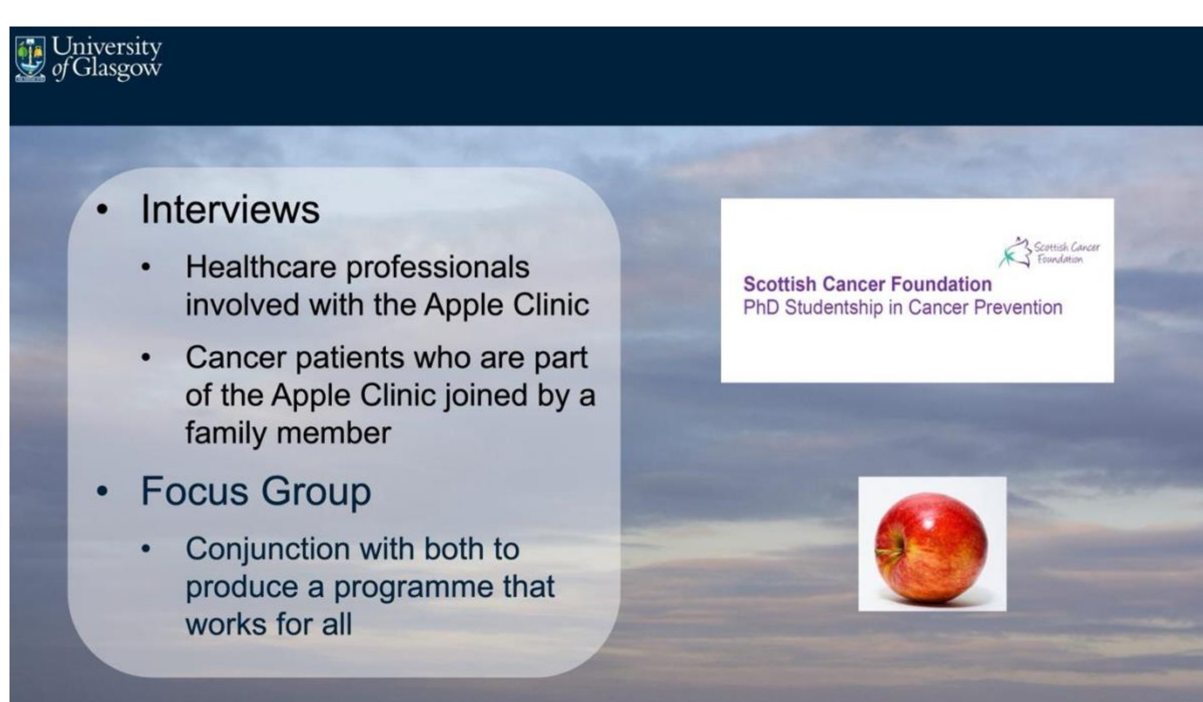
8. Closing and Thank You

- Summarise key points discussed during the focus group.

- Thank participants for their valuable insights and participation.

- Provide information on next steps or follow-up activities related to the research study.

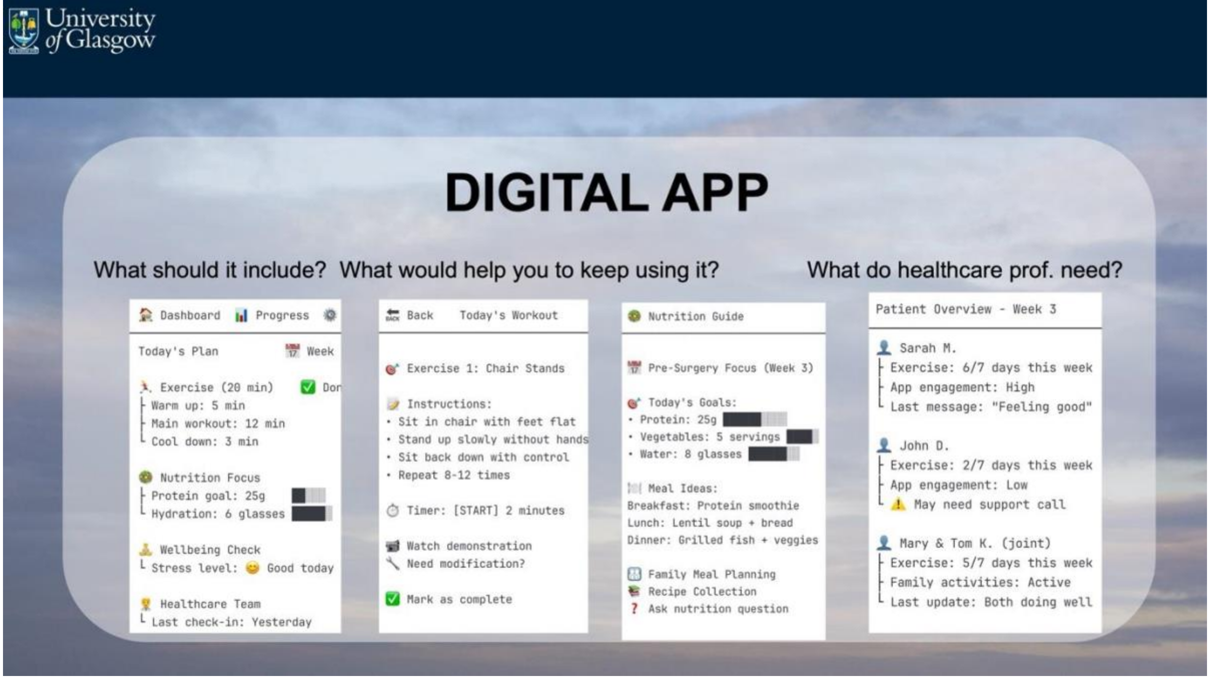
Appendix P – PowerPoint presentation – focus group

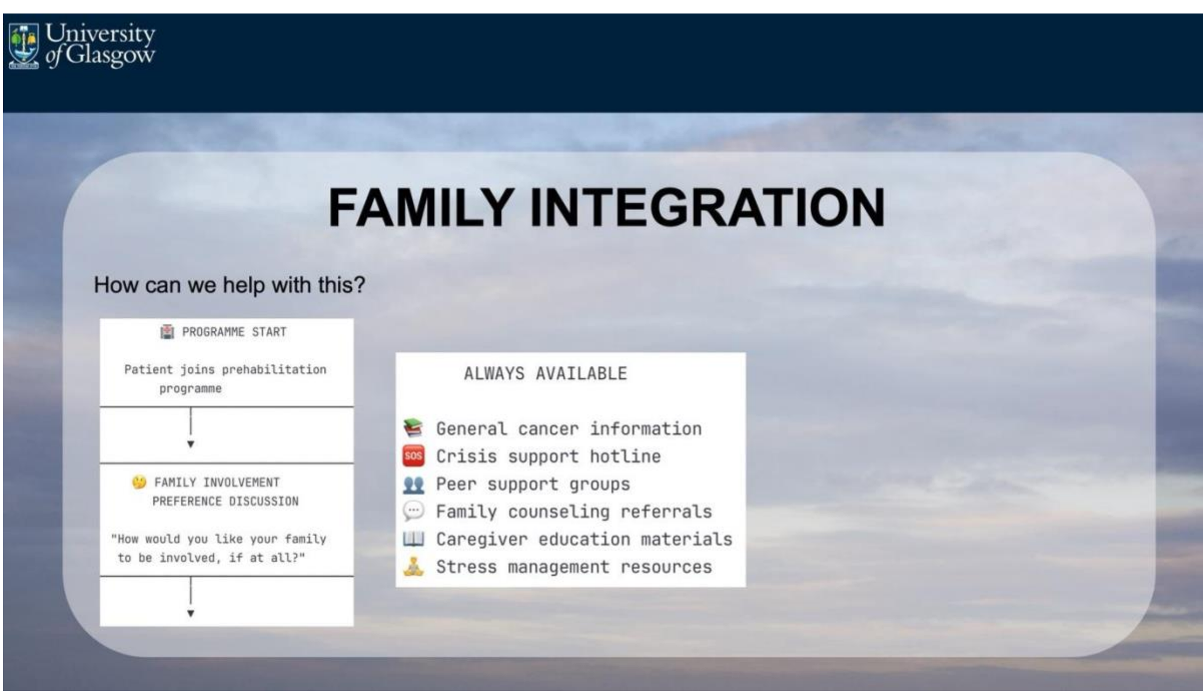

University of Glasgow
Interviews
Healthcare professionals involved with the Apple Clinic
Cancer patients who are part of the Apple Clinic joined by a family member
Focus Group
Conjunction with both to produce a programme that works for all
Scottish Cancer Foundation
Scottish Cancer Foundation
PhD Studentship in Cancer Prevention

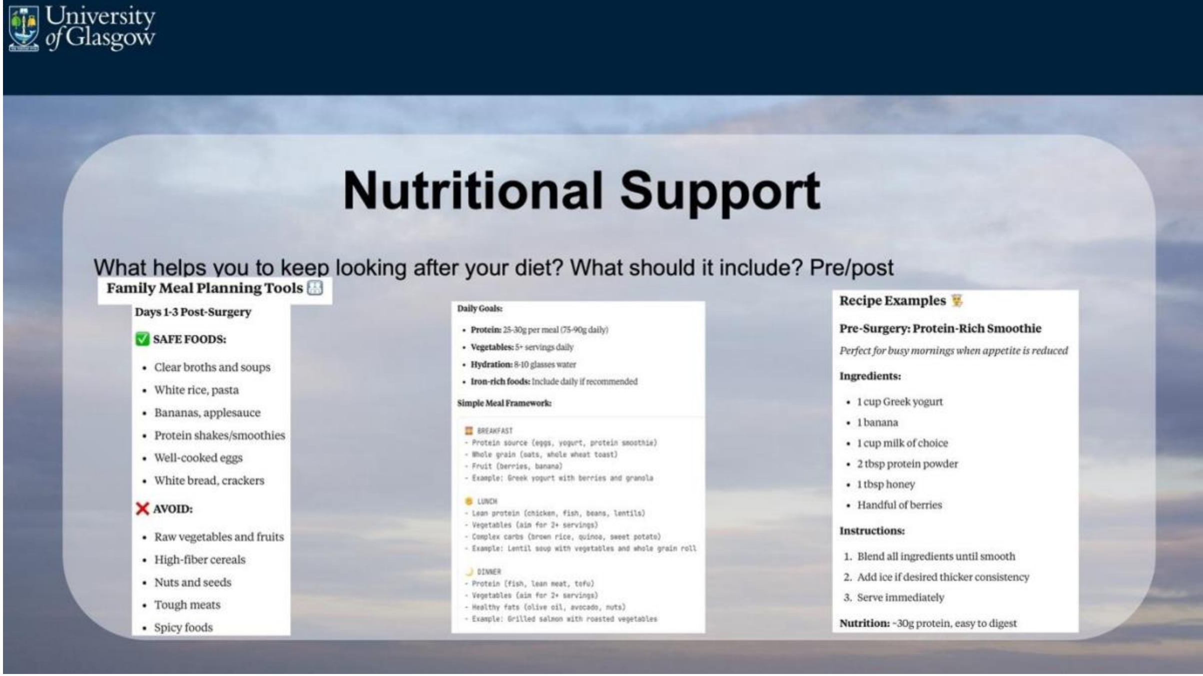
University of Glasgow
What needs to be improved?
Digital App
Family integration
Nutritional Support

What would help you to stick to the programme?

- Self monitoring?
- Knowing how exercise/nutrition are linked to your health?
- Being provided with instructions?
- Having someone occasionally doing the exercise with you (like Ludo)?
- Can stress management help to stay engaged?




University of Glasgow
FAMILY INTEGRATION
How can we help with this?
PROGRAMME START
Patient joins prehabilitation programme
FAMILY INVOLVEMENT PREFERENCE DISCUSSION
"How would you like your family to be involved, if at all?"
ALWAYS AVAILABLE
General cancer information
Crisis support hotline
Peer support groups
Family counseling referrals
Caregiver education materials
Stress management resources


University of Glasgow
Nutritional Support
What helps you to keep looking after your diet? What should it include? Pre/post
Family Meal Planning Tools
Days 1-3 Post-Surgery
SAFE FOODS:
Clear broths and soups
White rice, pasta
Bananas, applesauce
Protein shakes/smoothies
Well-cooked eggs
White bread, crackers
AVOID:
Raw vegetables and fruits
High-fiber cereals
Nuts and seeds
Tough meats
Spicy foods
Daily Goals:
Protein: 25-30g per meal (75-90g daily)
Vegetables: 5+ servings daily
Hydration: 8-10 glasses water
Iron-rich foods: Include daily if recommended
Simple Meal Framework:
BREAKFAST
- Protein source (eggs, yogurt, protein smoothie)
- Whole grain (oats, whole wheat toast)
- Fruit (berries, banana)
- Example: Greek yogurt with berries and granola
LUNCH
- Lean protein (chicken, fish, beans, lentils)
- Vegetables (aim for 2+ servings)
- Complex carbs (brown rice, quinoa, sweet potato)
- Example: Lentil soup with vegetables and whole grain roll
DINNER
- Protein (fish, lean meat, tofu)
- Vegetables (aim for 2+ servings)
- Healthy fats (olive oil, avocado, nuts)
- Example: Grilled salmon with roasted vegetables
Recipe Examples
Pre-Surgery: Protein-Rich Smoothie
Perfect for busy mornings when appetite is reduced
Ingredients:
1 cup Greek yogurt
1 banana
1 cup milk of choice
2 tbsp protein powder
1 tbsp honey
Handful of berries
Instructions:
1. Blend all ingredients until smooth
2. Add ice if desired thicker consistency
3. Serve immediately
Nutrition: ~30g protein, easy to digest

Appendix Q – Ethical approval not for amendment for focus group

IRAS 312935. Amendment

no-reply-IRAS <no-reply-iras@hra.nhs.uk>
To: Clara Kurtidu (PGR)

Friday, 26 July 2024 at 10:44

IRAS Project ID: 312935
Sponsor amendment reference: NSA01
The sponsor has reviewed the documentation and determined that this amendment is a non-substantial amendment therefore REC approval is NOT required.

Thank you for submitting a non-substantial amendment. Your amendment will be processed, and you will receive further communication in due course.

Do not reply to this email as this is an unmonitored address and replies to this email cannot be responded to or read.

Please note that acknowledgement from NHS Research Ethics is not required for non-substantial amendments.

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RE: Amendments

Neil Allan <Neil.Allan@glasgow.ac.uk>
To: Clara Kurtidu (PGR); MVLS Ethics Admin

Monday, 29 July 2024 at 17:06

Hi Clara

The Chair says the requested amendments are fine to approve. I've stored everything in the file for reference.

Regards
Neil

Neil Allan
MVLS Ethics Committee Administrator

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