

**Title:** To what extent do current total hip and knee replacement patient information resources adhere to Enhanced Recovery after Surgery principles?

### **Abstract:**

### **Objectives**

Total hip replacement (THR) and total knee replacement (TKR) are two of the most common orthopaedic surgeries that occur in the United Kingdom (UK) annually. Enhanced recovery after surgery (ERAS) programmes aim to decrease convalescence across procedures. It has been highlighted that post-operative physiotherapy routines may not contain the correct ingredients for promoting acceleration of return to function. This research aims to analyse if current THR and TKR patient information resources adhere to ERAS principles, thus optimising post-operative recovery.

### **Data Sources**

Twenty hip and knee replacement patient information booklets were sourced using a UK Google search. A flowchart of exercise prescription components was formulated from a review of 5 trial booklets. A content analysis was utilised to assess the information included within the patient information booklets.

### **Results**

Forty percent of patient information booklets identified their pathways to be ERAS. Fifty five percent of the hospitals stated their patients would be mobilised on the day of surgery. Ninety percent of THR and 100% of TKR guidelines suggested the use of bed exercises for rehabilitation. Fifteen percent of THR and 35% of TKR booklets suggested functional exercise as a method of rehabilitation. Strength or resistance based exercises were proposed in 40% of THR and 55% of TKR booklets.

### **Conclusion**

Many patient information booklets do not follow ERAS principles for fast-track rehabilitation and the exercise prescription procedure is non-specific. This must be considered within post-operative rehabilitation in order to enhance recovery and reduce length of stay following THR or TKR surgery.

## Contribution of the paper

- This paper reviews the rehabilitation information currently available to United Kingdom National Health Service patients following total hip or knee replacement surgery.
- The results show that many patient information booklets do not follow Enhanced Recovery after Surgery principles for fast-track rehabilitation. The exercise prescription procedure is non-specific.
- This paper offers suggestions as to how patient information resources could be updated to align with recent, peer reviewed literature which could facilitate the return to function following total hip or knee replacement surgery. This paper also includes examples of exemplar booklets which could guide the re-design of outdated resources.

**Keywords:** Hip replacement, knee replacement, physiotherapy, rehabilitation, patient information.

## Introduction

Total hip replacement (THR) and total knee replacement (TKR) are two of the most common orthopaedic surgeries that occur in the United Kingdom (UK) each year [1]. An increasing lifespan of the population has raised the number of THR and TKR surgery required [2] and is also increasing the rehabilitation requirement for patients wishing to return to work, social, sporting and leisure activities.

Enhanced recovery after surgery (ERAS) programmes aim to decrease convalescence across procedures, morbidity and length of stay [3]. ERAS, also termed fast-track, accelerated or rapid recovery, was first introduced by Henrik Kehlet [4] within colorectal surgery but has since been applied to a number of surgical sub-specialities. In the United Kingdom, the Enhanced Recovery Partnership Programme (ERPP) was introduced by the Department of Health and National Health Service (NHS) in 2009 to support the national implementation of ERAS for colorectal, orthopaedic, gynaecology and urology major elective surgical pathways [5].

The role of physiotherapy within ERAS programmes is important; rapid recovery of muscle function will improve patient recovery and reduce length of stay [6]. The post-operative physiotherapy routine is broadly similar across orthopaedic hospitals, however the pathway has been criticised for not containing the correct ingredients for a fast-track recovery [7]. Physiotherapy treatment aims to promote the return to function following THR and TKR; however, recent studies have questioned the value of the exercises currently prescribed to patients [7-9].

The protocols for recovery are generally static, bed exercises, prescribed without consideration of progressive strength or functional rehabilitation. The efficacy of such exercises in comparison to early functional exercises has recently been queried [10]. Expert comments suggest that the timing of the intervention may also be important [7]. Commonly, the exercises prescribed to patients following THR or TKR are without a clear course of progression and appear to not follow basic physiological guidelines that are known to improve patients' muscle hypertrophy and subsequent return to daily activities. Post-operative physiotherapy has been described as being of low intensity [11] despite research concluding that physiotherapy should be immediate and intensive following THR and TKR [7].

Members of the ERAS society, in collaboration with other medical societies, have published clinical guidelines to demonstrate exemplar practice. At present, there are no ERAS guidelines published for TKR and THR however related research offers guidance on key principles of post-operative physiotherapy. Early mobilisation is central to ERAS and the acceleration of discharge criteria, proving to reduce mortality and morbidity [12-14]. In addition, progressive strength or resistance training [15, 16] and high intensity functional exercise interventions have been recommended [17]. Exercise prescription should be informed by relative load and repetition maximum information [7]. In unselected groups, where consecutive patients are recruited without a selective referral process, patients can be discharged on the day of surgery or 1-2 days post-surgery [18]. If the pathways aim to facilitate post-operative recovery, patients must have clear instructions on how to progress their rehabilitation independently [19]. Accurate prescription of exercise training post-surgery can ameliorate the strength loss that occurs immediately after an operation. Rehabilitation following THR and TKR requires change. This research aims to analyse if current THR and TKR patient information resources adhere to ERAS principles, thus optimising post-operative recovery.

## Method

The study was conducted by adopting a qualitative data collection methodology which informed a quantitative data analysis procedure [20]. A content analysis was used to collect the pertinent data from the hospital information booklets, a method informed by previous studies that have evaluated patient resources [21-22]. The data collected was organised into basic descriptive statistics in preparation for analysis and discussion. The multi-stage data extraction pathway is shown in Figure 1. All data from the study was collected from freely accessible content available on the internet. Ethical approval was not pursued as the study did not involve human participation.

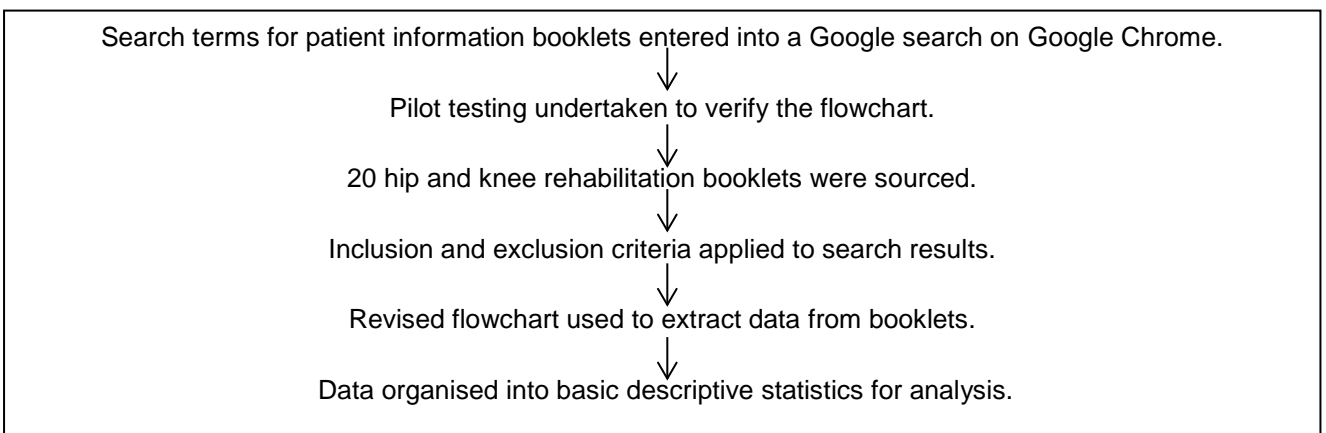


Figure 1: Process involved with data extraction and analysis.

## Search Strategy

A comprehensive search was undertaken in order to source UK NHS hospital patient information booklets. Due to its popularity, a UK Google Search was chosen as the generator for results. All searches were conducted from [www.google.co.uk](http://www.google.co.uk) on a Windows Chrome (version 57.0.2987.133) browser. A search strategy was constructed by selecting appropriate keywords and terms. Each search term was tested individually, and then the three phrases which generated the most, relevant results were combined with Boolean operators to create a final search formula (Figure 2).

Total hip replacement	Patient information on hip replacement OR UK NHS hospital guidelines for hip replacements OR hip replacement rehabilitation.
Total knee replacement	Patient information knee replacement recovery OR UK NHS hospital guidelines for knee replacements OR knee replacement recovery.

Figure 2: Search formula

## Inclusion and Exclusion Criteria

The search results were assessed for the exclusion and inclusion criteria in chronological order. We took a convenience sample of twenty booklets to analyse. Although this sample size does not reflect the total number of trusts that offer THR and TKR, it does offer a strong indication of the practice that is occurring nationwide due to the geographical spread of the resources. The first twenty appropriate results were downloaded into a secure, password protected file. Patient information booklets were only included if they were from a UK NHS hospital, not an independent provider of healthcare or charity. Booklets for unicompartmental replacements or revision surgery were excluded. The booklets had to be in a portable document format (PDF) to avoid the inclusion of modified or edited versions of hospital resources. The information booklets sourced were from an UK NHS hospital website, designed to be downloaded by patients. The booklets were only involved in the study if they contained exercise prescription advice post-surgery. If there were two versions of the file, the most recent was selected for analysis.

## Pilot Testing

A sample of five patient information booklets was sourced for pilot testing, whereby a flowchart of post-operative physiotherapy care components was formed. Two members of the research team reviewed the flowchart individually and discussed any changes that needed to be made to the data extraction procedure. Minor additions were made to the flowchart, including more detail added to the queries on bed and sitting exercises and the progression of walking and stair climbing. The final version is shown in Figure 3.

## 148 **Content Analysis**

149 A content analysis was used to collect the relevant data from the hospital booklets, followed by the  
150 creation of basic descriptive statistics, informed by existing methodologies from previous studies that  
151 evaluate patient resources [21-22]. Content analysis is a systematic, inexpensive and replicable  
152 technique used to organise vast quantities of data into predefined subgroups [23]. This method was  
153 utilised to classify the information within the patient information booklets in align with the flowchart  
154 categories. Neuromuscular exercises were defined as “exercises that challenge lower-limb muscles in  
155 functional positions” [24]. Cardiovascular guidelines were defined as “any activity that uses large  
156 muscle groups, and can be maintained continuously and is rhythmic in nature” [25]. The data was  
157 recorded in a Microsoft Excel (2010) spreadsheet and then organised into percentage totals in order  
158 to generate basic descriptive statistics in preparation for discussion. Length of stay data was  
159 compared to that of hospital generated data from the Dr Foster healthcare intelligence portal,  
160 (<http://my.drfooster.co.uk>), an online tool for presenting and comparing hospital episode statistics.

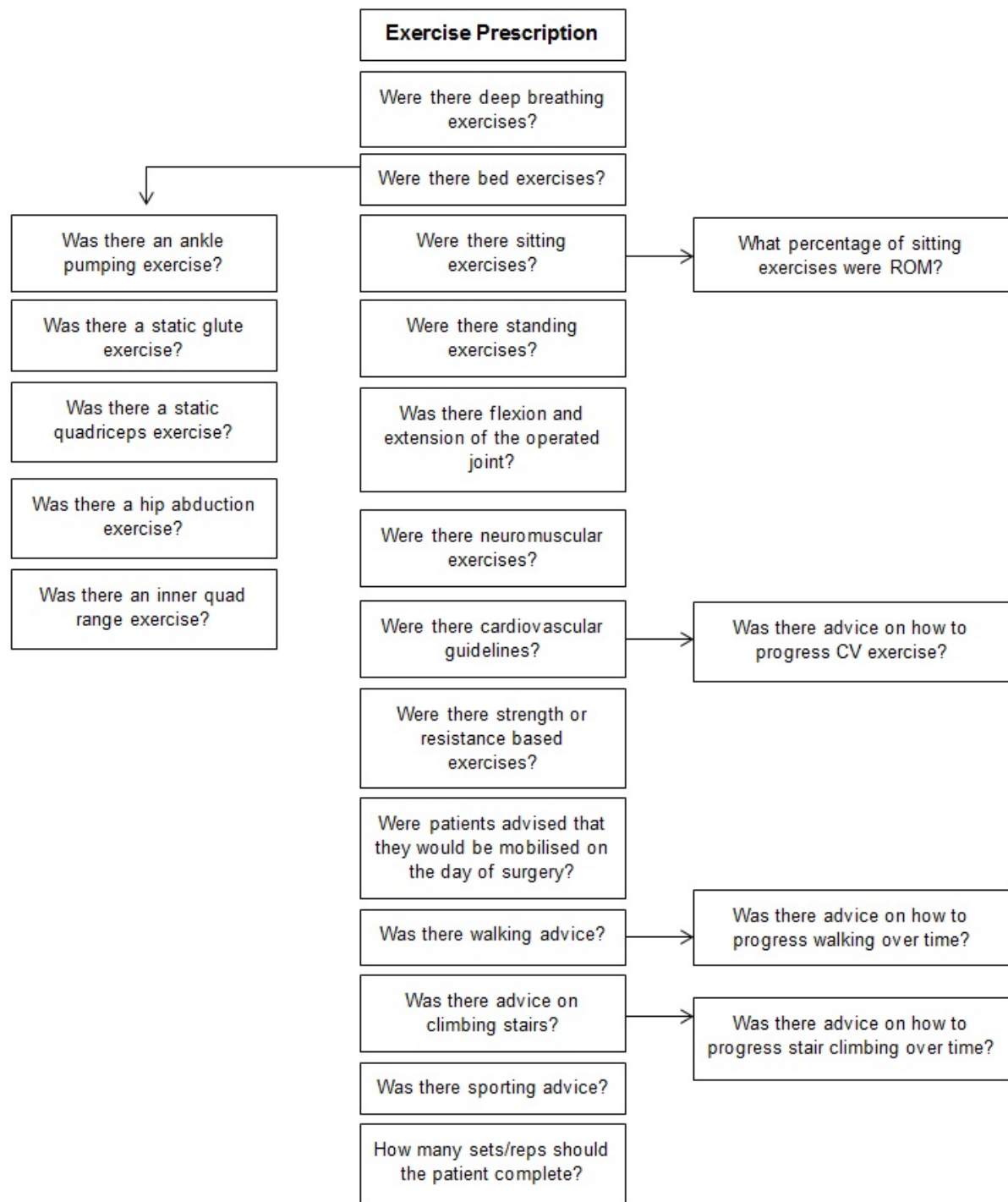


Figure 3: Flowchart for content analysis



	Inclusion rate THR (%)	Inclusion rate THR (n)	Inclusion rate TKR (%)	Inclusion rate TKR (n)
Last revised date (mean $\pm$ SD)	2013 $\pm$ 2 years	20	2012 $\pm$ 3 years	20
Was the pathway identified as ERAS?	40%	8	40%	8
Did it include photos/illustrations?	95%	19	100%	20
What was the expected Length of Stay?	3 $\pm$ 1 days		4 $\pm$ 1 days	
Was there advice on climbing stairs?	90%	18	95%	19
Was this stair advice progressed?	22%	4/18	16%	3/20
Was there walking advice?	95%	19	90%	18
Was the walking advice progressed?	68%	13/19	72%	13/18
Were patients advised that they would be mobilised on the day of surgery?	50%	10	55%	11
Were there bed exercises?	90%	18	100%	20
Were there deep breathing exercises?	65%	13	65%	13
Was there an ankle pumping exercise?	75%	15	65%	13
Was there a static gluteal exercise?	75%	15	40%	8
Was there a static quadriceps exercise?	70%	14	100%	20
Was there an inner quadriceps exercise?	20%	4	90%	18
Was there a hip abduction exercise?	90%	18		
Was there flexion or extension of the operated joint?	90%	18	95%	19
Were there sitting exercises?	35%	7	100%	20
What percentage of sitting exercises were ranges of motion?	100%	7/7	85%	17/20
Were there standing exercises?	85%	17	60%	12
Were there cardiovascular guidelines?	20%	4	20%	4
Were the cardiovascular guidelines progressed?	0%	0/4	25%	1/4
Were there neuromuscular exercises?	15%	3	35%	7
Was there sporting advice?	70%	14	55%	11
Were there strength or resistance based exercises?	40%	8	55%	11

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Figure 4: Results of content analysis

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## **ERAS and Length of Stay**

Forty percent of the hospitals examined reported to utilise an ERAS or fast-track recovery programme. For THR the predicted mean length of stay was  $3 \pm 1$  days. For TKR the predicted mean length of stay was  $4 \pm 1$  days. When ERAS and non-ERAS hospitals were analysed separately, length of stay was reduced in TKR patients who received a fast-track recovery programme ( $3 \pm 1$  days,  $4 \pm 1$  days respectively (mean  $\pm$  SD)). For THR patients, mean length of stay was  $3 \pm 1$  days during fast track recovery and  $3 \pm 2$  days in standard care. The mean last revised date for the patient information booklets was  $2013 \pm 2$  years (TKR) and  $2012 \pm 3$  years (THR).

Predicted length of stay data from the patient information sheets was compared to that of actual discharge data collected in the last 12 months on Dr Foster (<https://my.drfooster.co.uk>). When extracted from patient information booklets, the mean predicted length of stay for THR was  $3 \pm 1$  days. Actual discharge data for the same group of hospitals on Dr Foster found 46.5% of patients to be discharged on either day 3 or 4 and 37% of patients to be discharged on either day 5 or later. For TKR, Dr Foster discharge data found 46.5% of patients to be discharged on either day 3 or 4, and 37% of patients to spend either 5 or more days in hospital. Mean LOS for 2017 was 4.81 days for THR and 4.77 days for TKR (data available until September 2017).

## **Mobilisation**

For THR patients, 50% of patient information booklets state that they will be mobilised on the same day as surgery and 25% the day after. For TKR patients, 55% of hospitals advise mobilising on the day of surgery and 30% suggest the following day. Two guidelines (one identified as ERAS and one non-ERAS) suggest a patient will be mobilised within four hours post-surgery. For hospitals that did not specify a time frame, comments such as “as soon as possible” were used to describe the mobilising process.

## **Stair and Walking Progression**

Ninety five percent of THR and 90% of TKR patient information booklets offered advice on how to manage walking post-surgery. Ninety percent of THR and 95% of TKR booklets gave advice on getting up and down stairs following surgery. Twenty two percent of THR and 16% of TKR booklets

196 offered guidelines on how to progress stair climbing following the initial advice. Guidelines were often  
197 unspecific without a clear criterion of when and how the patient should progress:

198 *“Progress as you feel ready”*

199 *“Your physiotherapist will show you how to progress”*

200 *“Progression is dependent upon patient”*

201 *“Progression should occur when you feel able”*

202 Sixty eight percent of THR and 72% of TKR rehabilitation booklets gave patients advice on  
203 progressing walking with and without a walking aid. Although more frequent than stair progression,  
204 the advice was similarly vague:

205 *“Aim to increase the activity you do each day”*

206 *“Progression occurs when physiotherapist instructs or when you feel ready”*

207 *“Slowly increase walking distance”*

## 208 **Exercises**

209 Deep breathing, bed, sitting and standing exercises were all common amongst the patient information  
210 booklets. Ninety percent of THR and 100% of TKR booklets suggested utilising bed exercises for  
211 recovery, these commonly included; breathing exercises (65%), ankle pumps (75% and 65%  
212 respectively), static gluteal squeezes (75% and 40%), static quadriceps squeezes (70% and 100%),  
213 inner quadriceps range (20% and 90%) and hip abduction (90% of THR). Flexion and extension of the  
214 operated joint was common (90% of THR and 95% of TKR) and seated range of motion exercises  
215 were also regular (100% of THR and 85% of TKR). Standing exercises were prescribed in 85% of  
216 THR and 60% of TKR patient information booklets.

217 Cardiovascular exercise guidelines were offered in 20% of all patient information booklets.  
218 Cardiovascular progression was not seen in any of the THR guidelines and in 25% of the TKR patient  
219 information booklets. Cardiovascular recommendations included use of a step machine, low impact  
220 cycling, walking and swimming. Neuromuscular exercise was suggested in 15% of the THR and 35%  
221 of the TKR booklets and this mostly encouraged the sit-to-stand movement. Progressive strength  
222 exercises were propounded in 40% of the THR and 55% of the TKR rehabilitation programmes,  
223 including exercises such as step ups, mini squats, leg press, calf raises and hamstring curls.

224 **Sporting advice**

225 Seventy percent of THR and 55% of TKR rehabilitation booklets offered advice to patients on when  
226 and how to return to sporting and leisurely activities. Guidelines suggested avoiding high impact  
227 sports and movements, such as running and jumping.

228 **Exercise prescription**

229 For both THR and TKR rehabilitation guidelines, exercises were advised to be completed three times  
230 a day, in repetitions of ten. Five percent of THR patient information booklets did not offer any  
231 information on sets and repetitions of each exercise and others were vague with their exercise  
232 prescription:

233 *“Regularly x 10 per day”*

234 *“Every hour x 10”*

235 *“Four times a day”*

236 There was no information in any booklet regarding adjusting the prescribed exercises in relation to the  
237 patients’ one repetition maximum, maximum heart rate or VO<sub>2</sub> maximum. There was little information  
238 in the booklets suggesting how a patient could increase the intensity of the prescribed exercises.  
239 Some of the booklets gave a detailed rehabilitation programme, including details on how the patient  
240 could progress their exercises for each stage of recovery. One booklet offered a full rehabilitation  
241 programme for a year (appendix 1).

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## Discussion

ERAS or fast-track surgery aims to reduce length of stay post-surgery and thus promote the return to physical function. Only 40% of the patient information booklets examined reported to utilise ERAS or fast-track programmes despite the national implementation of the ERPP in 2009 [5]. The content of the ERAS patient information was generally better informed than non-ERAS resources and we found details of a yearlong rehabilitation plan in one booklet (appendix 1). The non-ERAS resources appeared to lack detail of the multifactorial rehabilitation process and progression through the phases of recovery were rare. The variety in exercises was also limited in compared to the pathways which identified themselves as ERAS.

Fast-track surgery has been successfully implemented in orthopaedic departments with recommendations for further utilisation after significantly reducing length of stay [26]. Although most patient information sheets claim their average length of stay to be 3 days, actual data from Dr Foster shows that a high number of patients are being discharged on day 5 or later. Length of stay has been reduced since the development of fast-track setups with functional discharge criteria however; pain, dizziness and general weakness are still being reported as clinical reasons for being hospitalised at 24 and 48 hours post-operatively [19]. Therefore, there is a need for change in rehabilitation practice currently delivered by physiotherapists. Exercise prescription recommendations to accelerate the achievement of discharge criteria and the return to function are discussed within this section.

## Exercise prescription

Current physiotherapy routines lack intensity [7, 11, 27] and require more specific, functional exercises. Exercise prescription is a dynamic process which should be considerate of a patient's physiological state, individual goals and comorbidities [28]. Older adults of the same age often differentiate in their baseline physiological state and using a standard exercise prescription of three sets of ten repetitions is nonspecific to the individual patient. General guidelines by the American College of Sports Medicine (ACSM) [29] recommend 8 to 12 repetitions to improve strength and power; however this prescription is not necessarily advisable in older adults. Exercise programmes focusing on knee-extensor strength have been found to be more effective in alleviating knee osteoarthritis pain and symptoms compared to general programmes, however the most effective exercise dosage is still under investigation [30]. Depending upon the physiological capacity and

disease burden of the patient population, it can be beneficial to prescribe fewer exercises with multiple sets, or numerous exercises using one set of up to 20 repetitions [31]. Appropriate progression of the prescribed exercises should be included within the patient information booklets, with further detail regarding work rate, sets and repetitions.

A high intensity rehabilitation programme leads to improvements in both long and short term strength and functional performance outcomes when compared to a lower intensity rehabilitation programme [17], following TKR and THR. The intensity of a strength programme should be prescribed as a percentage of the patients' 1-repetition maximum (1-RM). This is the maximum amount of weight that can be safely lifted in one contraction. Training at an intensity of 60-80% of an individuals' 1-RM has a direct correlation with producing significant gains in muscle strength and mass and offers a low risk of musculoskeletal injury in older adults [32]. Continuing contraction until muscular exhaustion can have significant hypertrophy and strength gains. The absolute load should be adjusted on a set-by-set basis as opposed to a week-by-week basis to consider the rapid changes in muscle strength when PRT is initiated post-surgery and as the patient moves through the acute and sub-acute phases of recovery [7]. Patient specific tailoring of exercise based on 1RM strength training principles has been found to be well tolerated and successful, providing sustained improvement in patients with knee osteoarthritis [33]. Crucially, these patients were able to train independently at home or in community gyms at 75% of their 1RM, which was calculated at a supervised exercise session prior to independent training [33].

An effective and safe intensity for cardiovascular exercise prescription can be calculated through a percentage of the patient's maximum heart rate ( $HR_{max}$ ), maximum oxygen consumption ( $VO_2 max$ ) or Borg's rate of perceived exertion (RPE). The gold standard for determining cardiorespiratory fitness is a  $VO_2 max$  test; however as maximal exercise testing is not feasible post-orthopaedic surgery [6], a calculation of  $HR_{max}$  may be more appropriate value for guiding aerobic activity during rehabilitation. The validity of the age-predicted  $HR_{max}$  equation ( $220-age$ ) has been criticised for creating an underestimated value of  $HR_{max}$  in older adults [34]. Using RPE to prescribe the intensity of cardiovascular exercise offers a patient-friendly option. It is an accessible, practical and valid psychophysical tool for both prescribing and monitoring exercise intensity [35], in which a patient can progress their rehabilitation effectively and independently.

## **Mobilising Patients**

Early mobilisation of a patient following orthopaedic surgery is associated with early discharge and accelerated functional recovery [36]. It is correlated with a decrease in the incidence of deep vein thrombosis, pulmonary embolism, atelectasis, pneumonia and urinary retention [37]. Lack of mobilisation on the day of surgery has been associated to need for blood transfusion [38] and blood transfusion was found to be the most important predictor of discharge on day 3. Preoperative haemoglobin concentration, body mass index and operating time are important and identifiable risk factors for excessive blood loss and transfusion in THR and TKR [39]. Early identification of high-risk patients may promote earlier mobilisation and the importance of this process should be presented in patient information leaflets. Early mobilisation is frequently advocated after THR and TKR and providing information regarding the ideal time to mobilise and which factors can be manipulated in order to encourage earlier mobilisation is essential. An example taken from Ashford and St Peter's Hospital's NHS Trust patient information can be found in figure 5 [40].

Early mobilisation can be achieved safely when a multidisciplinary approach involving a surgeon, anaesthetist, nursing staff and physiotherapist is adopted [41]. Patient satisfaction is improved, whilst the need for inpatient rehabilitation is reduced. Early mobilisation is not a recent concept, yet only 50-55% of the hospitals examined state that they will attempt to mobilise their patients within the first 24 hours post-operatively. Rehabilitation is patient specific; however aiming for a patient to achieve same-day mobilisation can increase expectations and outcomes of recovery. When post-operative pain is satisfactory, patients can be mobilised within 4 hours of surgery. Patient recovery may be enhanced and length of stay reduced with the expectation and achievement of early mobilisation. By using Hospital Episode Statistics sourced from Dr Foster (<http://my.drfooster.co.uk>) it was observed that in 2017, THR and TKR patients at Ashford and St Peter's Hospital NHS Trust had a shorter hospital stay than the national average. Mean LOS for THR was 3.96 days compared to a national mean of 4.81 days and mean LOS for TKR was 4.34 days compared to a national mean of 4.77 days.

### **Deep Vein Thrombosis / Pulmonary Embolism**

Deep vein thrombosis (DVT) can occur after any operation but is more likely following operations on the lower limb. DVT occurs when the blood in the large veins of the leg form blood clots within the veins. This may cause the leg to swell and become warm to touch and painful. If the blood clots in the vein break loose, they may travel in the circulation system and lodge in the lung. This is called a pulmonary embolism (PE) which in rare cases can cause death.

There are several methods employed to reduce the risk of DVT and PE and these include:

- Early mobilisation and exercises to increase blood flow
- Calf pumps whilst in hospital
- Elastic stockings for six weeks
- Blood thinning medication

### **Getting Up After Your Operation**

Between 4-8 hours after your operation a physiotherapist or nurse will try and mobilise you and get you to walk some steps around the ward and perhaps sit in a chair for a while. This will give you the confidence that you will be quite able to return home within 2 days of surgery. The modified surgical technique used for your operations means that unlike patients undergoing traditional hip replacements you should experience less pain and your post-operative progress should be much quicker. It is our aim to get you up and out of your bed on the day of your operation. The physiotherapists or nurse will assist you out of bed to stand with a Zimmer frame. You will be encouraged to take a few steps and sit you out in the chair. You will be advised how much weight you can put through your operated leg.

You should continue with the breathing exercises that a physiotherapist will teach you and exercise numbers 1 and 2 to help your circulation and strengthen your muscles.

### **The Day after Your Operation**

The nursing staff will encourage you to get out of bed. You should be able to assist more in this task. You can sit out of bed in the chair beside your bed. And get washed and dressed into your everyday clothing. The physiotherapist will assess your ability to walk with crutches (you should have practiced this prior to your operation) and progress to negotiating stairs as able. The physiotherapist will progress your exercise regime. The Occupational therapist will over advice on getting in and out of bed. You will have been taught how to get up and down from the chair correctly to avoid straining the new hip. If you have been advised by the physiotherapist or senior nursing staff to walk to the bathroom but not alone – please ask the staff for assistance even if you think they are too busy. It is important for you to walk as this will improve your muscles strength, stamina and gain your independence. You will be reminded of the hip precautions that you need to adhere to whilst recovering from surgery.

Figure 5: Exemplar patient information on early mobilisation [40]

### **Walking and Stair Climbing**

Ninety to ninety five percent of the patient information booklets offered advice on how to approach walking and stair climbing post-surgery. The ability to complete these activities has a significant impact on a patient's recovery and independence once discharged from hospital. The progression of walking was highlighted in 68% of THR and 72% of TKR information booklets; however the development of stair negotiation ability was less frequent. Stair negotiation is a discharge requirement post-surgery. Patients must possess sufficient leg strength, lower limb joint range of motion and



postural stability in order to combat the instability of the stair climbing movement [42]. The action requires neuromuscular control, proprioception and balance, challenging for patients with impaired gait mechanics post-surgery. Advancing the physiotherapy protocol for stair negotiation has the potential to improve performance outcomes and achievement of discharge criteria in patients post THR or TKR.

### **Bed Exercises**

Research highlights that bed exercises are not an additional benefit to mobility for patients during acute recovery [43] or one year post-operatively following THR and TKR [44]. Unless patients cannot be mobilised on the day of surgery, there is little evidence to support the inclusion of static bed exercises within physiotherapy practice. Previous literature has inaugurated the use of home-based, functional exercises as a method of rehabilitation [45, 46] yet this evidence has not been applied to patient information booklets. Functional exercises, such as stair climbing and the sit-to-stand movement have recently been proven to create a greater muscle activation level than static bed exercises [10]. They also improve a patients' kinaesthesia, preparing their neuromuscular system for further rehabilitation. ERAS guidelines encourage the questioning of traditional practice, and it is important for rehabilitation pathways to be re-evaluated and updated as new findings emerge.

### **Progressive Resistance Training**

In 2017, the mean age for THR in the UK was 69 years, and for TKR was 70 years [1]. Both aerobic and resistance forms of exercise training are well established in attenuating the decline of muscle mass and strength with age [47], however there is little application of either forms suggested in patient information booklets. Although aerobic exercise can improve endurance capacity and increases the cross sectional area of muscle fibres, it has a limited use for muscle hypertrophy. A reduced basal rate in muscle protein synthesis can contribute to age-related muscle atrophy and subsequent loss of functional ability [48]. Progressive resistance training (PRT) is seen as the most effective intervention for sarcopenia [47, 49]; augmenting a patient's hypertrophy, muscular endurance, balance and strength. PRT involves exerting muscular force against an applied weight, and ameliorates the cross sectional area of a muscle and type 2 muscle fibres. These physiological enhancements improve power and the rapid recovery of muscle function.

Increasing the velocity of the exercise performed produces greater limb power and muscular strength, with significant gains in muscle strength observed during control groups involved with high intensity PRT interventions. Exerting the concentric component of an isotonic PRT exercise with speed, and a slow, controlled eccentric contraction can help a patient gain the maximum muscular benefits [50].

A systematic review of randomised control studies evaluating the effects of PRT pre and post THR and TKR determined PRT to be a safe, feasible and well tolerated form of rehabilitation with no side effects or adverse events [15]. Home-based PRT is well tolerated by patients post-operatively [16] and can be implemented into rehabilitation with substantial load progression, with no overall exacerbation of post-operative pain [51]. Applying PRT training principles to patients following THR or TKR could offer an adjunctive rehabilitation plan to the current NHS physiotherapy guidelines.

## **Limitations**

Although the data from this study was taken directly from UK NHS hospital websites, the information available to patients may not accurately reflect the practice implemented by clinicians. It could be, however, a strong indication of the treatment that occurs post-operatively. Resources are likely to be given in addition to expert opinion and therefore the exercise prescription process may be more effective than reviewed in this study. As length of stay reduces for THR and TKR, patients spend less time in hospitals and consequently have less contact time with clinicians. Therefore it is important that patient information mirrors best practice and it is necessary for resources to be regularly updated. We acknowledge that the process of updating and replacing patient resources is often complex and physiotherapists do not solely possess the authority to complete this elongated task.

The study was limited to a selection of the patient information available, rather than an evaluation of all UK NHS hospital resources for patients post THR and TKR. The number of procedures performed at each trust we examined varies (between 144-1178 THR procedures and 189-1161 TKR procedures in 2016) and thus it is difficult to determine the actual effect on patient population. However, the geographical spread of results suggests that the issues presented amongst this study are likely to be similar nationwide.

## 414 **Conclusion**

415 The majority of information available within patient information booklets for hip and knee  
416 replacements appears outdated, with little application of recent, peer-reviewed literature that has  
417 offered recommendations of how to enhance recovery after surgery. Forty percent of rehabilitation  
418 booklets described their pathways as Enhanced Recovery, despite the national implementation of  
419 ERAS to orthopaedic pathways through the ERPP in April 2009. The guides are dated to be four or  
420 five years old, with the content reflecting this. To progress post-operative rehabilitation effectively, UK  
421 NHS hospitals should consider updating their paper recourses to ensure both patients and healthcare  
422 professionals are well informed of recent literature that aims to enhance recovery after surgery. This  
423 includes personalising the exercise prescription procedure, mobilising patients on the day of surgery,  
424 progressing walking and stair negotiation guidelines and replacing static, bed exercises with  
425 functional and progressive resistance training.

## 426 **Ethical Approval**

427 Ethical approval was not pursued for this study as it did not involve human participation.

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429 No funding was received for this study.

## 430 **Conflict of interest**

431 There are no conflicts of interests within this paper.

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**Information and exercises following a total hip replacement (trauma)****1) Static quads**

Lying with your legs out straight in front of you, tighten the muscles on the front of your thigh by squashing your knee down in to the bed and pulling your toes up towards you.

Hold for a count of 5, relax completely

**2) Gluteal squeeze**

Squeeze your buttock muscles together as tightly as possible for a count of 5, relax completely.

**3) Hip flexion/ Heel slide**

Lying with your legs out straight in front of you, slide the heel of your operated leg up towards your bottom, allowing your hip and knee to bend. Do not let your hip bend more than a right angle. Slide your heel back down again, relax completely.

**4) Hip abduction**

Lying with your legs out straight in front of you, keeping both legs straight and your toes pointing towards the ceiling throughout, move your operated leg out to the side slowly. Return your leg to the start position, relax completely.

**5) Long arc quadriceps**

In your chair, kick your foot forward and straighten your operated leg slowly, hold for 5 seconds and slowly lower back down. Relax completely.



Once you are mobile with a frame or crutches you can progress to the following exercises. Make sure you are holding onto a firm surface for all standing exercises. Again, you should be doing 10 of each exercise, four times a day

Information and exercises following total hip replacement, November 2016

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**Information and exercises following a total hip replacement (trauma)****6) Hip flexion**

Slowly lift the knee of your operated leg towards your chest.

Do not bend your hip more than a right angle.

Lower your foot back down, relax completely.

**7) Hip extension**

Keeping your body upright throughout the exercise, slowly move your operated leg as far back as possible, return to the starting position, relax completely.

**8) Hip abduction**

Keeping your body upright throughout the exercise, slowly move your operated leg out to the side, keeping your toes pointing forwards. Return to the starting position, relax completely.

**9) Hip hitching**

Keeping your body upright, your feet together and your legs straight, shorten one leg to lift the foot. Repeat on the other side, relax completely.

The following information and exercises are guidelines only. Everybody is an individual, some of you will find that you meet the targets documented easily and some of you will never achieve them. The same applies to the exercises; some of you will find them easy and others will not be able to manage them particularly the advanced ones. Only do those you feel comfortable with.

**Discharge – 2 weeks**

Continue the exercises that you were shown in hospital. Be aware now that you are home you may feel more tired, this is normal and may take a few weeks to go away. You may still need to rest for part of the day.

You should be confident mobilising around the house and should be able to begin mobilising outside. Mobilise as far as you feel comfortable doing so, there is no minimal or maximal distance.

Information and exercises following total hip replacement, November 2016

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**Information and exercises following a total hip replacement (trauma)**

When negotiating a kerb place both crutches down first, then the operated leg followed by the non-operated leg. Going up the kerb, put the non-operated leg first followed by the operated leg and then the crutches (the same as you would for stairs).

**2-3 weeks post op**

At this point all total hips should continue to use to crutches outside but you may find that you can manage with 1 crutch around the house (held in the opposite hand to your hip replacement). Continue to increase the distance you walk each day.

Once the clips have been removed or the wound fully healed if it has been glued you may start to massage the scar if you wish, this will help loosen and soften the scar.

Massage the scar with your thumb, making small circular movements along the incision. Change direction of the circles frequently. Do 10-15 circles in each area, then move about one inch along the scar and repeat.

Use of creams such as body lotion, vitamin E cream or E45 is purely one of personal choice; they will not harm the scar and will probably make the massage more comfortable.

You can now try the following exercises as well if you wish.

**Half squats**

Stand holding onto something solid.

Bend both knees.

Go as far as you can comfortably then return to the upright position.

Repeat 10 times.



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**Heel raises in standing**

Stand, holding onto something solid.

Rise up and down on your toes, lifting your heels off the ground.

Repeat 10 times.



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**Information and exercises following a total hip replacement (trauma)****3-4 weeks post-op**

Continue with the above exercises and continue to increase the distance that you walk outside, some patients by this time may be comfortable walking as much as a mile a day.

Hopefully you may feel confident enough to go to the local shop or supermarket. A handy tip when shopping is to use a trolley as a walking frame.

If you have an automatic car and have had a left hip replacement and are comfortable to do so you may be able to drive.

**4-6 weeks post op**

You may have an outpatient physiotherapy appointment arranged where your progress will be reviewed and further advice and exercises provided. Some patients if you have no limp, will be able to manage with no walking aids or 1 stick only at this point some may still require two. You hopefully should be confident to mobilise outside on your own with or without walking aids.

Around the house you may be able to manage without any walking aids.

Travelling as a passenger in a car should now be more comfortable over short distances but longer distances may still be uncomfortable. You may be able to drive at this point if you have little or no pain and have sufficient reflexes to be able to do an emergency stop.

If you have a static bike you may be able to start using this now. It is advisable to have the seat slightly higher than you would normally for comfort. Start with no resistance initially and increase this as you become stronger. If at first you cannot make a full revolution of the pedals spend a few minutes rocking the pedals backwards and forwards as a warm up. If after the warm up you still cannot pedal correctly continue with the rocking motion pushing to end of range and holding for a few seconds; rock or pedal for 5-10 minutes three times a day and gradually increase the length of time as the hip becomes more comfortable.

If the wound has completely healed and you can get into a swimming pool safely you may like to do the following exercises in water but you cannot start breast stroke until 6 weeks after your operation.

How long you exercise will be dependent on the temperature of the water and your exercise tolerance.

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#### Information and exercises following a total hip replacement (trauma)

##### Marching on the spot

Stand holding onto the edge if necessary.  
March on the spot.  
Do this for a few minutes.



##### Half squats

Stand, holding onto the edge if necessary.  
Bend both knees as far as comfortable. Repeat 10 times.  
If you wish to make this exercise harder do it as a single leg squat.



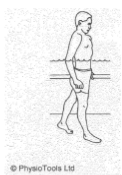
##### Hip abduction in standing

Stand holding onto the edge if necessary.  
Take the operated leg out to the side, hold for a few seconds, relax and return to the middle.  
Make sure that the toes remain pointing forward and you do not lean to the opposite side.  
Repeat 10 times.



##### Hip extension in standing

Stand, holding onto the edge if necessary.  
Take the operated leg out behind you, taking care not to lean forward at the same time.  
Hold for a few seconds, relax and repeat 10 times.



##### External rotation in standing

Stand holding onto the edge if necessary.  
Bend your hip as far as possible but not beyond 90 degrees for the first 6 weeks.  
Twist your knee outwards keeping your foot next to your other knee.  
Return to the middle, repeat 10 times.



##### Walking exercises

- Walking forwards – concentrate on spending equal time on each foot.

Information and exercises following total hip replacement, November 2016

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#### Information and exercises following a total hip replacement (trauma)

small rubber ring around your ankle or by wearing fins. Most public pools do not allow the use of fins so check with the pool first.

More advanced pool exercises include:

- Jumping up and down in the pool.
- Crunch jumps – jumping up and down, but bringing your knees towards your chest.
- Running on the spot.
- Hopping side to side on both legs.
- Hopping forwards and backwards on both legs.
- Star jumps.

##### 6-8 weeks

You should now be able to mobilise around the house and outside without walking aids if you are not doing so already.  
If not doing so already you should be able to drive a manual car if you meet the criteria detailed in the introduction.

You may also return to a sedentary job, if you can get to work.

It is no longer necessary to avoid crossing your legs.

If you would like a bath please try it first with no water and fully dressed to make sure that you can get out easily.

The following exercises can now be tried, but they are quite difficult and you may not succeed initially but persevere.

##### Single leg balance

Hold onto something solid.  
Put all of your weight onto the operated leg and lift your good leg backwards off the ground by bending your knee.  
To make this exercise harder, let go of your support.  
Aim to build up to holding this position for up to 30 seconds, repeat 5 times.



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#### Information and exercises following a total hip replacement (trauma)

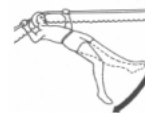
- Walking backwards – good for strengthening the buttock muscles and the muscles at the back of the thigh.
- Walking sideways – take one leg out to the side, then bring the other towards it.
- Practice leading with both the right and the left leg.

##### Floating exercises

If you are comfortable floating you can try the following exercises. Holding onto the side of the pool or placing a float around your waist will help keep you on the surface.

##### Hip extension

Floating on your back, try and lower your operated leg towards the bottom of the pool, return to the surface, repeat 10 times.



##### Knee towards chest

Bring your knee towards your chest, push out straight, repeat 10 times.



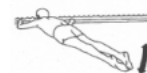
##### Hip abduction

Take your leg out to the side as far as possible, return to the middle, repeat 10 times.



##### Floating on your front

Hold onto the side of the pool, pull your knees towards your chest then push your legs straight as hard as you can.  
Repeat 10 times.



These exercises can be advanced by increasing the number of repetitions of each exercise or by increasing the speed at which you do them. It is also possible to make them harder by placing a float (i.e. a child's armband or

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#### Information and exercises following a total hip replacement (trauma)

##### Step ups

Stand facing the stairs.  
Place operated leg on the bottom step.  
Hold onto the banister, and try and lift your weight up on the operated leg and place your other foot on the bottom step.  
Lower the good foot back down to the floor.  
Repeat 10 times.



##### Step downs

Stand on the bottom step facing down the stairs.  
Hold onto the rail.  
Try and lower your good leg to the floor.  
Straighten up and return foot to the bottom step.  
Repeat 10 times.



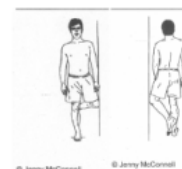
##### Hip extension in prone

Lying on front try and lift operated leg towards ceiling.  
Hold for a few seconds, relax.  
Repeat 10 times.



##### External rotation against a wall

Stand with your good leg against the wall.  
Bend the knee of your good leg and rest your good foot against the knee of your operated leg.  
Twist your good leg outwards pushing your knee into the wall.  
Hold for 10 seconds, relax, repeat 10 times.



##### Bridging

Lie on your back with your knees bent.  
Tuck your hips under and lift your bottom off the bed until your hips are in a straight line with your knees and shoulders.  
Hold for a slow count of 10.  
Relax and repeat.



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Clam shell

Lie on your opposite side.

Bend both knees.

Twist your top leg until your knee is pointing towards the ceiling or as far as you can.

Do not allow your hips to roll backwards.

Hold for a few seconds, relax.

Repeat 10 times.



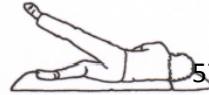
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Hip abduction in side lying

Lie on your good side, with the knee of your operated leg straight or only slightly bent. Lift your leg towards the ceiling taking care to not turn the toes towards the ceiling or to roll backwards.

Hold for a slow count of 10, relax and repeat 10 times.



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3-6 months

Continue with the exercises that you find of most benefit.

Most of the swelling should now have resolved but some may remain.

It may also be possible to do the stairs normally.

You can now also return to golf, cycling on the road, doubles tennis, dancing, gardening including cutting the grass and light digging.

You may also return to light physical work.

6 months

You should now be back to full activities with the exception of high impact sports.

All swelling and stiffness should have resolved, but there may still be some weakness of the muscles of the hip.

1 year

You should now be fully recovered and able to carry out all activities of daily living without problems.