School of Physiotherapy

Total Joint Replacements: Analysis of the Impact of Physiotherapy on Hospital Length of Stay and Models of Care

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DECLARATION

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgment has been made.

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

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ABSTRACT

Background: Physiotherapy has been identified as an essential component of the rehabilitation process post total joint replacement (TJR). However, there is no existing literature examining why patients fail to achieve physiotherapy discharge targets in a timely fashion, or if a relationship exists between patient ability to achieve physiotherapy goals on a daily basis, and overall hospital length of stay (LOS). The primary aim of this research was to investigate the relationship between physiotherapy and discharge delay following major joint replacement surgery.

Aims This observational natural cohort study with retrospective and prospective phases aimed to investigate the prevalence of and reasons for discharge delay relating to physiotherapy service provision following elective joint replacement surgery. It also examined the differences between physiotherapy and non-physiotherapy related discharge delay, and when and why patients fail to achieve daily physiotherapy clinical pathway goals. Another aim was to investigate whether the inclusion of comorbidity in the Risk Assessment and Prediction Tool (RAPT) would increase its predictive capacity for risk of discharge delay in this patient population. The final aim was to utilise the results of the study to implement change in a public hospital model of care for elective joint replacement surgery.

Methods: A retrospective analysis of an existing cohort from a large, tertiary hospital's dedicated elective orthopaedic surgery unit was undertaken. A prospective examination to observe patient progress along the post-operative clinical pathway was also performed at the same facility.

Results: Of the retrospective cohort, 44.3% did not achieve timely discharge as per the existing clinical pathway. The most prevalent reason for physiotherapy related discharge delay was non-specific slow progress with physiotherapy rehabilitation in the absence of any pre-existing disability or post-operative medical complications. The most prevalent reason for non-physiotherapy related discharge delay was due to the medical monitoring of wound issues. There were significantly more days attributed to monitoring wound issues following total knee replacement compared to total hip replacement. Failure to achieve minimum daily physiotherapy goals in the first two post-operative days was related to medical issues. From post-operative day three onwards, failure to meet physiotherapy

mobility goals was the primary reason. Patients who were older than 72.4 years and assessed as high risk by RAPT score for discharge delay were 3.4 times more likely to experience discharge delay compared to those younger. Patients who were morbidly obese (38 kg/m² or greater) and assessed as high risk by RAPT score for discharge delay were 11.4 times more likely to experience discharge delay compared to those who had a lower body mass index. The results from this study were used to guide the development of a new model of care and clinical pathway for elective joint replacement services in a large, public, tertiary hospital undergoing service reconfiguration in 2014. Twelve months after implementation a two day reduction in median hospital length of stay was achieved.

Conclusions: This is the first study to examine in-depth the post-operative inpatient period following total joint replacement surgery with regards to physiotherapy and non-physiotherapy causes of discharge delay. It is also the first study to investigate including comorbidity in the RAPT for predicting the risk of discharge delay. The successful implementation of the new model of care based on research findings shows that change within hospital systems is possible allowing for high quality care within a shorter hospital stay. This study advocates for regular and ongoing critical review of hospital processes in the ongoing quest for continuous quality improvement, optimal patient care and reduced hospital length of stay.

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LIST OF ABBREVIATIONS

ADL	activity of daily living
AF	atrial fibrillation
AHP	allied health professional
AMTS	abbreviated mental test score
APS	Acute Pain Service
ASA	American Society of Anesthesiologists
BMI	body mass index
CAD	coronary artery disease
CHF	congestive heart failure
COPD	chronic obstructive pulmonary disease
CPM	continuous passive motion
deg.	degrees
DVT	deep vein thrombosis
ECG	electrocardiogram
FTE	full-time equivalent
HDU	high dependency unit
HITH	hospital in the home
ICU	intensive care unit
IDC	indwelling catheter
INR	international normalised ratio
IQR	interquartile range
JRAC	Joint Replacement Assessment Clinic
LMWH	low molecular weight heparin
LOS	length of stay
LR	likelihood ratio
MI	myocardial infarction
MMSE	mini-mental state examination
MUA	manipulation under anaesthetic
NSQHS	National Safety and Quality Health Service
OT	occupational therapy
PAAS	pre-admission assessment services
PCA	patient controlled analgesia
PF	pulpit frame

PMHx	past medical history
POAS	Pre-operative Assessment Clinic
PT	physiotherapy
RA	rheumatoid arthritis
RAPT	Risk Assessment and Prediction Tool
Reg.	Registrar
RITH	rehabilitation in the home
RMO	resident medical officer
ROC	receiver operator curve
ROM	range of movement
RPH	Royal Perth Hospital
THR	total hip replacement
TJR	total joint replacement
TKR	total knee replacement
TUG	timed up and go
VHD	valvular heart disease
WA	Western Australia
WHO	World Health Organisation
WZF	wheeled zimmer frame

CHAPTER 1. INTRODUCTION

1.1 Research problem

Physiotherapy has been identified as an essential component of the rehabilitation process post total joint replacement (TJR) (1-4). Standard physiotherapy care reported in current western hospital systems involves early mobilisation (usually on the first post-operative day), gait retraining and exercise prescription (1, 3, 4). Clinical pathways feature functional discharge criteria such as independence with ambulation and other mobility tasks (1, 2, 5, 6). Physiotherapists therefore have an important impact on patient LOS due to their role in guiding patients to achieve pre-set functional discharge criteria. Physiotherapists have a key role in both the rehabilitation and discharge planning process. One retrospective review of patient clinical notes in 2010 identified rehabilitation factors, such as failure to achieve physiotherapy targets, as a cause of delayed discharge post TJR (7). However, there is no existing literature examining why patients fail to achieve physiotherapy discharge targets in a timely fashion, or if a relationship exists between patient ability to achieve physiotherapy goals on a daily basis, and overall hospital length of stay (LOS). The primary aim of this research was to investigate the relationship between physiotherapy and discharge delay following major joint replacement surgery.

Admission to hospital exposes patients to the risk of experiencing hospital specific adverse events, such as adverse drug reactions, infection and ulcers (8). It is generally accepted that hospitals must strive to optimise multidisciplinary health care within the shortest feasible time that allows patients to achieve their health care goals. Accordingly, extended hospital stay relating to physiotherapy requirements may expose patients to further risk. Therefore, this research set out to ascertain whether physiotherapy could be linked to unnecessary hospital stay caused by sub-optimal service provision or clinical decision making.

Total joint replacement (TJR) surgery of the hip and knee is one of the most common and successful elective procedures performed today, with a relatively straightforward pre- and post-operative care pathway. This health care service is therefore ideal for investigating the prevalence, causes, and impact of unnecessary hospital stay, and whether changes can be made to effectively reduce or eliminate it. Considerable reductions in average hospital length of stay (LOS) following elective TJR have occurred over the last decade due to

advancements in surgical techniques and initiatives such as standardised clinical pathways, often driven largely by economic pressure on healthcare systems (9, 10). However, focusing on eliminating unnecessary time spent in hospital may have a more important impact that is, improving outcomes in this patient population. A more detailed understanding of the prevalence of and reasons for delayed patient discharge following TJR surgery will provide evidence for changing hospital processes and systems. This study investigated this premise at Royal Perth Hospital's (RPH) rehabilitation campus in Perth, Western Australia (WA), an ideal setting for such research as it had a quarantined elective operating theatre and standardised post-operative pathways, in a high volume quarantined elective orthopaedic ward. The research period also presented a unique window of opportunity to evaluate a nationally recognised model of care for elective TJR surgery, prior to the scheduled closure of the rehabilitation hospital in October 2014. The findings from this research guided the model of care changes aimed at further improving this service on relocation to the acute RPH campus.

1.2 Elective joint replacement services in Western Australia

In Australia, elective TJR services are provided by both the public (government funded) and private (patient funded) sectors. At the time of data collection RPH provided 30 to 40% of all publicly funded TJRs undertaken in WA hospitals (11). Services at RPH specifically cater for public patients who may have more complex care requirements (such as post-operative intensive care unit (ICU) admission), or are at an increased risk of post-operative complications, compared to patients undergoing similar procedures in a private hospital. Once the decision to operate has been made by the orthopaedic specialist, the wait time for surgery is according to nationally recognised urgency categories (12):

- Category 1 - Admission within 30 days is desirable for a condition that has the potential to deteriorate quickly to the point that it might become an emergency;
- Category 2 - Admission within 90 days is desirable for a condition causing pain, dysfunction or disability, which is not likely to deteriorate quickly or become an emergency;
- Category 3 - Admission at some time in the future is acceptable for a condition causing minimal or no pain, dysfunction or disability, which is unlikely to deteriorate quickly and does not have the potential to become an emergency.

1.3 Efficacy of reducing hospital length of stay

In Australia the average LOS for primary TJR during 2010 was six days, with an average cost of more than $17,000 per patient (13). Whilst many of the costs associated with TJR such as prostheses and theatre time are fixed, inpatient hospital stay is a variable cost which can be optimised. As a result, health care organisations focus on developing strategies aimed at predictable lengths of stay in an attempt to standardise costs. One of the most popular strategies adopted around the world has been the implementation of clinical pathways (14, 15). Clinical pathways provide a standardised guideline for patient post-operative management and generally feature a multidisciplinary team approach with specific discharge goals and functional discharge criteria (14). They may also include pre-operative assessment and education, as well as standardised post-operative pain management and early patient mobilisation protocols (9). Clinical pathways have been shown to be successful in reducing overall LOS, but without compromising patient outcomes and satisfaction, or increasing variable costs, rates of re-admission or adverse events (5, 6, 9, 16-20). In fact, a positive association between reduced LOS and patient satisfaction has been reported in the literature (10, 19, 21).

1.4 Research aims

This research had three principal aims:

1. To investigate the relationship between physiotherapy and discharge delay following TJR, and whether sub-optimal service provision or clinical decision making from a physiotherapy perspective may be related to extended hospital LOS.

Discharge delay was defined as hospital inpatient stay beyond the six day clinical pathway target. Initial clinical observation at RPH indicated that discharge delay was occurring frequently, despite the existence of a standardised clinical pathway advocating for patient discharge on post-operative day six or earlier.

2. To investigate whether the presence of patient comorbidity increases the predictive capacity of the Risk Assessment and Prediction Tool (RAPT).

The RAPT was the first multi-factorial tool developed for predicting a patient's discharge destination (i.e. directly home or to extended rehabilitation) after elective TJR (22). The tool is based on seven key characteristics, indicative of pre-admission function and social support (see Table 1.1). Assessment of RAPT score has been a routine part of pre-operative assessment at RPH since 2006 following a clinical audit which found the RAPT score to be predictive of delayed discharge (defined as LOS

greater than the average) in that setting. The RAPT scores are used to assist with hospital bed management and for predicting the need for hospital in the home (HITH) or rehabilitation in the home (RITH) services at discharge.

Table 1.1: The Risk Assessment and Prediction Tool (RAPT) (22)

	Value	Score
1. What is your age group ?	50 -65 years 66 – 75 years > 75 years	=2 =1 =0
2. Gender ?	Male Female	=2 =1
3. How far, on average, can you walk ? (a block is 200 m)	Two blocks or more (±rests) 1-2 blocks (the shopping center) Housebound (most of the time)	=2 =1 =0
4. Which gait aid do you use ? ? (more often than not)	None Single-point stick, Crutches/frame	=2 =1 =0
5. Do you use community supports? (home help, meals-on-wheels, district nurse)	None or 1 per week Two or more per week	=1 =0
6. Will you live with someone who can care for you after your operation?	Yes No	=3 =0
Your score (out of 12)		=

KEY : Destination at discharge from acute care predicted by score :
Scores < 6 = Extended rehabilitation
Score 6-9 = directly home after additional acute intervention
Scores > 9 = directly home
Patient's expectation of discharge destination is also a determinant. The prediction indicated by the score is discussed with the patient and the destination agreed to.

Patient'spreference	Prediction (score)	Agreed destination

The RAPT was originally developed in an orthopaedic service model where patients transferred from an acute site to a rehabilitation facility, and where the median LOS was nine to ten days (22). At the time, comorbidity was not found to be significantly related to discharge destination, so was excluded from the tool. More recent evidence from a hospital with a shorter LOS (mean 4.55 days) makes a link between increased pre-operative comorbidity and the risk of post-operative complications which can result in a longer hospital stay (5). Thus it was hypothesised that the inclusion of specific comorbidity with RAPT risk scores would increase its predictive capacity in health care facilities such as Royal Perth Hospital, where acute care and rehabilitation primarily occurs within the same facility, and where average LOS is shorter than when the RAPT was originally developed.

3. To develop and implement a new clinical pathway that facilitates ongoing high quality care within a shorter inpatient period in the new elective joint replacement service at Royal Perth Hospital.

Once the data collection and results had been obtained for the first two aims it was hoped that these findings would be valuable in guiding the development of the new model of care for elective TJR at RPH post-transition to the acute campus.

1.5 Approach adopted

A retrospective audit was undertaken to ascertain the extent of and reasons for discharge delay, relating to physiotherapy requirements, over a period of time with consistent clinical data (1 year, n=404). Other non-physiotherapy related reasons for discharge delay were also identified. These data were then examined to determine the relative risk of discharge delay in patients with a high risk RAPT score plus the presence of comorbidity. A prospective audit was similarly undertaken, as well as investigation of patient ability or inability to achieve minimum daily physiotherapy goals. To clearly identify in real time reasons for any discharge delay, the prospective data were collected daily on the orthopaedic ward. Patients and staff were interviewed to ensure clinical information was not missed.

1.6 Scope of the study

At the time of data collection, the RPH elective orthopaedic surgical unit performed around 500 joint replacements per annum (including revision procedures) thus providing excellent context for this research project. This research was conducted within a stable service period well prior to commencing relocation of rehabilitation services and the closure of this hospital. The full reconfiguration of WA's metropolitan health services from 2014 is described in detail in the South Metropolitan Health Service Clinical Service Plan 2012-2020 (23). The planned relocation of elective TJR services to the acute RPH site provided a source of motivation to collect data and develop strategies to further evolve this recognised model of care with the goal of improving the quality and timeliness of patient care and reducing unnecessary hospital stay.

CHAPTER 2. THE RESEARCH SETTING

2.1 Introduction

Contextually, this research was critical to the new elective TJR model of care implemented when this service transitioned to the acute hospital in 2014. Therefore, this chapter describes the research setting in detail. At the time data collection took place in 2010-12, Royal Perth Hospital's services were divided between two campuses: Wellington St Campus (acute care services) and Shenton Park Campus (rehabilitation services including the elective TJR service). Service processes and structures in place were consistent with western hospital systems described in the literature (2, 4, 5, 20), and are described in detail in this chapter. There were no changes to the existing model of care, staffing, surgical techniques, or medical, nursing, allied health or administrative practices during the period of the research.

2.2 Pre-operative assessment service clinic

All patients due to undergo elective TJR surgery were reviewed at the pre-operative assessment service (POAS) clinic as standard procedure. This may have occurred either a few weeks prior to surgery or at short notice if a cancellation arose. Clinic pre-operative processes involved assessment and education from the orthopaedic intern, the anaesthetist, a registered nurse, a physiotherapist and occupational therapist about the anaesthetic and surgical procedures, as well as post-operative rehabilitation. The anaesthetist assessed the patient's ASA (American Society of Anesthesiologists) score, the nurse provided education about post-operative nursing care and hospital in the home (HITH) services, the physiotherapist determined the RAPT score and provided education about post-operation rehabilitation goals and rehabilitation in the home (RITH) services, and the occupational therapist provided routine home equipment such as shower chairs and over toilet frames pre-operatively.

As outlined in the Introduction, the RAPT score was used to assist in hospital bed management and therefore admission and surgical planning. Patients with a lower risk RAPT score were expected to be ready for discharge within six post-operative days. Those with a higher risk score were considered likely to require extended rehabilitation beyond the six days of the clinical pathway. The RAPT score was also used to predict which patients were likely to achieve 'early' or timely discharge, therefore requiring referral to HITH and

RITH services. A key aspect of the clinical pathway was the routine provision of ongoing home based nursing (primarily wound care) and physiotherapy rehabilitation services to all eligible patients discharged on pathway (i.e. on post-operative day six or earlier). HITH and RITH provide services to patients living within the Perth metropolitan area and some outlying regions. Generally these services commenced on the first day following hospital discharge and were designed to facilitate early discharge knowing that ongoing care would be provided in the home environment. Patients living beyond the HITH/RITH catchment areas were not eligible for these services on discharge.

Meanwhile in 2013 at the RPH acute campus, an Elective Taskforce was created to reform pre-admission services for all elective surgical specialties. Each element of the patient journey through pre-admission clinic was mapped. It revealed the pre-admission process was inefficient, with patients often waiting hours for specific tests and reviews. Subsequent pre-admission service reformation was aimed at providing a more efficient, patient centred service. One important change implemented in 2014 was the creation of a full-time physiotherapist position in the pre-admission clinic. One of the key roles of this physiotherapist was to drive the new elective TJR model of care following service transition to the acute campus. How this was achieved is described in detail in Chapter 7: Implementation.

2.3 The elective orthopaedic surgery service

The elective orthopaedic surgery unit at RPH was a dedicated, quarantined 28 bed ward with a connected eight bed High Dependency Unit (HDU). The HDU had physiological monitoring, 24 hour nursing care and an On-call Registrar overnight. Patients were admitted on the day of surgery and transferred to the HDU post-operatively, then to a ward bed when medically stable (usually the following morning). A small percentage of patients considered to be at much higher risk of peri-operative complications had surgery performed at the acute campus, then transferred to the elective campus as soon as medically stable. Most patients were discharged directly home. Rarely, patients may have required further slow stream rehabilitation or restorative care. These cases were considered outliers.

2.4 Surgical and acute care

During the research period, elective TJR surgery was performed by one of eight orthopaedic surgeons and their registrars, or by one of three Surgical Fellows. Surgery was

performed five days per week (Monday to Friday, on average three TJRs per day). Surgical approach for THR was posterior, posterolateral, direct lateral, anterolateral or anterior. Standard post-operative hip precautions observed at RPH included no hip flexion greater than 70^{o} for posterior approaches and no greater than 90^{o} for lateral approaches. All prostheses components were among those most commonly utilised Australia wide (11). Components were cemented or uncemented at the discretion of the surgeon. Computer navigation techniques were often utilised during TKR procedures. Surgical outcomes were systematically evaluated via the Joint Replacement Assessment Clinic (JRAC) established by the Orthopaedic Department in 1998.

Pain management techniques at RPH included epidural or regional blocks with patient controlled analgesia (PCA). All patients were reviewed daily by the Acute Pain Service (APS) until such time as their epidural or regional blocks were ceased. They were then discharged from APS care upon commencement of an oral analgesia regime. This usually occurred by the end of post-operative day one, to facilitate rehabilitation. Indwelling urinary catheters (IDC) were routinely inserted pre-operatively, and generally removed within 24-48 hours. Surgical drains were used at the discretion of the surgeon and generally removed within 24-48 hours. Pharmacists performed medication reconciliation for pre-admission and admission medications.

2.5 Clinical pathway

The clinical pathway in use at RPH during the research period was initially implemented in 2005. It was based on work commenced in 1997 by a committee set up to review the feasibility of implementing an early discharge program utilising HITH and RITH. A six day pathway was chosen based on a literature review and a pilot study performed by the committee at RPH. The overall aim was for discharge on post-operative day four, five or six with HITH and RITH follow up. The clinical pathway included daily goals or targets for each post-operative day, with an emphasis on functional outcomes (Table 2.1). These goals were specific to whether surgery was a total hip replacement (THR) or total knee replacement (TKR).

Table 2.1: Royal Perth Hospital THR/TKR clinical pathways

	Primary THR	Primary TKR
Day 1	PCA +/- epidural or regional block, IDC and wound drains in situ Check haemoglobin, blood pressure and oxygen saturations Stand a.m. with PF and be able to take 5-10 steps marching on the spot – **if motor block present call APS** Re-enforce hip precautions Commence exercise program aimed at increasing ROM and strength of the operated limb Commence sitting out of bed for meals if able Wound drain out by 1700	PCA +/- epidural or regional block, IDC and wound drains in situ Check haemoglobin, blood pressure and oxygen saturations Stand a.m. with PF and be able to take 5-10 steps marching on the spot – **if motor block present call APS** Commence exercise program aimed at increasing ROM of the knee and decreasing quadriceps lag Commence sitting out of bed for meals if able Achieve ≥ 60^{o} active flexion knee and quadriceps lag <25^{o}. Wound drain out by 1700
Day 2	Attachments removed Progress to walking with PF Continue/progress exercise program Continue to educate re: hip precautions Sit out of bed for meals	Attachments removed Knee dressing de-bulked Progress to walking with PF Continue/progress exercise program Achieve ≥70° flexion and quadriceps lag <20 Sit out of bed for meals
Day 3	Progress walking aid to WZF or elbow crutches Continue/progress exercise program Continue to educate re: hip precautions	Progress walking aid to WZF or elbow crutches Continue/progress exercise program Achieve ≥80° active knee flexion and quadriceps lag <15°
Day 4	Progress ambulation with walking aid to independent Be independent on steps (if required) using walking aid Be compliant with hip precautions during all mobility **Discharge with HITH/RITH if meet the criteria/sign off**	Progress ambulation with walking aid to independent Be independent on steps (if required) using walking aid Achieve 80° – 90° active flexion and quadriceps lag < 10° **Discharge with HITH/RITH if meet the criteria/sign off**
Day 5/6	As per day 4 **Last chance for discharge with HITH/RITH** To be reviewed by HITH/RITH staff day after discharge Discharged with home exercise program To be followed up as an outpatient by a physiotherapist at patient's local hospital for further rehabilitation	As per day 4 **Last chance for discharge with HITH/RITH** To be reviewed by HITH/RITH staff day after discharge Discharged with home exercise program To be followed up as an outpatient by a physiotherapist at patient's local hospital for further rehabilitation to achieve 90°-110° active flexion and 0°(nil) quadriceps lag

The clinical pathway process included a form, detailing specific multi-disciplinary discharge criteria, being placed in the front of each patient's medical notes to be signed off by each appropriate health professional when the criteria had been met (shown as it appeared at RPH in Table 2.2).

Table 2.2: Royal Perth Hospital THR/TKR multi-disciplinary discharge criteria form

ASSESSMENT	ACCEPTABLE CRITERIA	RESPONSIBILITY	SIGN OFF
Wound Status	1. Dry, no cellulitis & afebrile 2. Minor serous ooze not associated with cellulitis & afebrile 3. If above criteria met & sutures/staples in situ **UNACCEPTABLE** 1. Febrile 2. Cellulitis 3. Haemoserous ooze 4. Haematoma	**REGISTRAR** **Patients discharged with wound ooze:** 1. Will have daily dressings until the suture line is clean & dry provided by HITH nurse 2. The HITH nurse will report any concerns immediately to the treating team's Registrar 3. The patient will be reviewed in outpatient clinic 1 week post discharge	Signature (Registrar): _____ Printed Name Date:
Anticoagulation Profile	1. Patients may be discharged to HITH with an INR* <2 2. Post discharge LMWH* can be arranged. 3. The INR range must be stated on the anticoagulation chart	**REGISTRAR/RMO** 1. GP, RMO or Coagulation Clinic to manage second daily INR. 2. Usual target therapeutic INR range of 2-2.5 3. Once INR is therapeutic INR is managed by the GP	Signature (RMO*/Reg*): _____ Printed Name Date:
Activities of Daily Living	The patient must be: 1. Independent and safe with daily activities and use of appropriate equipment as provided. 2. Equipment and modifications will be provided as indicated. **THR**: Safe with all transfers including car transfers.	**OCCUPATIONAL THERAPIST**	Signature (OT*): _____ Printed Name Date:
Mobility Status	The patient is: 1. Able to be functionally independent in their own home with appropriate aids 2. Able to access own home 3. Independent with all transfers in and out of bed	**PHYSIOTHERAPIST**	Signature (PT*): _____ Printed Name Date:
Range of Movement and Understanding of Precautions	**TKR** AROM 10^{o}-70^{o} or better Quads lag <20^{o} **THR** Demonstrates understanding of hip precautions	**PHYSIOTHERAPIST IN CONSULTATION WITH REGISTRAR**	Signature (PT): _____ Printed Name Date:
Social Support	1. Adequate supports must be in place for all patients 2. Patients who live alone may be discharged providing adequate supports are in place 3. Patients must have arranged own transport for discharge 4. Meets HITH criteria	**NURSE COORDINATOR** Liaise with all members of the health care team to coordinate the patient's discharge to HITH 1. Refer to Social Work as required for appropriate assistive services 2. Telephone referral to HITH made once sign off complete for all disciplines	Signature (Nurse Coordinator): _____ Printed Name Date:

*INR: International Normalised Ratio; LMWH: low molecular weight heparin; RMO: resident medical officer; Reg: registrar; OT: Occupational Therapy; PT: Physiotherapy

Once all discharge criteria were met and 'signed off' by the appropriate health professional, the patient was deemed ready for discharge. All patients discharged on post-

operative day six or earlier that lived within the Perth metropolitan catchment area were referred to HITH for ongoing wound management and RITH for ongoing home based rehabilitation as previously described. This was designed to facilitate discharge based on the individual's ability to cope at home at a basic level, not necessarily their pre-admission level of function. If a patient was discharged later than post-operative day six, referral to HITH/RITH no longer applied but community based services would be accessed if required. A recent Australian meta-analysis assessing the effectiveness of HITH services reported that HITH was associated with reduced mortality, readmission rates and costs, increased patient and carer satisfaction and no change in carer burden (24).

2.6 Inpatient rehabilitation

The rehabilitation philosophy at RPH reflected those outlined in existing qualitative studies at the time (2, 4). Inpatient rehabilitation involved a multi-disciplinary team approach with the overall goal being safe, efficient and timely discharge from hospital, with associated optimal functional outcomes and patient satisfaction. However, each profession tended to have a specific role that was reflected in the discipline specific discharge criteria (see Table 2.2). Each surgeon had one allocated registrar and intern. The orthopaedic intern or registrar reviewed the patients wound site and medical status daily. Nursing allocation was one nurse to four patients and daily care involved appropriate provision of analgesia to facilitate participation in physiotherapy and active participation in activities of daily living (ADLs) to reduce any abnormal illness behaviours. These activities included showering, dressing in their own clothes, sitting out of bed in a chair during the day and for meals, and frequent ambulation (with appropriate aid and level of assistance as prescribed by the physiotherapist). One occupational therapist was available six days per week (excluding Sundays) to review patients as required with regards to bed transfers (providing equipment such as temporary bedrails or leg lifter straps as required), ADLs and to teach and assess safe transfers in and out of a car (specifically for THR patients complying with hip precautions). Patients also had access to a social worker and clinical psychologist if required (Monday to Friday). Physiotherapy services were provided seven days per week and will be detailed in the following section.

2.7 Inpatient physiotherapy

During the research period, ward based physiotherapy services at RPH were provided by two full time physiotherapists working from 8am to 4.30pm Monday to Friday, each with a 14 bed caseload. Daily caseload requirements varied based on the surgical case mix and

the degree of input required by each patient to achieve physiotherapy goals. One to two physiotherapists were available on both Saturday and Sunday to ensure that all patients on the TJR clinical pathway were reviewed and progressed towards discharge as appropriate, a practice which is supported by the literature (21, 25, 26). Physiotherapy treatment occurred on the ward or in a rehabilitation gym setting, utilised at the physiotherapist's discretion. As exposure to patients from other wards was discouraged to reduce infection risk, a gym timetable was specifically allocated by ward, with equipment and plinths cleaned after use. Equipment such as slide boards and bolsters for exercise programs were provided at each individual patient's bedside, or appropriately cleaned between use as per infection control standards. Portable steps were accessible on the ward, or a set of training steps available in the gym. Each patient received physiotherapy treatment once or twice daily at the physiotherapist's discretion, based on the level of input required and resources available to achieve daily goals. Specific physiotherapy treatment consisted of gait re-training progressing to independent mobility with appropriate walking aid, graduated exercise prescription and education to prevent joint dislocation.

Patient mobilisation was commenced on the first post-operative day, usually with the aid of a pulpit frame (PF), with the aim of standing and marching on the spot for at least five to ten steps. On the second post-operative day the aim was to commence ambulating to the bathroom to allow toileting and showering with the nursing staff. The patient was progressed from the pulpit frame to either a wheeled zimmer frame (WZF) or elbow crutches at the physiotherapist's discretion based on the patient's ability, pre-admission function and preference. Progression to WZF or crutches usually occurred on the second or third post-operative day. Once a patient was deemed safe to ambulate independently with an aid they were taught to negotiate step(s) as appropriate for home access requirements.

Exercises were aimed at increasing ROM and strength of the operated joint and limb. Exercises for TKR were specifically aimed at increasing knee flexion and extension and reducing quadriceps lag or weakness. Active and active-assisted exercises were routine intervention, however if patients were unable to achieve ROM targets, Continuous Passive Motion (CPM) was utilised at the physiotherapist's discretion. Daily knee range of movement (ROM) measures including degree of knee extension lag, were measured by goniometer and recorded in the patient's medical record.

Physiotherapy specific TJR discharge criteria outlined in the multi-disciplinary discharge criteria form (Table 2.2) were based on the following: independence with transfers in and out of bed, independence with transfers in and out of a chair, independence with ambulation with prescribed aid, independence negotiating step(s) as appropriate for home access requirements and independence undertaking a home exercise program. Specifically for THR, a demonstrated understanding of hip precautions was necessary. For TKR, whilst the aim was to achieve 90 degrees of knee flexion by discharge, a minimum requirement of 60-70 degrees was enforced; a flexible approach was taken if the patient was making daily gains in ROM or could be progressed by RITH post discharge. Other TKR ROM goals were full knee extension or -10^{o} accepted for discharge with RITH, and no more than 20^{o} quadriceps lag. The decision as to when these criteria had been suitably met to allow "sign off" was primarily at the treating physiotherapist's discretion. All patients were routinely referred for outpatient physiotherapy at their most conveniently located service for ongoing outpatient based rehabilitation within six weeks of their operation. If and at what point this follow up actually occurred was not monitored by the ward physiotherapy staff.

The ward physiotherapists had routinely collected specific data to evaluate quality outcomes e.g. the validity of the RAPT in the RPH setting. Data included age, gender, pre-operative mobility status, RAPT score, comorbidities, discharge outcomes (e.g. ROM and mobility status), day of physiotherapy clearance for discharge versus actual day of discharge and reason for variance between these. This database, originally created for a clinical audit undertaken in 2006 formed the basis of this research.

CHAPTER 3. LITERATURE REVIEW

3.1 Introduction

This research was designed to evaluate existing physiotherapy services following elective joint replacement surgery. This ultimately resulted in the updating of the existing model of care to one that better reflected a contemporary shift in focus from economic reform to improving the safety and quality of health service provision. This shift was driven by the publication of the National Safety and Quality Health Service (NSQHS) Standards in 2012 as developed by the Australian Commission on Safety and Quality in Health Care. The primary aim of the NSQHS Standards were to protect the public from harm and improve the quality of health service provision (27). Hospital stay presents risks to all patients. Well documented complications of hospital stay and prolonged bed rest include hospital acquired infections and pneumonia, deep vein thrombosis, lung atelectasis, depression, deconditioning, and falls. A study titled "How dangerous is a day in hospital?" by Hauck and Zhao (2011) (8) reported their findings that the risk of adverse drug reactions, infection and pressure ulcers increased with each additional night in hospital. The key aspect of this research undertaken at RPH was investigating and identifying causes of unnecessary hospital stay relating to physiotherapy requirements. It was hypothesised that with an increased understanding of the underlying causes of unnecessary hospital stay and discharge delay, we would be better equipped to develop solutions to these issues and develop an improved model of care for patients undergoing joint replacement surgery. To facilitate change and improvements in service delivery, it was also essential to understand the impact of hospital systems and processes on the patient journey.

3.2 Impact of hospital culture on length of stay

Average hospital LOS following elective TJR at Royal Perth Hospital reduced greatly from 24 days in the 1970's, to twelve days in 1999, down to nine days in 2005. Following the implementation of the clinical pathway in 2005, which allowed for discharge on post-operative day four, five or six, LOS stabilised at around six to seven days (six days at the time of this research). Anecdotally, it was thought that the six days of LOS was necessary due to the increased complexity (surgical, medical and socioeconomic) and comorbidity of the RPH patient demographics. The literature emphasised that variations in average hospital LOS following TJR surgery existed across countries, cultures and institutions. For example, in Japan where a culture of extended inpatient convalescence existed, the

average LOS for 3577 patients following TKR performed in 345 hospitals in 2006-2007 was 35 days (28), whereas TJR units from countries such as Denmark (2010) and the United States (2004-2006) were reporting 'fast track' protocols resulting in an average LOS of less than three days (16, 20). Clearly, this large variance in LOS had less to do with the patient cohort characteristics, and more to do with the processes and practices of the institution and health care system. This premise was of interest in the context of this research as it clearly demonstrated the impact of a health care system or culture on patient LOS, and that this was a highly modifiable factor. Physiotherapy is widely accepted as an essential component of post-surgical hospital based management following TJR(1-4). There is evidence reporting physiotherapy practices, such as pre-operative education (29, 30) early mobilisation (31) and 7 day service provision (26), being associated with reduced hospital LOS. There is no literature to date specifically investigating whether physiotherapy service provision can be directly related to delays in timely discharge following TJR surgery. This research aimed to identify the physiotherapy specific reasons for discharge delay. It was hypothesised that this information could assist in identifying whether sub-optimal physiotherapy clinical management or decision making could be impacting on patient hospital LOS. It was also hoped that inefficiencies in the existing system could be identified and optimised to achieve safe and high quality health care within a shorter hospital stay.

3.3 Patient centred care

In alignment with the Australian National Standards and with the goal of patient centred care, effective partnering with consumers was considered to be an essential component of developing an improved model of health care for patients undergoing joint replacement surgery. Engaging patients in a collaborative discussion about the expectations of their hospital stay would not only ensure they were appropriately informed but would also empower them to be more accountable for their health care needs. This in turn would assist staff in ensuring that the appropriate health care interventions were provided at the optimal time. An essential part of this process would involve providing pre-operative education to patients that a short hospital stay is not only safe but achievable, and is in their best interest. It was considered essential that patients receive consistent information from all health care professionals, particularly the medical staff, who have the power to strongly influence patient behaviour. Research by Oldmeadow et al (22), Mahomed et al (32) and Tan et al (33) all found that patient preference (with regards to early discharge directly home versus discharge to a rehabilitation facility for ongoing care) was the most important factor relating to discharge destination. Short hospital stay relating to patient

expectations is also reflected in health care systems where individual cost is a factor. For example, patients without health insurance tend to seek to discharge as early as possible to reduce financial liability in countries such as the USA (34). A Cochrane review in 2004 (35) reported pre-operative education within six weeks of TKR or THR had no effect on pain, function, LOS or post-operative anxiety. More recent research by Yoon et al (30) and Jones et al (29) in 2011 both found a significantly shorter LOS in those patients who received a specific pre-operative education session which included clear post-operative expectations following surgery. Elective surgery has the benefit of being a planned procedure with access to the patient pre-operatively. Utilising the pre-operative period to "partner plan" with patients, provide comprehensive clinical education and clarify expected optimal LOS was considered to be one of the most important aspects of the new RPH model of care.

3.4 Causes of discharge delay following elective joint replacement surgery

There are many studies looking at patient characteristics (which are not easily modifiable) and their relationship with LOS following elective TJR surgery. However, there is very little research examining the post-operative patient journey and the modifiable factors causing discharge delay in this population. One retrospective medical record analysis by Williams et al (7) in 2010, reviewed 189 records to identify causes of failure to achieve a target inpatient LOS of five days or less. Of these records, 58% (n=110) did not achieve LOS of five days or less. Mean inpatient stay was 6.2 days. Rehabilitation factors were reported as the primary cause of delayed discharge (60% or 66 of 110). In ten of these patients, the specific reason for discharge delay was related to prolonged action of nerve blocks, mobilisation inhibited by surgical drains, pain and patient compliance issues. For the rest of these patients (56 of 66) the reason for failure to meet target discharge date was reported as "inability to meet physiotherapy targets with no specific overriding reason". This research aimed to investigate the patient post-operative journey from a physiotherapy perspective to identify specifically why patients may be failing to reach physiotherapy targets.

Two more recent studies implementing 'fast track' TJR protocols prospectively reviewed patients with the aim of identifying barriers to two day discharge (16, 20) with a mean LOS of 2.3 and 2.6 days respectively. The main reasons for delayed discharge (i.e. greater than two days) were reported as pain, nausea, dizziness and general weakness. Although Gulotta et al (20) selected a 'low risk' patient group for their study, Husted et al (16) described their patients as 'unselected' and these results show that short LOS such as

two days is possible for many patients. In these studies, physiotherapy specific factors were not reported. These studies demonstrate very short hospital LOS without physiotherapy specific discharge delay. This research sought to replicate these findings in developing the new TJR model of care at RPH.

3.5 Increasing the predictive capacity of the Risk Assessment and Prediction Tool

A key aim of this research was to investigate whether including specific comorbidity in the RAPT (Table 1.1) would increase its predictive capacity for risk of discharge delay. As described previously, comorbidity was not included in the development of the original tool as no significant relationship between comorbidity and discharge destination (home versus ongoing rehabilitation) was found at the time (22). It was hypothesised that comorbidity may have an impact on hospital LOS in facilities with a shorter LOS (less than 10.2 days) and which tend to have complex, comorbid patient caseloads (such as RPH). Research outcomes at RPH could then be used for more pro-active planning and targeted service provision at the pre-admission assessment phase. This premise was supported by Kimmel et al (5) who recommended large population studies investigating the significance of medical comorbidities alongside the RAPT.

It was important for the comorbidity variables to be both independent of peri-operative factors and easily assessed in a pre-operative environment, making them appropriate for use in a predictive capacity. The following specific variables representing comorbidity were selected for analysis in this study:

- Older age – the literature consistently reports older age to be a factor associated with increased LOS following elective joint replacement surgery (7, 21, 36-40). The literature also shows that increasing age is associated with increased risk for post-operative complications following TJR (40-43). Age is already an assessment criterion in the RAPT. However, it was thought that identifying an “up to date” critical age would be useful in predicting those patients at higher risk of discharge delay in the context of a progressively aging population.
- American Society of Anesthesiologists (ASA) physical rating scale – A correlation between ASA score (Table 3.1) as a measure of pre-existing comorbidity and post-operative complications has been identified in the literature (5, 41). The purpose of including it in this study was to investigate it’s impact alongside RAPT score in predicting or identifying those at risk of delayed hospital discharge.

Table 3.1: American Society of Anesthesiologists (ASA) physical rating scale

ASA Class	Description
1	Normal healthy patient
2	Patient with mild systemic disease
3	Patient with severe systemic disease
4	Patient with severe systemic disease that is a constant threat to life
5	A moribund patient who is not expected to live 24 hours with or without surgery
6	Brain dead

- Cardiac comorbidity - Risk factors for post-operative cardiac complications in the literature include a history of arrhythmia, a history of coronary artery disease (CAD), myocardial infarction (MI), congestive heart failure (CHF) or valvular heart disease (VHD)(42, 43). These studies did not discuss hospital LOS in relation to cardiac related post-operative complications which was hoped to be ascertained in this study.
- Hypertension and diabetes – Jain et al (44) reported that patients with these comorbidities had significantly greater rates of post-operative complications compared to those without. These comorbidities were also found to be very common in the RPH elective joint replacement population making it a useful variable if predictive of delayed discharge.
- Obesity - Studies investigating increased Body Mass Index (BMI) have identified an increased incidence of joint replacement surgery at a younger age, as well as increased risk of post-operative complications in this population(45-47). However, with regards to LOS, results have been largely inconclusive with some studies finding a significant association (41, 46, 48) but with many studies finding no association (21, 37, 38, 49). These conflicting findings may have been due to the relatively small number of patients in the obese and morbidly obese categories in these study populations. However, rates of obesity are increasing worldwide making this an important factor for ongoing investigation. According to the Australian Bureau of Statistics (50) the prevalence of overweight and obesity in Australian adults continues to rise to 63.4% in 2011-12 and worldwide obesity has

more than doubled since 1980 (51). Jain et al (44) did find that patients who were obese were 1.3 times (95% CI: 1.22 – 1.41) more likely to have a post-operative complication compared to those who were not obese, and this was related to increased "non-homebound" discharges. Amin et al (45) investigated outcomes in morbidly obese (BMI greater than 40 kg/m²) patients undergoing TKR and found that the overall rate of post-operative complications was higher in the morbidly obese group compared with the non-obese group. Similarly, Sadr Azodi et al (46) and Parvizi et al (41) found a tendency for increased risk of post-operative complications with increasing BMI. Further research into the impact of obesity on the risk for post-operative complications and discharge delay is warranted given the rapidly increasing incidence of obesity worldwide. The World Health Organisation (WHO) (51) describes patient weight according to the range of scores in which BMI falls (see Table 3.2).

Table 3.2: Body Mass Index (BMI: body weight/height²) classification (WHO)

BMI	Description
<18.5 kg/m²	Underweight
18.5 – 24.9 kg/m²	Normal Weight
25 – 29.9 kg/m²	Overweight
>30 kg/m²	Obese
>40 kg/m²	Morbidly Obese

3.8 Summary

On review of the literature, a gap in knowledge was identified about the potential for physiotherapy service provision impacting on timely discharge from hospital following TJR surgery. It also identified a gap in knowledge about the daily post-operative patient journey, and the impact that physiotherapy targets may be having on overall hospital LOS. This study aimed to examine in-depth, physiotherapy service provision during this period, with the goal of identifying whether physiotherapy requirements and targets may be resulting in considerable discharge delay. It was hoped that the information attained could then be used to reform this service for greater efficiency and effectiveness.

CHAPTER 4. RESEARCH METHODS

4.1 Introduction

This study was an observational natural cohort study including a retrospective and prospective phase, over the period of 2010 to 2012. This chapter describes both phases and the specific data collected during each.

4.2 Retrospective phase

The retrospective phase of this research involved completing, collating and evaluating data from a large existing database to ascertain the reasons for physiotherapy (and non-physiotherapy) related discharge delay in a cohort of 404 patients in 2010. In the context of this study, discharge delay is defined as hospital LOS greater than the six day clinical pathway target. This database was originally commenced in 2006 for a registered quality improvement study.

The following hypotheses were proposed for the retrospective phase of this study:

H_1: Delays in achieving physiotherapy related rehabilitation goals will be the most prevalent reason for discharge delay following elective TJR surgery;

H_2: The presence of comorbid diseases and a high risk RAPT score will significantly increase the risk of discharge delay.

4.2.1 Retrospective phase inclusion criteria, exclusion criteria and sample size

The retrospective phase included all consecutive patients admitted to RPH for primary elective TKR and THR in one calendar year (2010 N = 404). This time frame was chosen to ensure seasonal variations, extended holiday periods and consistency of surgeon was captured. Patient data was excluded if their indication for TJR surgery was due to:

- Trauma e.g. an acute fracture (therefore a non-elective procedure);
- Pathological fractures, or a prophylactic TJR procedure to prevent pathological fracture;
- Revision surgery (due to the variability of procedures).

Given the potential for patients to undergo more than one TJR procedure within one year, each datum was described as an ‘episode’ of TJR. However, depending on the context the term ‘episode’ and ‘patient’ are used interchangeably throughout this thesis.

4.2.2 Retrospective phase protocol

A list of patients fitting the criteria for the study was generated by the RPH Elective Orthopaedic Surgery Business Manager. The existing quality improvement database contained most of the data required for the study. These existing data were transferred to a new specifically created research database. Other information such as patient medication lists to cross check for the presence of comorbidities, were obtained directly from the patient medical record. ASA scores were provided by the hospital's Joint Replacement Assessment Clinic using a list of unique patient identifier numbers. Each variable and how the data were collected is described in detail in Table 4.1.

Table 4.1: Retrospective phase data and collection method

Variable	Method of raw data collection
Age	Date of birth information was collected by the treating physiotherapist at POAS clinic and entered into the existing physiotherapy database. A Microsoft Excel® 2010 formula automatically calculated patient age via date of birth. This information was transferred to the research database.
RAPT Score	RAPT score for each patient was determined by the treating physiotherapist at the POAS clinic. Stickers printed with the RAPT (Table 1.1) were placed in the patient medical records and the physiotherapist circled the appropriate score for each variable. The total score out of twelve was documented on the sticker. Based on this score, risk for extended LOS (high, medium or low) was determined and documented in the patient's medical records. RAPT score was routinely entered into the existing physiotherapy database by the treating physiotherapist. This information was then transferred to the research database.
ASA Score	ASA score was determined by the anaesthetist at the POAS clinic and was recorded on the patient's anaesthetic report which was filed in their medical records. ASA score data were not routinely collected by the physiotherapists at RPH. Thus for retrospective analysis, these data were obtained from the Joint Replacement Assessment Clinic (JRAC) database and entered into the research database.
BMI	BMI was calculated by the anaesthetist at the POAS clinic and was recorded on the patient's anaesthetic report which was filed in their medical records. BMI for every patient was routinely entered into the existing physiotherapy database by the treating physiotherapist. This information was then transferred to the research database.
Cardiac comorbidity	Past medical history information was routinely obtained by both the orthopaedic doctor and the anaesthetist at the POAS clinic. This information was recorded in the patient's medical records in both the admission section as well as on the anaesthetic report. Past medical history was routinely recorded by the treating physiotherapist, and entered into the existing physiotherapy database. Patient medications lists were obtained by the Research Physiotherapist from the medical records and were used to confirm the presence of chronic comorbidity. In this study, cardiac comorbidity was defined as any history of CAD, CHF, VHD or MI. This information (i.e. 'present' or 'absent') was entered into the research database.
Other major comorbidity	Past medical history information was obtained and recorded as described above. In this study the presence of hypertension, diabetes and hypercholesterolaemia, confirmed via review of medications, was included in the research database as either 'present' or 'absent'. Note hypercholesterolaemia was chosen as a variable for investigation in this study, primarily due to its prevalence in the retrospective cohort.
Actual LOS	Date of patient admission and discharge was routinely recorded by the treating physiotherapist and entered into the existing physiotherapy database. A Microsoft Excel® 2010 formula automatically calculated LOS in whole days from admission to discharge. These data was

	transferred to the research database.
Physiotherapy clearance for discharge	Date of physiotherapy clearance for discharge was routinely recorded by the treating physiotherapist, and entered into the physiotherapy database. It was also routinely documented in each patient's medical record on the relevant day. This information was transferred to the research database by the Research Physiotherapist and the number of days until physiotherapy clearance was calculated automatically using a Microsoft Excel® 2010 formula.
Variance	Variance (if any) between date of physiotherapy clearance for discharge and actual discharge, was automatically calculated in whole days via a Microsoft Excel® 2010 formula in the existing physiotherapy database. These data were transferred to the research database. If variance existed but discharge was still achieved within six post-operative days it was still considered discharge on pathway and was not included in the discharge delay data.
Reasons for delayed physiotherapy clearance for discharge	Physiotherapy clearance for discharge after post-operative day six was described as delayed physiotherapy discharge, even if the reason for delayed physiotherapy discharge was directly related to a medical or surgical issue. Reasons for delayed physiotherapy discharge were routinely recorded by the treating physiotherapist and entered into the physiotherapy database as a subjective description. For the purposes of this study, these descriptions were further classified into categories to describe the overall reason: • **Mobility issues** - where the primary cause for extended LOS was related to patient mobility and failure to achieve independence with physiotherapy discharge criteria; • **Medical complications** - where a medical complication directly impacted on patient participation in physiotherapy and rehabilitation; • **Surgical complications** - where a surgical complication directly impacted on patient participation in physiotherapy and rehabilitation; • **Organisational issues** – where a physiotherapy related organisational/logistical or administrative issue directly resulted in discharge delay. These reasons were verified by the Research Physiotherapist via review of the medical records and entered into the research database.
Non-physiotherapy related reasons for discharge delay	Recorded by the treating physiotherapist and entered into the physiotherapy database as a subjective description. For the purposes of this study, these descriptions were further classified into the following categories to describe the overall reason for discharge delay: • **Wound issues** - any wound related issue including wound ooze, erythema, blisters or cellulitis; • **Other medical issues** - any issue requiring medical investigation, monitoring or intervention excluding wound issues; • **Organisational issues** - where an organisational/logistical or administrative issue directly resulted in discharge delay; • **Social support issues** - any delays resulting from issues relating to lack of social support at home including waiting for service set up; • **Occupational therapy** - any delays relating to occupational therapy; • **ROM issues** - any delays as a result of a medically driven decision to keep a patient in hospital due to poor ROM. This information was entered into the research database by the Research Physiotherapist.

4.2.3 Retrospective phase statistical analyses

Basic descriptive statistics (Microsoft Excel® 2010) were used to determine the characteristics of the raw data (N = 404). This included information such as the number of THR and TKR, median LOS, the number of patients who experienced discharge delay, and the number of patients at high, medium and low risk of discharge delay as determined by the RAPT score.

Frequency tables were generated to describe the reasons for and prevalence of discharge delay relating to both physiotherapy and non-physiotherapy issues, including the associated number of days of extended LOS for each reason. Variance between physiotherapy discharge and actual hospital discharge was graphed (Microsoft Word® 2010).

The relative risk for discharge delay (attributed to both physiotherapy and non-physiotherapy related causes) was calculated for each variable individually i.e. RAPT score, age, BMI, ASA score, cardiac comorbidity, hypertension, diabetes and hypercholesterolemia. The relative risk for discharge delay was also calculated for a high risk RAPT score plus the presence of each variable. This was achieved by generating likelihood ratios (LR) using custom built 2x2 univariate analysis tables (Microsoft Excel® 2010). This analysis required datum to be dichotomous (i.e. present or absent). Some variables were already dichotomous e.g. presence or absence of cardiac comorbidity, presence or absence of a high risk RAPT score. For continuous variables (e.g. age, BMI, ASA) receiver operator curves (ROC) were created to determine the critical threshold for sensitivity and specificity to make them dichotomous (e.g. a score above the critical threshold would be considered 'present'). ROC analysis was performed using a web-based calculator for ROC curves, retrieved in 2013 from www.jrocfit.org. In this study a LR (positive) of at least 2 was considered useful. This was based on Jaeschke et al (55) (1994) who indicate that a LR of 2-5 can be interpreted to "generate small, but sometimes important shifts in probability". Chi squared tests (retrieved 2013, www.socscistatistics.com/tests/chisquare/, Microsoft Excel® 2010) were performed to determine statistical significance. An a priori confidence limit was set at the 95% limit (Alpha = 0.05) for reporting statistical differences and distribution estimates.

4.3 Prospective phase

The prospective phase involved daily observation of patients throughout their post-operative journey recording any failure to achieve specific minimum daily physiotherapy goals. Such specific patient information is not reliably recorded in the medical record, therefore was prospectively obtained by the Research Physiotherapist.

The following hypotheses were proposed for the prospective phase of this study:

H_1: Failure to achieve minimum physiotherapy goals on a specific post-operative day will be predictive of delayed discharge;

H_2: The reasons for and prevalence of failure to achieve minimum daily physiotherapy goals will be different for TKR and THR;

H_3: Patients at high risk of discharge delay (as per RAPT score) are more likely to fail to meet daily physiotherapy targets on each post-operative day.

4.3.1 Prospective phase inclusion criteria, exclusion criteria and sample size

The prospective phase involved observing the patient post-operative journey on a daily basis from a physiotherapy goal perspective. This created a substantial workload for the Research Physiotherapist ensuring accurate, quality data were obtained for each patient examined. Therefore, the decision was made to collect three equal cohorts of 50 consecutive patients at high, medium and low risk of extended LOS (as categorised by RAPT score) who were admitted to RPH for primary elective TJR from January 2011. This would optimise the use of Researcher time over the subsequent twelve months, based on the 2010 cohort (i.e. 68 patients had a high risk RAPT score in that twelve month period). Furthermore, statistical power of between group comparisons is substantially influenced by the smallest group sample size. An independent paired comparison of means with a power of 0.80 is 95% likely to detect a change of 0.56 SD of the pooled sample. Comparison of proportions of the magnitude of (for example) 75% vs 50% are 95% are likely to be detected with a power of 0.80 with sample sizes of 50. These differences reflect clinically moderate changes and therefore the sample size of 50 was selected.

Patients were excluded from the prospective phase if their indication for TJR surgery included trauma, malignancy or revision, as described previously. If a patient was permanently non-ambulant or wheelchair bound pre-operatively they were also excluded from the prospective phase of the study, as they could not be expected to achieve the minimum daily physiotherapy mobility goals. This resulted in the exclusion of one patient with pre-existing cerebral palsy.

4.3.2 Prospective phase protocol

Prospective data collection was conducted by the Research Physiotherapist in collaboration with the treating physiotherapists commencing in January 2011. Eligible patients were identified at the Pre-operative Assessment Service (POAS) Clinic. For these patients, the same data that were collected retrospectively were also collected prospectively (as described in Table 4.1) to provide validity to the retrospective results.

Minimum daily physiotherapy goals were determined for each post-operative day for both THR and TKR. These goals were considered to be the minimum daily clinical achievement that would still allow timely discharge based on what was currently occurring on the ward. For example, it was customary practice for patients who were motivated, making daily gains in ROM and who were eligible for RITH, to be discharged with as little as 70 degrees' knee flexion, as it was expected they would go on to achieve greater range during their home-based rehabilitation. The 80-90 degree 'ideal' ROM stated in the existing clinical pathway did not exclude a patient from discharge, thus this needed to be reflected in the gaols for this study. It is important to note that the clinical pathway was not changed in practice. The variation in goals was simply designed to accommodate what was happening more accurately from a clinical perspective. Importantly, it would not have contributed to extending hospital LOS.

New prospective data collection sheets were created by the Research Physiotherapist to capture this information (Tables 4.2 and 4.3). Note that the goal "walk with aid independently" does not specify a distance and refers to a patient's ability to walk the distances required to function independently within their own home environment as determined by the treating physiotherapist. Also the goal "independent transfers" refers to all mobility related transfers (such as in and out of bed, and standing from a chair) that will allow the patient to function independently at home. For THR these transfers were to be achieved with a demonstrated understanding of relevant hip precautions. These sheets were completed only by the Research Physiotherapist. Patient achievement of daily physiotherapy goals ('yes' or 'no'), along with the specific overall reasons (if any) for failure to achieve these goals were ascertained by the end of each post-operative working day. If a patient received a 'no' for any specific daily goals, they were considered to have failed to achieve minimum physiotherapy goals for that day. This information was corroborated with the treating physiotherapist in collaboration with other team members e.g. medical or nursing staff. Nursing observation charts, scans, X-rays or blood results were also examined to cross check information. This occurred until post-operative day six, beyond which the patient was considered to have fallen off the clinical pathway. Prospective data collection was completed in May 2011 for the low risk RAPT group (score greater than nine) and the medium risk RAPT group (score six to nine). As anticipated the high risk RAPT group (score less than six) was completed much later, in February 2012.

Table 4.2: Prospective data collection sheet TKR (minimum daily physiotherapy goals)

Day 1 • March on spot with PF* 5-10 steps Y/N • Knee flexion ≥60^{o} Y/N • Achieved daily physiotherapy goals Y/N Reason (if no): _____ _____	**Day 2** • Walk minimum 10m with PF Y/N • Knee flexion ≥60^{o} Y/N • Achieved daily physiotherapy goals Y/N Reason (if no): _____ _____
Day 3 • Progress to walking with WZF or crutches (with or without assistance) minimum 10m Y/N • Knee flexion ≥60^{o} Y/N • Quads lag ≥30^{o} Y/N • Achieved daily physiotherapy goals Y/N Reason: _____ _____	**Day 4** • Progress to walking with WZF or crutches (with or without assistance) • minimum 20m Y/N • Knee flexion ≥70^{o} Y/N • Quads lag ≤20^{o} Y/N • Achieved daily physiotherapy goals Y/N Reason: _____ _____
Day 5 • Walk with aid independently Y/N • Independent transfers Y/N • Knee flexion ≥70^{o} Y/N • Quads lag ≤20^{o} Y/N • Achieved daily physiotherapy goals Y/N • Reason: _____ _____	**Day 6** • Walk with aid independently Y/N • Independent transfers Y/N • Knee flexion ≥70^{o} Y/N • Quads lag ≤20^{o} Y/N • Independent ↑↓ step/s Y/N • Achieved daily physiotherapy goals Y/N Reason: _____ _____
Overall reason for failure to achieve discharge by post-operative day 6: _____ _____ _____ _____	

* Pulpit Frame

Table 4.3: Prospective data collection sheet THR (minimum daily physiotherapy goals)

Day 1 • March on spot with PF 5-10 steps Y/N • Achieved daily physiotherapy goals Y/N Reason (if no): _____ _____ _____	**Day 2** • Walk minimum 10m with PF Y/N • Achieved daily physiotherapy goals Y/N Reason (if no): _____ _____ _____
Day 3	**Day 4**

• Progress to walking with WZF/crutches (with or without assistance) minimum 10m Y/N • Achieved daily physiotherapy goals Y/N Reason: _____ _____	• Progress to walking with WZF/crutches (with or without assistance) minimum 20m Y/N • Achieved daily physiotherapy goals Y/N Reason: _____ _____
Day 5 • Walk with aid independently Y/N • Independent transfers Y/N • Achieved daily physiotherapy goals Y/N Reason: _____ _____ _____	**Day 6** • Walk with aid independently Y/N • Independent transfers Y/N • Independent ↑↓ step/s Y/N • Achieved daily physiotherapy goals Y/N Reason: _____ _____
Overall reason for failure to achieve discharge by post-operative day 6: _____ _____ _____ _	

Table 4.4 defines the prospective phase variables and how they were specifically determined in the context of the study.

Table 4.4: Prospective phase data and collection method

Variable	Method of raw data collection
Achievement of daily physiotherapy goals	Overall achievement of daily physiotherapy targets was determined by the Research Physiotherapist in collaboration with the treating physiotherapist, and recorded as either 'yes' (having adequately met daily goals) or 'no' (having not adequately met daily goals) for the first six post-operative days (unless discharge occurred before day six). If scored a 'no' overall, the patient was described as having fallen off the clinical pathway on that post-operative day. These data were entered into the research database by the Research Physiotherapist.
Reason for not achieving daily physiotherapy goals	Reasons (if any) for not achieving daily physiotherapy goals were determined by the Research Physiotherapist in collaboration with the treating physiotherapist and recorded on the Prospective Data Collection Sheets (see Tables 4.2 and 4.3) for the first six post-operative days (unless discharge occurred before day six). This information was entered into the research database by the Research Physiotherapist.

4.3.3 Prospective phase statistical analyses

The same statistical analyses performed on the retrospective data were repeated on the prospective data to provide validity to both results. A frequency table was generated to

describe the reasons for and prevalence of failure to achieve minimum daily physiotherapy goals on each post-operative day for both THR and TKR. Next the prospective data (N = 150 individuals in three cohorts) were compared using a linear regression model and estimates of hazard (risk) of individuals who fell off the clinical pathway on specific days were determined. The single days for which each individual "fell off the pathway" was noted, and the relative risk of this cohort experiencing discharge delay compared to the cohort who did not fall off the pathway (base risk) were compared. A second analysis was undertaken to determine if multiple days 'off pathway' was a significant factor in discharge delay. Baseline risk was determined for those with zero and one day off pathway and this risk was compared to the cohort who had two to three days and four to five days off pathway. The hazard ratio was determined and 95% confidence limits calculated. Finally, the relative risk for failing to achieve minimum daily physiotherapy goals for patients at high risk of discharge delay (as assessed by the RAPT) compared to those at medium and low risk, was determined for each post-operative day on the clinical pathway.

4.4 Blinding measures

Blinding measures were not applicable to the retrospective phase. The Research Physiotherapist and the treating physiotherapists were not blinded for the prospective phase of this study. All treating physiotherapists were aware the research was being conducted and were involved in prospective data collection. In addition, the Research Physiotherapist was responsible for providing physiotherapy management to some of the patients who were prospectively examined. The Research and treating physiotherapists, being aware and involved in the study had the potential to change their practice to achieve a specific result. It is acknowledged that lack of blinding may have biased the results of the prospective data relating to physiotherapy, thus represents a considerable weakness of this study. At the time of data collection, lack of blinding was considered acceptable as it affected all subjects, and it was thought that any bias would be towards increasing efficiency to achieve a more favourable result. Physiotherapists accordingly under public sector standards have a duty of care to provide intervention as required based on need and to facilitate patient discharge when it is appropriate to do so. It is unlikely that any physiotherapist would clear a patient for discharge prematurely, risking liability and patient safety. Furthermore, physiotherapy discharge criteria are inherently intertwined with patient acceptance and it is unlikely any patient would be discharged without their consent. However, it is also recognised that there was opportunity to decrease efficiency and therefore delay discharge, particularly as one of the key aims of the study was to decrease

length of stay through the implementation of change. It is acknowledged that blinding would have reduced the risk of behaviour (and therefore outcome) changes.

4.5 Ethical issues

Institutional approval was obtained from the RPH Quality Unit. As this study did not impact on current patient care, it was deemed to be a clinical audit without requirement for hospital human research ethical approval. University approval was obtained from the Human Ethics Committee of Curtin University. Support for this research was also provided by Associate Professor John Buchanan (Director of Allied Health, RPH) to conduct the research project in the Physiotherapy Department at RPH.

This study did not introduce any new physiotherapy interventions; it was observational with the aim of better understanding the post-operative inpatient period after hip or knee replacement surgery. No participant was compromised or denied necessary treatment by inclusion in this study.

4.6 Data storage

All data from this study were stored at the RPH physiotherapy department. It will be stored for a minimum of five years after study completion and information will only be accessible by the Research Physiotherapist and Supervisor Professor Garry T Allison. Data are coded to ensure individuals are not identifiable. All paper copies of data collection sheets are stored in a locked room in the physiotherapy department and all information stored on the computer is password protected as per the ethical requirements of the institution.

CHAPTER 5. RESULTS

5.1 Introduction

This chapter details the findings of the retrospective and prospective clinical audits conducted at Royal Perth Hospital in 2010-2012. The retrospective phase involved identifying episodes of delayed discharge (defined as greater than the clinical pathway target of six days), due to any physiotherapy and non-physiotherapy related causes. The retrospective data were also used to investigate whether the inclusion of comorbidity with RAPT score increased the predictive capacity of the tool. The prospective data assisted in validating the retrospective results, and provided detailed insight into patient achievement of daily physiotherapy gaols.

5.2 Retrospective audit findings

Data from 404 episodes of primary elective TJR (240 or 59.4% female and 164 or 40.6% male) from the year 2010 were examined for the retrospective phase of this study. Of these, 161 or 39.9% were THR and 243 or 60.1% were TKR. The median actual LOS was six days for THR (IQR: 5 to 8), six days for TKR (IQR: 5 to 8) and six days for the combined data (IQR: 5 to 8). The median LOS to achieve physiotherapy clearance for discharge was five days for THR (IQR: 4 to 7), five days for TKR (IQR: 4 to 6) and five days for the combined data (IQR: 4 to 6).

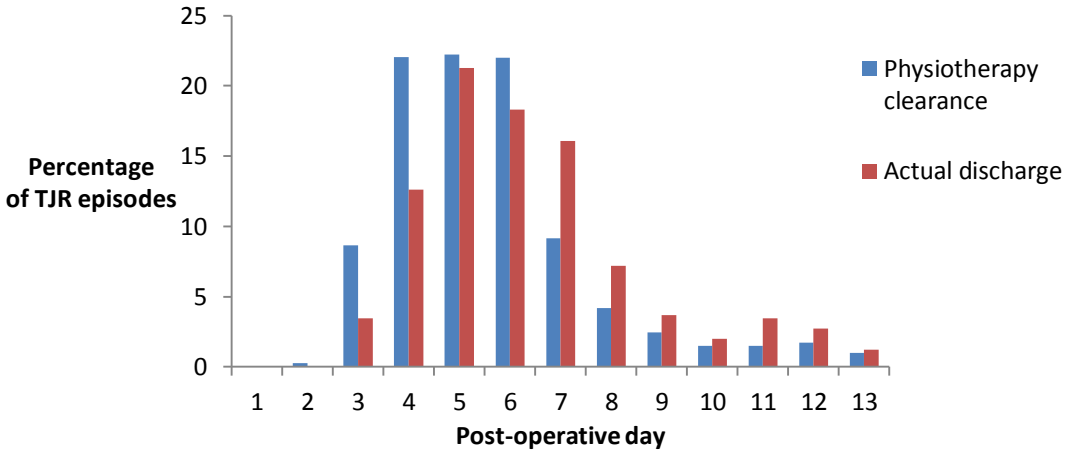

Figure 5-1: Percentage of TJR episodes who achieved physiotherapy clearance and actual discharge on each post-operative day (retrospective data 2010)

Of all episodes of TJR audited, 44.3% (179) experienced discharge delay, associated with a total of 789 days of inpatient hospital stay after post-operative day six. Of these,

36.3% (65/179) were THR and 63.7% (114/179) were TKR. Discharge delay occurred in 24.8% (100) who did not achieve physiotherapy clearance on or before post-operative day six. This was associated with a total of 418 extra days of hospital stay until physiotherapy clearance was achieved. Of the 100 who experienced delayed physiotherapy discharge, 49 were still not discharged on the day of physiotherapy clearance but were further delayed due to non-physiotherapy related issues, resulting in a further 158 days of extended LOS.

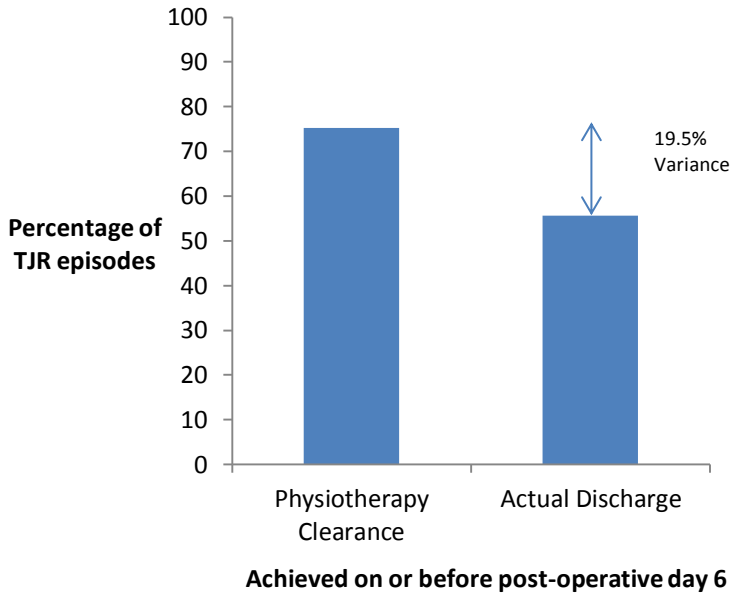

Figure 5-2: Percentage of TJR episodes who achieved physiotherapy clearance and percentage who were actually discharged on or before post-operative day six (retrospective data 2010)

Of TJR episodes who did receive physiotherapy clearance on or before post-operative day six, 19.5% (79) experienced non-physiotherapy related discharge delay resulting in a total of 213 extra days of hospital stay after post-operative day six. Some (6.9% or 28 episodes) experienced variance between physiotherapy clearance and actual discharge, however were still discharged on or before post-operative day six (i.e. still on clinical pathway target) so were not included in this analyses.

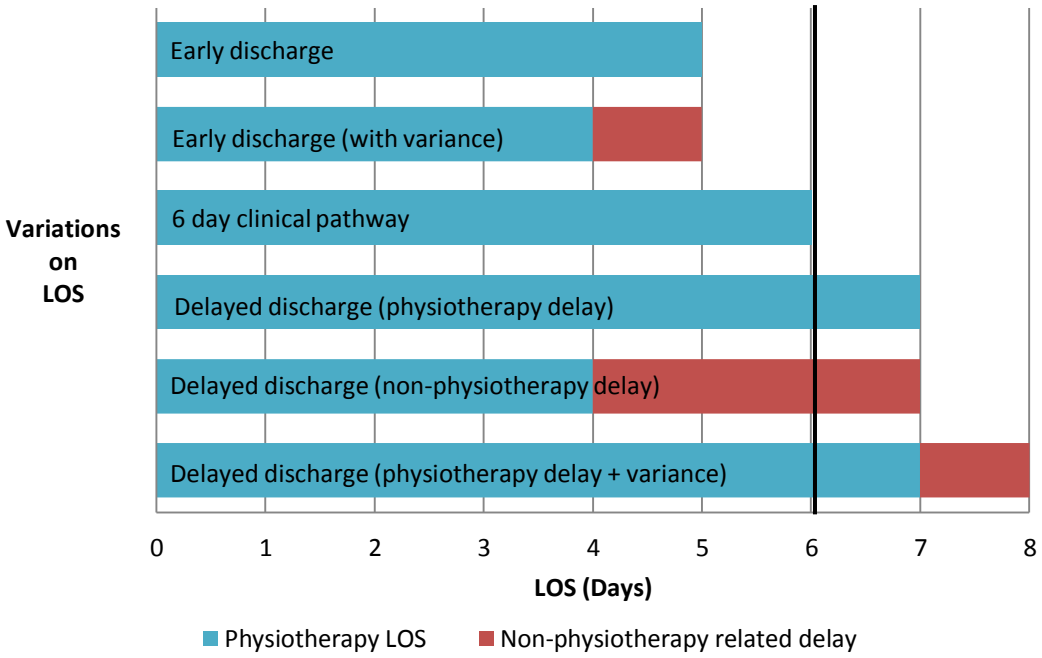

Figure 5-3: Diagrammatic representation of examples of variations in LOS described in study where clinical pathway discharge target is six days or less

5.2.1 Discharge delay due to delayed physiotherapy clearance

All 404 patients received physiotherapy clearance prior to discharge. Of these, 24.8% (n = 100) did not receive clearance on or before post-operative day six. Reasons for failure to achieve physiotherapy discharge criteria by post-operative day six are presented in Table 5.1. The most prevalent reason (63%) for failure to achieve timely discharge was directly related to patient "mobility issues". Twelve of the 63 mobility related failures were related to a pre-existing disability/disease e.g. one patient with pre-existing hemiplegia (who was independently ambulant using a quad stick on their non-hemiplegic side pre-operation), was reported as unable to use a frame or crutches bilaterally and was therefore slow to progress from a mobility perspective. Fifty-one of the 63 failures were attributed to "non-specific slow progress" with physiotherapy rehabilitation and were not cleared for discharge by the treating physiotherapist on post-operative day six or earlier. No specific reasons for this slow progress were documented by the treating clinicians and no other specific reasons for discharge delay could be ascertained from the patient medical record.

Table 5.1: Reasons for delayed physiotherapy clearance resulting in discharge delay (retrospective data 2010)

Reason for delayed physiotherapy clearance	Number of episodes		
	THR (n=42)	TKR (n=58)	Total (N=100)
Total mobility issues	**28**	**35**	**63/63**
Non-specific slow progress with physiotherapy rehabilitation	**22**	**29**	**51/63**
Mobility issues relating to pre-existing disability:	**6**	**6**	**12/63**
• Hemiplegia	1	1	2
• Chronic severe LBP	2		2
• Severe OA of opposite hip	2		2
• Impaired vision		1	1
• Joint contractures from old burn injuries		1	1
• Dementia		1	1
• Severely impaired exercise tolerance (COPD)	1		1
• Rheumatoid Arthritis (RA)		1	1
• Intellectual disability		1	1
Total medical complications	**9**	**17**	**26/26**
Serious medical complications requiring patient transfer to acute care facility for management: • Pulmonary emboli • Acute bowel obstruction • Acute pulmonary oedema • Respiratory failure • Acute gastro-intestinal bleed	3	4	7
Haemodynamic instability (e.g. low haemoglobin or blood pressure)	2	2	4
Respiratory complications	1	2	3
Cardiac complications		3	3
Pain issues requiring extended APS management	1	2	3
Post-operative delirium		2	2
DVT		2	2
Urological Issues	2		2
Total surgical complications	**5**	**5**	**10/10**
Wound issues (requiring bed rest or surgical washout)	1	5	
Intra-operative neuropraxia resulting in foot drop	3		
Intra-operative femur split (50% weight bearing status post-operatively)	1		
Administrative/organisational Issues		**1**	**1/1**
No official documented physiotherapy discharge over long weekend			

Medical complications accounted for 26% of attributed failures resulting in slow or delayed rehabilitation. In these cases, progress with physiotherapy was documented as being delayed due to the patient being too medically unwell to participate in physiotherapy, being unavailable for physiotherapy (e.g. off the ward for extended periods undergoing tests or investigations) or having enforced mobility restrictions (e.g. due to deep vein thrombosis in the lower limb) preventing participation in physiotherapy. Complications relating directly to the surgical procedure resulted in ten per cent of physiotherapy related discharge delay e.g. surgical wound issues, intra-operative fracture, return to theatre for wound washout, iatrogenic neuropraxia, which were all documented as impacting on the patients ability to participate or progress with physiotherapy rehabilitation. One episode of failure was attributed to physiotherapist failure to document in the patient medical record over a weekend, resulting in the patient remaining in hospital awaiting a physiotherapy review for discharge on the Monday.

The number of extra days of hospital stay (after post-operative day six) attributed to each of the reasons for discharge delay are presented in Table 5.2. Delayed physiotherapy discharge resulted in a total of 418 days of extended LOS. One hundred and thirty-eight of these days were directly related to specific medical and surgical complications. Non-specific slow progress with rehabilitation accounted for the highest numbers of extra hospital days. Mobility issues associated with pre-existing disability also contributed to high numbers of extra hospital days.

Table 5.2: Reasons for delayed physiotherapy clearance and number of related extra hospital days after post-operative day six (retrospective data 2010)

Reason for delayed physiotherapy clearance	THR (days)	TKR (days)	Total (days)
Non-specific slow progress with physiotherapy rehabilitation	80	95	**175**
Mobility issues relating to pre-existing disability	18	85	**103**
Medical complications	25	76	**101**
Surgical complications	18	19	**37**
Administrative/organisational Issues		2	**2**
Total	141	277	**418**

5.2.2 Discharge delay after physiotherapy clearance

Of all the TJR episodes who were cleared for discharge from a physiotherapy perspective within six post-operative days, 19.5% (n = 79 of total 404) experienced discharge delay for other non-physiotherapy related reasons. Reasons for non-physiotherapy related delay is presented in Table 5.3 and shows that 48.1% were due to the medical team deciding the wound status was unacceptable for discharge. The most common wound issue recorded was 'wound ooze' that required ongoing monitoring. Other medical issues contributed 30.4%, requiring ongoing intervention or monitoring e.g. bowel and bladder disorders; 15.2% were due to organisational issues e.g. late medical review, awaiting transport; 3.8% were due to social support issues e.g. waiting for home services to be organised; one episode was due to failure to achieve a safe car transfer with the occupational therapist; one episode was due to medical decision to monitor knee ROM ultimately resulting in manipulation under anaesthetic (MUA).

Table 5.3: Reasons for discharge delay after physiotherapy clearance (retrospective data 2010)

Reason for non-physiotherapy related discharge delay	Number of episodes		
	THR (n=28)	TKR (n=51)	Total (N=79)
Total wound issues	**11**	**27**	**38/38**
Wound ooze	10	20	30
Cellulitis, erythema	1	3	4
Blisters, broken skin		2	2
Wound dehiscence		1	1
Haematoma		1	1
Other medical complications	**9**	**15**	**24/24**
Bowel and bladder complications	1	3	4
Neurological complications	1	2	3
Pain issues	1	2	3
INR non-therapeutic	1	2	3
Nausea and vomiting	1	1	2
Atrial fibrillation (AF)	1	1	2
Dehydration	1	1	2
Deep vein thrombosis (DVT)		1	1
Febrile		1	1
Respiratory failure	1		1
Norovirus/gastrointestinal complications	1		1
Intravenous antibiotics		1	1
Administrative/organisational Issues	**5**	**7**	**12/12**
Transport issues (awaiting pick up or flights home)	2	5	7
Late medical review/clearance for discharge	3	2	5
Social support issues	**2**	**1**	**3/3**
Patient anxiety regarding ability to cope at home alone			
Occupational therapy	**1**		**1/1**
Non-compliant with hip precautions during car transfer			
ROM issues		**1**	**1/1**
Medical decision to monitor knee ROM and undergo MUA			

The number of extra days of hospital stay (after post-operative day six) attributed to each of the non-physiotherapy related reasons for discharge delay are presented in Table 5.4. These numbered 213 additional bed days.

Table 5.4: Reasons for discharge delay after physiotherapy clearance and number of related extra hospital days after post-operative day six (retrospective data 2010)

Reason for non-physiotherapy related discharge delay	THR (days)	TKR (days)	Total (days)
Total wound issues	28	111	**139**
Other medical complications	20	28	**48**
Administrative/organisational issues	6	12	**18**
ROM issues		4	**4**
Social support issues	2	1	**3**
Occupational therapy	1		**1**
Total	57	156	**213**

5.2.3 Summary of reasons for discharge delay in order of prevalence

Of 404 patients, 179 experienced discharge delay in the retrospective cohort. If physiotherapy and non-physiotherapy related discharge delay directly related to medical or surgical complications is grouped together (based on the premise that rehabilitation delays were potentially unavoidable), medical and surgical complications were associated with the most number of patients who experienced discharge delay (54.7%). Of these complications 44.9% were wound related. Slow progress with physiotherapy rehabilitation was then the second most prevalent cause of discharge delay (35.2%).

Table 5.5: Summary of reasons for discharge delay in order of prevalence (retrospective data 2010)

Reasons for discharge delay	Number of episodes		
	THR (n=70)	TKR (n=109)	Total (N=179)
All discharge delay directly related to medical/surgical complications	**34**	**64**	**98/98**
• Wound issues (separately)	12	32	44/98
Total mobility issues	**28**	**35**	**63/63**
Non-specific slow progress with physiotherapy rehabilitation	22	29	51/63
Mobility issues relating to pre-existing disability	6	6	12/63
Administrative/organisational issues	**5**	**8**	**13/13**
Social support issues	**2**	**1**	**3/3**
Occupational therapy	**1**	**0**	**1/1**
ROM issues	**0**	**1**	**1/1**

5.2.4 Comparison of discharge delay for hip versus knee replacement surgery

No statistical difference was found between THR versus TKR for experiencing discharge delay for any reason (see Figure 5-4).

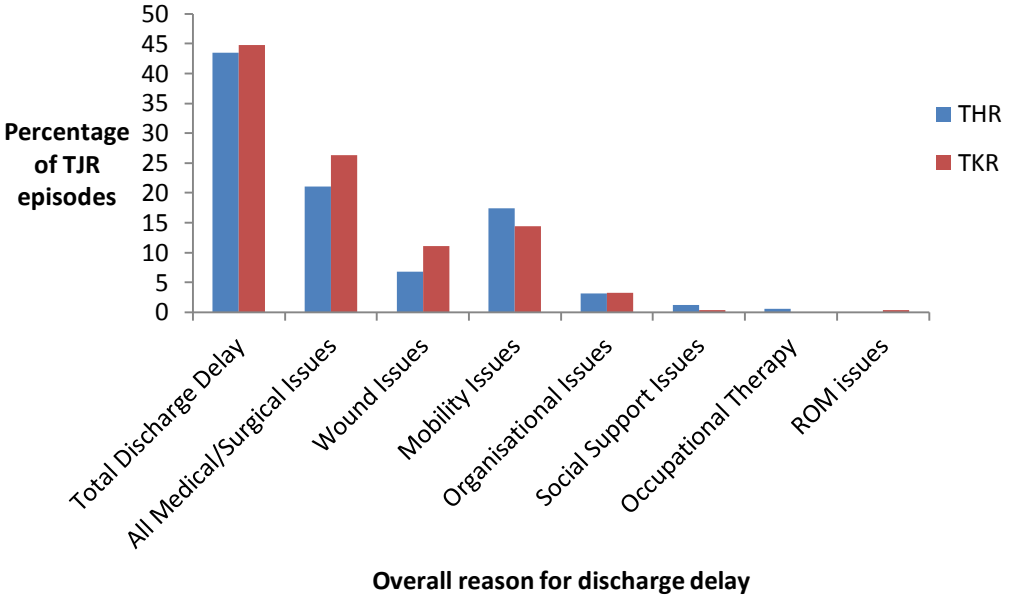

Figure 5-4: Discharge delay according to type of procedure being THR or TKR (retrospective data 2010)

TKR had less discharge delay days related to mobility issues (95 days or 34.3% of total) relative to THR (80 days or 56.7% of total). This was found to be statistically significant (Relative Risk: 0.60; 95% CI: 0.49 to 0.75).

TKR had more discharge delay days related to wound issues (111 days or 58.4% of total) relative to THR (28 days or 33.7% of total). This was found to be statistically significant (Relative Risk: 1.73; 95% CI: 1.25 to 2.39).

5.2.5 RAPT score and discharge delay

Of the 404 episodes of TJR in the retrospective cohort, 16.8% (68) were at high risk, 48% (194) were at medium risk, and 35.1% (142) were at low risk of discharge delay.

Patients at high risk of discharge delay with RAPT score less than six (n=68):

- 46/68 (67.6%) experienced discharge delay.
- 31/68 (45.6%) received physiotherapy clearance by post-operative day six.
- 22/68 (32.4%) were actually discharged by post-operative day six.

Patients at medium risk of discharge delay with RAPT score of six to nine (n=194):

- 89/194 (45.9%) experienced discharge delay.
- 148/194 (76.3%) received physiotherapy clearance by post-operative day six.
- 105/194 (54.1%) were actually discharged by post-operative day six.

Patients at low risk of discharge delay with RAPT score greater than nine (n=142):

- 43/142 (30.3%) experienced discharge delay.
- 127/142 (89.4%) received physiotherapy clearance by post-operative day six.
- 99/142 (69.7%) were actually discharged by post-operative day six.

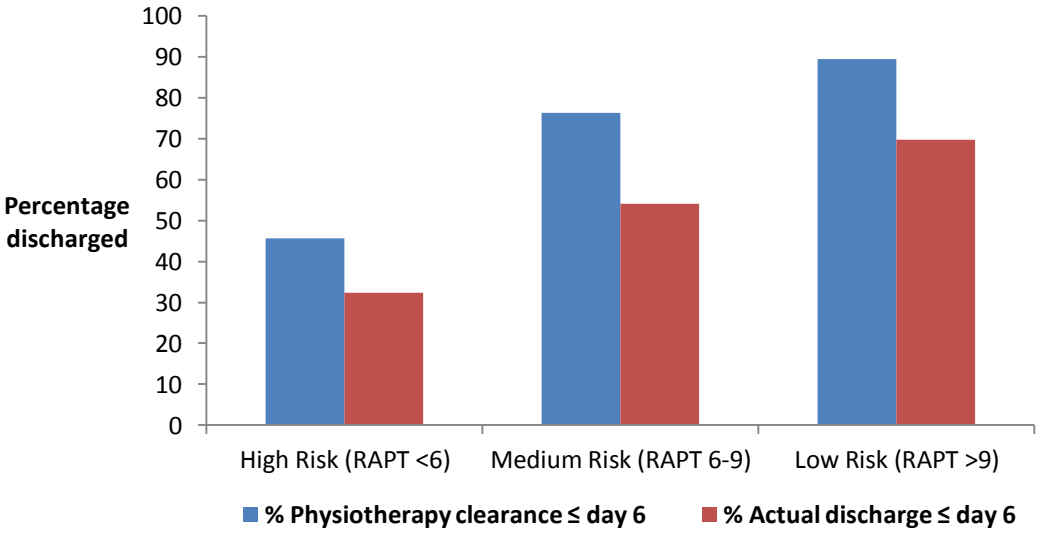

Figure 5-5: RAPT score and physiotherapy clearance versus actual discharge by post-operative day six (retrospective data 2010)

5.2.6 Predictive factors for discharge delay

The variables selected based on the literature review were initially analysed to determine whether they were predictive of discharge delay individually. The variables cardiac comorbidity (included 69 episodes), hypertension (included 233 episodes), diabetes (included 62 episodes), hypercholesterolaemia (included 136 episodes), high risk RAPT score (included 68 episodes) and low risk RAPT score (included 142 episodes) were considered to be present or absent (dichotomous) for the purposes of this study. Receiver operator curves (ROC) were created to determine the critical threshold of sensitivity and specificity for continuous variables in order to make them dichotomous (i.e. data were either above or below the critical threshold). The critical threshold for age was 72.4 years (included 145 patients) with those being older at higher risk of discharge delay. The critical threshold for BMI was 38 kg/m² meaning those in the high end obese to morbidly obese categories (as per WHO classification) were at higher risk of discharge delay (included 53

episodes). For ASA it was those with a score of greater than two (included 126 episodes) who were at higher risk. Each episode of TJR was described as a '1' (higher risk variable present) or a '0' (higher risk variable not present) for each of the selected variables. All variables except diabetes were individually significant ($p < 0.05$) (see Tables 5.6 and 5.7).

Table 5.6: Risk of discharge delay based on RAPT score (retrospective data 2010)

	RAPT Score <6 "High risk"	RAPT Score >9 "Low risk"
Sensitivity	0.2570	0.2402
Specificity	0.9022	0.5600
LR (positive)	2.6282	0.5460
LR (negative)	0.8235	1.3567
Chi test	18.050	17.455
P	0.00001	0.00001

The RAPT scores of greater than nine (low risk) although significant were not predictive or specific. Having a RAPT score of less than six (high risk) was predictive, being 2.6 times more likely to experience discharge delay than those not at high risk (sensitivity 0.26, specificity 0.90, Chi Squared test $x^2 = 18.05$, $p < 0.00001$).

Table 5.7: Risk of discharge delay based on selected variables (retrospective data 2010)

	Age	BMI	ASA	Cardiac comorbidity	HTN	Diabetes	↑Cholesterol
Sensitivity	0.4749	0.2011	0.4246	0.2346	0.6313	0.1844	0.3855
Specificity	0.7111	0.9244	0.7644	0.8800	0.4667	0.8711	0.7022
LR (positive)	1.6437	2.6618	1.8025	1.9553	1.1837	1.4304	1.2945
Chi test	14.770	13.790	16.388	9.251	3.918	2.361	3.433
P	0.0001	0.0002	0.0001	0.0024	0.0478	0.1244	0.0639

BMI was the most predictive variable, with those with a BMI of 38 kg/m² or greater being 2.7 times more likely to experience discharge delay than those with a BMI of less than 38 kg/m² (sensitivity 0.20, specificity 0.92, Chi squared test $x^2 = 13.79$, $p < 0.0002$). Those with cardiac comorbidity and a high ASA score were 1.9 and 1.8 times more likely respectively to experience discharge delay compared to those without. The other significant variables were not particularly predictive of discharge delay, with a likelihood ratio of 1.6, 1.3 and 1.2 for age, hypercholesterolemia and hypertension respectively.

5.2.7 Predictive factors for physiotherapy clearance

Due to the frequent variance observed between number of days to achieve physiotherapy clearance for discharge and number of days until actual discharge, predictive factors for physiotherapy clearance were also calculated using the same critical thresholds as described previously. For physiotherapy clearance, only age, ASA, cardiac comorbidity and RAPT score were significant ($p < 0.05$).

Table 5.8: Risk of delayed physiotherapy clearance based on RAPT score (retrospective data 2010)

	RAPT Score <6 "High risk"	RAPT Score >9 "Low risk"
Sensitivity	0.3663	0.1584
Specificity	0.8977	0.5842
LR (positive)	3.5806	0.3810
LR (negative)	0.7059	1.4407
Chi test	37.722	22.022
P	0.00001	0.00001

Patients with a high risk RAPT score of less than six were 3.6 times more likely to have delayed physiotherapy clearance compared to those who were not high risk. Low risk RAPT score was interpreted as having low probability of delayed physiotherapy clearance compared to those who were not low risk. Patients older than the critical threshold of 72.4 years were 2.2 times more likely to have delayed physiotherapy discharge compared to those younger. Those with cardiac comorbidity were 1.8 times more likely to have delayed physiotherapy discharge compared to those without. Those with an ASA score higher than two were 1.9 times more likely to have delayed physiotherapy discharge compared to those with a score of two or less.

Table 5.9: Risk of delayed physiotherapy clearance based on selected variables (retrospective data 2010)

	Age	BMI	ASA	Cardiac comorbidity	Hypertension	Diabetes	↑Cholesterol
Sensitivity	0.6238	0.1782	0.4950	0.2574	0.5842	0.1980	0.3861
Specificity	0.7129	0.8845	0.7393	0.8581	0.4257	0.8614	0.6799
LR	2.1724	1.5429	1.8987	1.8140	1.0172	1.4286	1.2062
Chi test	36.774	2.613	19.136	7.137	0.030	2.058	1.478
P	0.0001	0.1060	0.0001	0.0076	0.8615	0.1514	0.2241

5.2.8 High risk RAPT score plus one other variable for risk of discharge delay

The same critical thresholds and statistical analysis described above were used to analyse patients at high risk of discharge delay (RAPT score less than six) with one of the following variables: BMI (included seven episodes), ASA (included 38 episodes), or the presence of cardiac comorbidity (included 17 episodes), hypertension (included 52 episodes), diabetes (included twelve episodes) or hypercholesterolaemia (included 24 episodes). Age, BMI, ASA and hypertension were all significant when considered with high risk RAPT score. In general, there was a large increase in risk when these variables were considered together compared to when they were considered individually. However, for ASA and hypertension (LR 2.64 and 2.59 respectively), the combined risk was the same as the risk for a RAPT score of less than six by itself (LR 2.63). Individuals with a high risk RAPT score when considered with age above 72.4 years were 3.4 times more likely to experience discharge delay compared to those who didn't fit this criterion. Patients with a BMI of 38 kg/m² or greater and a high risk RAPT score were 11.36 times more likely to experience discharge delay (sensitivity 0.04, specificity 0.99, Chi test $x^2 = 4.39$, $p < 0.036$).

Table 5.10: Risk of discharge delay with high risk RAPT score plus one other variable (retrospective data 2010)

	RAPT + Age	RAPT + BMI	RAPT + ASA	RAPT + Cardiac comorbidity	RAPT + Hypertension	RAPT + Diabetes	RAPT + ↑Cholesterol
Sensitivity	0.1842	0.0439	0.1228	0.0526	0.1404	0.0439	0.0789
Specificity	0.9457	0.9961	0.9535	0.9690	0.9457	0.9845	0.9690
LR	3.3947	11.3596	2.6404	1.6974	2.5865	2.8289	2.5461
Chi test	10.024	4.394	4.664	0.717	5.234	1.739	2.747
P	0.0015	0.0361	0.0308	0.3971	0.0222	0.1872	0.0975

5.2.9 High risk RAPT score plus one other variable for risk of delayed physiotherapy clearance

All variables except cardiac comorbidity and BMI were significant when considering high risk RAPT score plus another variable for risk for delayed physiotherapy clearance. The risk was higher for age, ASA, diabetes and hypercholesterolaemia (LR of 5.6, 3.1, 4.2 and 3.6 respectively) than for RAPT score of less than six on its own (LR 2.63).

Table 5.11: Risk of delayed physiotherapy clearance with high risk RAPT score plus one other variable (retrospective data 2010)

	RAPT + Age	RAPT + BMI	RAPT + ASA	RAPT + Cardiac Comorbidity	RAPT + HTN	RAPT + Diabetes	RAPT + ↑Cholesterol
Sensitivity	0.3051	0.0508	0.1695	0.0678	0.1695	0.0678	0.1186
Specificity	0.9457	0.9891	0.9457	0.9674	0.9293	0.9837	0.9674
LR	5.6136	4.6780	3.1186	2.0791	2.3990	4.1582	3.6384
Chi test	27.550	3.543	7.842	1.402	5.093	4.234	6.531
P	0.00001	0.0598	0.0051	0.2364	0.0240	0.0396	0.0106

5.3 Prospective audit findings

Fifty consecutive TJR procedures at high, medium and low risk of discharge delay as assessed using the RAPT (N = 150) were examined prospectively (69 THR and 81 TKR). The median LOS for the total 150 episodes of TJR (IQR: 5 to 10), those at medium risk (IQR: 5 to 8) and those at low risk (IQR: 5 to 7) was six days. Those at high risk had a median LOS of eight days (IQR: 6 to 14). The statistical analyses performed on the retrospective data were repeated for the prospective data. Mobility issues were the most prevalent reason for physiotherapy discharge delay and medical issues were the most prevalent reason for non-physiotherapy related discharge delay at all levels of risk. Medical issues were slightly more prevalent than wound issues for non-physiotherapy related discharge delay in the prospective cohort. Reasons for physiotherapy and non-physiotherapy discharge delay prospectively are summarised in the following tables.

Table 5.12: Reasons for delayed physiotherapy clearance for patients with high risk RAPT score of less than six (prospective data 2011-12)

Reason for delayed physiotherapy clearance	**Number of episodes**		
	THR (n=10)	**TKR (n=11)**	**Total (N=21)**
Mobility issues Non-specific slow progress with physiotherapy rehabilitation	7	9	**16/16**
Medical complications Haemodynamic instability (e.g. low haemoglobin or blood pressure) Nausea and vomiting (requiring nasogastric tube and nil oral intake) Respiratory failure Cardiac complications	2	2	**4/4**
Surgical complications Intra-operative femur fracture resulting in post-operative partial weight bearing status	1		**1/1**

Table 5.13: Reasons for non-physiotherapy related discharge delay for patients with high risk RAPT score of less than six (prospective data 2011-12)

Reason for non-physiotherapy related discharge delay	Number of episodes		
	THR (n=6)	TKR (n=8)	Total (N=14)
Medical complications	**3**	**3**	**6/6**
Low haemoglobin or platelets			
Nausea and vomiting			
Urinary retention			
Diarrhoea			
Cardiac complications (CHF, angina, fluid overload) + blisters on feet			
Wound issues		**4**	**4/4**
Wound ooze			
Social support issues	**3**	**1**	**4/4**
Anxiety regarding ability to cope at home alone on discharge			

Table 5.14: Reasons for delayed physiotherapy clearance for patients with medium risk RAPT score of six to nine (prospective data 2011-12)

Reason for delayed physiotherapy clearance	Number of episodes		
	THR (n=4)	TKR (n=4)	Total (N=8)
Mobility issues	**2**	**4**	**6/6**
Non-specific slow progress with physiotherapy rehabilitation			
Medical complications	**2**		**2/2**
AF requiring transfer to acute medical facility			
Low blood pressure			

Table 5.15: Reasons for non-physiotherapy related discharge delay for patients with medium risk RAPT score of six to nine (prospective data 2011-12)

Reason for non-physiotherapy related discharge delay	Number of episodes		
	THR (n=5)	TKR (n=9)	Total (N=14)
Medical complications	**2**	**5**	**7/7**
Cardiac complications (CHF)			
Lower limb swelling			
Post-operative confusion/delirium			
Pneumonia			
INR non-therapeutic			
Low haemoglobin, urinary tract infection + blisters around wound			
Acute delirium			
Wound issues	**2**	**3**	**5/5**
Wound ooze			
Organisational issues	**1**	**1**	**2/2**
Awaiting medical review/clearance for discharge			
Awaiting transport home			

Table 5.16: Reasons for delayed physiotherapy clearance for patients with low risk RAPT score of greater than nine (prospective data 2011-12)

Reason for delayed physiotherapy clearance	Number of episodes		
	THR (n=3)	TKR (n=2)	Total (N=5)
Mobility issues	**2**	**2**	**4/4**
Non-specific slow progress with physiotherapy rehabilitation			
Medical complications	**1**		**1/1**
Chest pain and ECG changes			

Table 5.17: Reasons for non-physiotherapy related discharge delay for patients with low risk RAPT score of greater than nine (prospective data 2011-12)

Reason for non-physiotherapy related discharge delay	Number of episodes		
	THR (n=4)	TKR (N=7)	Total (N=11)
Medical complications	**1**	**3**	**4/4**
Febrile			
INR non-therapeutic			
Cardiac complications requiring transfer to acute medical facility			
Organisational issues	**2**	**2**	**4/4**
Awaiting medical review/clearance for discharge			
Patient unable to organise required GP follow over weekend (for Warfarin check)			
Awaiting CT scan (Registrar review noted knee in valgus position)			
Wound issues	**1**	**2**	**3/3**
Wound ooze			

5.3.1 Failure to achieve minimum daily physiotherapy goals

Regression analysis found that no particular post-operative day was predictive of LOS at any level of risk. That is, no specific day of failure to achieve minimum daily physiotherapy goals (as per the clinical pathway) was seen as a critical factor in predicting discharge delay.

Table 5.18: Risk of extended LOS related to failure to achieve minimum daily physiotherapy goals on any particular day where baseline hazard ratio is: failure = 0; non-failure = 1 (prospective data 2011-12)

The day of failure	Hazard Ratio	Std. Err.	95% CI	Z	P
Day 1	1.45	0.517	0.722 to 2.92	1.05	0.296
Day 2	1.15	0.520	0.471 to 2.79	0.3	0.764
Day 3	0.942	0.448	0.371 to 2.39	-0.13	0.900
Day 4	2.22	1.13	0.822 to 6.00	1.57	0.116
Day 5	1.79	0.677	0.853 to 3.76	1.54	0.124

As expected, patients who did not achieve minimum daily physiotherapy gaols on any two or three days were more likely to experience discharge delay (statistically significant) compared to zero or one days off pathway. See Table 5.19.

Table 5.19: Risk of discharge delay related to the total number of days failing to achieve minimum daily physiotherapy goals (prospective data 2011-12)

Number of days off pathway	Hazard Ratio	Std. Err.	95% CI	Z	P
0-1	1	(base)			
2-3	4.18	1.89	1.72 to 10.13	3.16	0.002*
>3	3.58	1.59	1.50 to 8.53	2.88	0.004*

* Significant p <0.05

The percentage of patients who failed to achieve minimum daily physiotherapy goals on each post-operative day according to RAPT score is presented in Figure 5-6.

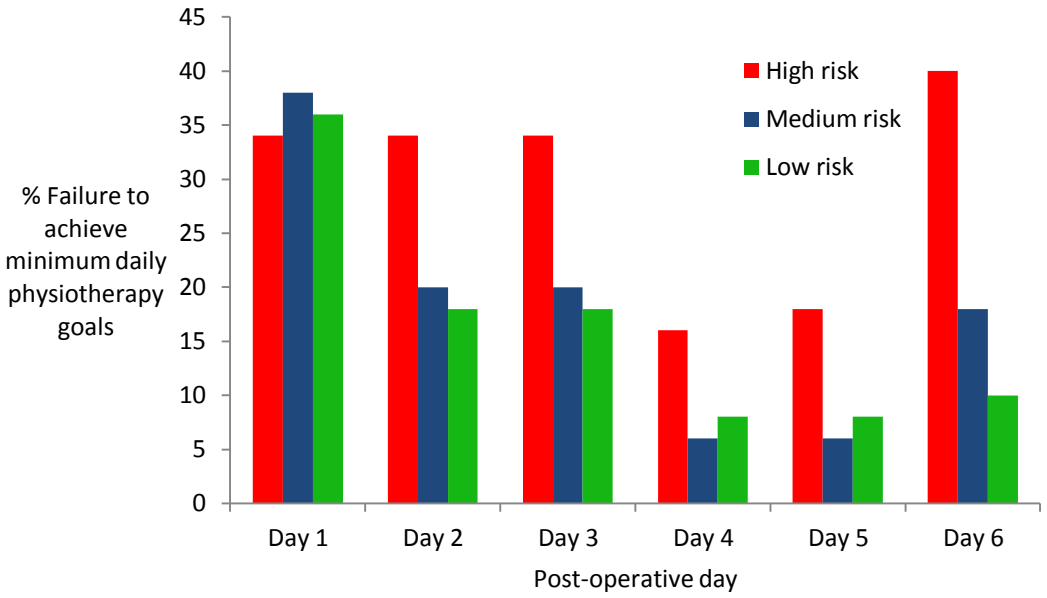

Figure 5-6: Percentage of patients who failed to achieve minimum daily physiotherapy goals on each post-operative day according to RAPT score (prospective data 2011-12)

Although the incidence of high risk failure was greater on each post-operative day, no significant difference was found between high, medium and low risk until day six, at which point those at high risk were found to be 2.2 times more likely to fail compared to medium risk (95% CI: 1.12 to 4.40), and 4.0 times more likely to fail compared to low risk (95% CI: 1.63 to 9.82).

5.3.2 Reasons for failure to achieve minimum daily physiotherapy goals

Examination of the reasons for failure to achieve minimum daily physiotherapy goals as described in the Research Methods section are detailed in Table 5.20 in order of prevalence. Note "general poor mobility" referred to patients who did not achieve the mobility goals for that day, or were not deemed independent with mobility goals as expected for that day.

Table 5.20: Reasons for failure to achieve minimum daily physiotherapy goals on each post-operative day (prospective data 2011-12)

Post-op Day	Reason for failure to achieve minimum daily physiotherapy goals	THR	TKR	Total
Day 1	Motor block (due to epidural or peripheral nerve block)	3	25(*)	28
	Hypotension/dizziness	7	6	13
	Pain issues		6	6
	Confusion/anxiety/agitation	2		2
	Wound issues (medical team request strict bed rest)		1	1
	Nausea/vomiting		1	1
	Low haemoglobin	1		1
	Pre-operative disability (hemiplegia)	1		1
	Cardiac complications	1		1
Day 2	Pain issues	2	6	8
	Hypotension/dizziness	4	1	5
	Nausea/vomiting	1	3	4
	Motor block (due to epidural or peripheral nerve block)	2	1	3
	Pre-existing disability	2	1	3
	Cardiac complications	2	1	3
	Low haemoglobin		3	3
	Confusion/anxiety/agitation		2	2
	General poor mobility	2		2
	Wound issues (medical team request bed rest)		1	1
	Weekend physiotherapist did not mobilise as PCA still in situ		1	1
	Patient too short to safely stand out of bed, awaiting special bed		1	1
Day 3	General poor mobility	6	12	18
	Pain issues	2	2	4
	Hypotension/dizziness	2	2	4
	Nausea/vomiting	1	2	3
	Cardiac complications	1	2	3
	Confusion/anxiety/agitation	1		1
	Low haemoglobin	1		1
	Pre-existing disability	1		1
	Epidural in situ (on-going associated sensory/motor dysfunction)		1	1
Day 4	General poor mobility	2	5	7

	Cardiac complications	2	1	3
	Pre-existing disability	1	1	2
	Pain issues		1	1
	Confusion/agitation/anxiety	1		1
	Epidural in situ (on-going associated sensory/motor dysfunction)		1	1
Day 5	General poor mobility	5	4	9
	Pain issues		2	2
	Cardiac complications	1	1	2
	Hypotension/dizziness		1	1
	Nausea/vomiting	1		1
	Pre-existing disability	1		1
Day 6	General poor mobility	13	15	28
	Cardiac complications	2	3	5
	Pre-existing disability	1		1

(*) P<.001, Z=4.16. 1 sample proportion test (z-test) with the null hypothesis at 50%. All other comparisons non-significant. Zero incidence not compared.

5.4 Summary of key retrospective findings

- Of TJR episodes in the retrospective cohort, 44.3% did not achieve timely discharge as per the existing clinical pathway.
- Of TJR episodes audited, 24.8% did not achieve physiotherapy clearance for discharge on post-operative day six or earlier, which was associated with 418 days of extra inpatient stay.
- The most prevalent reason for delayed physiotherapy clearance for discharge (51%) was non-specific slow progress with physiotherapy rehabilitation, in the absence of any medical/surgical complications or pre-existing disability.
- Of the TJR episodes that were cleared for discharge from a physiotherapy perspective on or before post-operative day six, 19.5% experienced discharge delay due to non-physiotherapy related issues, which was associated with 213 days of extra inpatient stay.
- The most prevalent reason for non-physiotherapy related discharge delay (48%) was related to the medical monitoring of wound issues.
- Summary of overall reasons for discharge delay in order of prevalence were medical and surgical issues (54.7%), mobility issues (35.2%), administrative/organisational issues (7.3%), social support issues (1.7%), occupational therapy issues (0.6%) and ROM issues (0.6%).
- TKR had more discharge delay days related to the medical monitoring of wound issues relative to THR.

- High risk RAPT score and BMI provided the highest likelihood that a patient will experience discharge delay. High risk RAPT score and age provided the highest likelihood that a patient will experience delayed physiotherapy clearance for discharge.
- Older age and high BMI when combined with high risk RAPT score increased the likelihood of discharge delay the most (3.4 and 11.4 times respectively). Older age increased the likelihood for delayed physiotherapy clearance the most (LR of 5.6).

5.5 Summary of key prospective findings

- No particular post-operative day was predictive of discharge delay at any level of RAPT risk.
- Patients who did not achieve daily physiotherapy targets on any two or more days were likely to experience discharge delay.
- Patients with a high risk RAPT score failed to achieve minimum daily physiotherapy goals on post-operative day six more frequently than patients with a medium or low risk RAPT score.
- Failure to achieve minimum daily physiotherapy goals in the first two post-operative days was most frequently related to medical issues such as epidural motor block, regional block, and low blood pressure.
- Failure to achieve minimum daily physiotherapy goals from post-operative day three to six was primarily related to mobility issues.
- The only statistically significant difference between TKR and THR for failure to achieve minimum daily physiotherapy goals was motor block on post-operative day one, with TKR having significantly more failures than THR.

CHAPTER 6. DISCUSSION

6.1 Introduction

The results of this study provide an interesting insight into the impact that physiotherapy service provision, as well as other hospital processes such as clinical pathways, can have on the patient journey and inpatient LOS following elective TJR surgery. Importantly, these processes are all amenable to change. Royal Perth Hospital (RPH) prepared for a comprehensive service restructure in 2014 and work commenced on developing an evolved model of care for elective joint replacement surgery that was more efficient, effective and patient centred than the existing model. The findings from this research were key in identifying aspects of the clinical pathway that were inefficient resulting in potentially unnecessary hospital stay. These findings, their clinical implications and recommendations for further research are detailed in this section.

6.2 Research findings

In this study the median LOS was six days for the retrospective data from 2010. This was consistent with the national average (13) as well as with other institutions reported in the literature (5, 7). Despite the existence of a clinical pathway aiming for discharge on post-operative day six or earlier, only 55.7% examined retrospectively actually achieved this, meaning that just under half of all the episodes of TJR examined fell off the clinical pathway resulting in extended LOS. This is consistent with the prospective analysis with only 32% of those at high risk of extended LOS (as assessed by the RAPT), 56% of those at medium risk and 68% of those at low risk being discharged on post-operative day six or earlier. On face value this would indicate that the clinical pathway is not realistic or achievable for many patients undergoing a TJR procedure. However, closer examination of the reasons for extended LOS, reveal several thematic issues which warrant further investigation and are potentially amenable to systems change.

6.2.1 Delayed physiotherapy clearance for discharge

The results of this study indicate that physiotherapy service provision can itself be a major cause of delayed discharge following TJR surgery. The potential for sub-optimal clinical management and sub-optimal clinical decision making must be acknowledged, in the context of existing hospital processes and clinical pathways that may not support physiotherapy clinicians in facilitating timely discharge. The possibility of physiotherapy

service provision being a direct cause of delayed discharge from hospital has not been considered in the literature to date. As previously described, despite general acceptance of post-operative physiotherapy, no evidence based clinical guidelines for physiotherapy rehabilitation post TJR surgery currently exist. During the data collection period, the physiotherapy discharge goals at RPH were based on expert opinion and the decision as to when these targets had been met was made by the treating physiotherapist based on their clinical judgement. As per the clinical pathway, no patient could be discharged without physiotherapy clearance. Almost 25% (100 episodes of TJR) of all patients examined retrospectively did not achieve timely discharge as a result of failing to achieve physiotherapy discharge goals. This supports previous retrospective work by Williams et al (7). Thirty-six episodes of physiotherapy discharge delay were associated with major medical or surgical complications such as respiratory failure or post-operative foot drop which resulted in slow or delayed rehabilitation. Rehabilitation delay in these cases is understandable and potentially unavoidable. In twelve episodes of physiotherapy discharge delay, pre-existing disability, such as hemiplegia and dementia were cited as primary reasons for slow rehabilitation. Again, in these cases, the impact of a major joint operation adding to the pre-existing burden of disability, may have made extended LOS unavoidable, despite the fact that these individuals were coping at home pre-operatively. However, 51 episodes of delay were due to non-specific slow progress with physiotherapy rehabilitation in the absence of any pre-existing disability or post-operative medical or surgical complications, resulting in 175 days of extended LOS. These findings were consistent in the prospective data, with 71.4% of high risk (RAPT score less than six), 75% of medium risk (RAPT score six to nine) and 80% of low risk (RAPT greater than nine) episodes of physiotherapy discharge delay being due to non-specific slow progress with physiotherapy rehabilitation.

Closer prospective examination of why patients failed to achieve minimum daily physiotherapy goals revealed that in the first two post-operative days, the main reasons for failure were related to medical and pain management issues, such as motor block caused by epidural or regional blocks, hypotension/dizziness, nausea and vomiting and suboptimal pain management. This is supported by previous research by Husted et al (16) who found that pain, dizziness and general weakness were responsible for delayed discharge in a cohort described as unselected (i.e. no exclusion criteria) where almost 80% of patients were discharged within two days and almost 100% discharged within three days. Similarly Gulotta et al (20) found that pain, nausea and dizziness were the main barriers to a two day

discharge in a cohort with an average LOS of 2.6 days. The results reported in this thesis show that from post-operative day three onwards the most prevalent reason for failure to achieve daily physiotherapy goals was general poor mobility. As the primary goals on these post-operative days are to achieve independence in walking and other mobility tasks, this means that the treating physiotherapist did not deem the patient independent in these tasks, and therefore not ready for discharge as per the clinical pathway.

This raises questions about the efficiency of the clinical pathway and specifically the physiotherapy discharge goals. It could be argued that the 175 days of extended LOS in the absence of pre-existing disability or post-operative medical complications were unavoidable to ensure patient safety on discharge. However, Husted et al (10) comparing institutions with short and long LOS found that the institutions with longer LOS had additional discharge criteria regarding mobilisation or ROM which negatively affected LOS. Other recent research also tells us that two to three day discharge is achievable for patients who do not suffer post-operative complications (5, 16, 20) without an increased rate of post discharge adverse events.

It is clear that suboptimal pain management may result in undesirable side effects in post-operative patients, which may then result in reduced ability to participate in physiotherapy and rehabilitation goals. Certainly this is a topic that warrants ongoing review and research as it is clear that issues relating to pain management, such as nausea, drowsiness, suboptimal pain relief, and neurological deficits relating to epidural and peripheral nerve blocks, have an impact on patient post-operative rehabilitation. In this study aiming for a six day LOS, these factors were mainly found to be an issue on the first two post-operative days. As previously described, a clinical audit undertaken at Royal Perth Hospital in 2009 found that patient inability to stand or mobilise on the first post-operative day as a result of epidural or regional block induced ‘motor block’ was not related to discharge delay, indicating that this iatragenic factor, once resolved, allowed the patient to ‘catch up’ with the clinical pathway and discharge in a timely fashion (i.e. on post-operative day six or earlier). However, recent published work suggests that early physiotherapy and mobilisation on the day of or after surgery is related to reduced LOS (31, 52). Therefore, for health care facilities aiming for discharge earlier than day six, factors such as motor block could have an impact on patients who might otherwise have a shorter non-complicated stay. These issues are emphasised in the literature in studies looking at barriers to two day LOS (16, 20)and were discussed by Husted et al (16) who recommended more intensive

multimodal non-opioid pain management. It is clear that pain management strategies have an impact on patients' participation in daily physiotherapy. Reducing the incidence of inadequate pain relief, nausea and drowsiness and neurological deficits related to pain management strategies will have a considerable impact on overall hospital LOS and warrants ongoing review of best practice.

The literature suggests that earlier and increased physiotherapy intervention may reduce patient LOS following TJR surgery (21, 25, 26, 31, 52). Certainly, this study indicates that physiotherapy has an impact on patient LOS and that failure to achieve physiotherapy goals is a cause of extended LOS. In the current economic environment, employing more staff is not the answer to reducing unnecessary discharge delay. Hospitals need to focus on restructuring available resources in a way that facilitates early discharge, including focused pre-operative patient education aimed at empowering patients to *choose* early discharge over a longer stay (22, 32, 33), day of surgery physiotherapy intervention (31), and optimisation of community service providers such as HITH and RITH.

It would appear based on the results of this study that physiotherapy service provision is indeed a key factor impacting on hospital LOS and also a clear cause of discharge delay for a considerable number of patients following TJR surgery. Clinical pathways that better support optimal clinical decision making are warranted to reduce unnecessary hospital stay relating to inefficient physiotherapy targets or sub-optimal clinical decision making.

6.2.2 Non-physiotherapy related discharge delay

As per the clinical pathway, 75.2% of episodes of TJR examined retrospectively were ready for discharge from a physiotherapy perspective on post-operative day six or earlier. However, only 55.7% of episodes were actually discharged within six days, meaning that 19.5% of patients fell off the clinical pathway due to other non-physiotherapy related reasons.

Excluding the 63 episodes of discharge delay attributed to failure to achieve physiotherapy targets (including those with pre-existing disability), the remaining 116 episodes of retrospective TJR experienced some kind of non-physiotherapy related issue resulting in 511 days of extended LOS. This includes episodes of delayed physiotherapy clearance for discharge where a non-physiotherapy factor (such as a medical complication), had a direct impact on a patient's ability to participate in rehabilitation. Ninety eight

episodes of delay were cited as being due to medical issues or surgical complications, such as DVT and UTI requiring medical investigation, management and monitoring. Therefore it could be argued that these delays were unavoidable from a medical perspective. Forty four episodes of delay were due to wound issues such as cellulitis and blisters. Thirty of these were described as being due to non-specific “wound ooze”, in the absence of other wound issues such as cellulitis, requiring on-going monitoring. The clinical pathway at Royal Perth Hospital has specific guidelines with regards to patient discharge with wound ooze (see Table 2.2 in the Research Setting). Specifically, patients who are afebrile with minor serous wound ooze not associated with cellulitis are acceptable for discharge with HITH. HITH will provide daily dressings and wound review in the home environment and have the responsibility of contacting the relevant registrar immediately with any concerns. Routine outpatient clinic follow up is also organised one week after discharge. Could the medical teams have utilised these services more effectively to decrease the amount of discharge delay? Interestingly no other studies reviewed in the literature cited wound ooze as a barrier to discharge. Furthermore, the literature has found that reducing hospital LOS does not result in an increase in re-admissions, complications or infection (5, 6, 9, 15-17, 19), and that HITH is associated with reductions in mortality and readmission rates (24). Certainly, the consequences of missing a post-operative joint infection could be catastrophic making the decision a difficult one for the individual doctor and potentially contributing to the 139 days of extended LOS attributed to monitoring wound issues. However, most peri-prosthetic infections are not detected during the acute inpatient period anyway, as shown by Pulido et al (53). These findings indicate that the specific discharge criteria relating to wound status may in fact be hindering timely discharge, in the absence of any real benefit to the patient. It should also be noted that although TKR accounted for 60% of the retrospective cohort, 80% of extended LOS days caused by wound issues involved TKR (statistically significant). Perhaps some, if not most of this increased wound ooze was directly related to the aggressive knee ROM exercises performed post-operatively, which involve direct movement and stretch to the surgical wound. These findings indicate that ongoing review of discharge criteria relating to post-operative wound monitoring, and whether HITH could be more effectively utilised to ensure more timely discharge for patients with wound ooze, is warranted. Further research into post-operative wound ooze from a medical management perspective would also be beneficial.

Other non-medical causes of discharge delay were more systems related and emphasise the importance of timely review by the relevant health care professional to

ensure timely discharge, that is “the right person, providing the right service, at the right time”. Twelve episodes of delay (resulting in 18 days of extended LOS) were due to organisational issues such as awaiting medical review and clearance for discharge, or awaiting transport home. Both of these delays could easily be avoided with more effective and pro-active communication between staff as well more effective communication of discharge expectations to patients and their families/carers. Three episodes of delay (resulting in three days of extended LOS) were due to social support issues and could be avoided with earlier recognition and more pro-active implementation of support services on discharge. One episode of delay (resulting in one day of extended LOS) was due to non-compliance with hip precautions with occupational therapy car transfer, and could potentially have been prevented by earlier OT intervention and training. Although seemingly small when considered individually, these delays represent systemic inefficiency that is both unnecessary, costly and of no benefit to the patient.

6.2.3 Predictive factors for extended LOS and physiotherapy clearance for discharge

Identifying factors that are associated with an increased risk of extended LOS is useful in a pre-operative environment for planning hospital bed management. For these factors to be useful they must be easy to assess in a pre-operative environment e.g. age and BMI. Examining factors relating specifically to physiotherapy clearance for discharge may reflect their impact on the ability to achieve physiotherapy rehabilitation goals. This aspect of the post-operative period has never been examined from this perspective before.

As expected, this study found that the RAPT was predictive for extended LOS. In fact those at high risk (RAPT score less than six), were 2.6 times more likely to have extended LOS than those not at high risk. This supports previous work validating the RAPT as predictive of extended LOS (33, 54). From a physiotherapy specific perspective, those at high risk were found to be 3.6 times more likely to have delayed physiotherapy clearance for discharge. These results show that the RAPT can be a valuable tool for use in dedicated elective joint replacement units for the purpose of facilitating appropriate pre-operative planning and post-operative targeted care and physiotherapy. They also indicate that high risk RAPT score, as a measure of pre-operative patient function and social support, has a relationship with a patient’s ability to comply with post-operative physiotherapy goals.

Patients with a BMI of greater than 38 kg/m² (high end obesity and morbid obesity categories as per WHO classification) were 2.7 times more likely to have extended LOS than

those those with a BMI of less than 38 kg/m², supporting previous published work finding BMI to be related to longer hospital LOS (41, 45, 46, 48). This means that patients who are morbidly obese have the same risk for extended LOS as those with a high risk RAPT score and can be quickly and easily identified as being at high risk of extended LOS based on this factor alone. Fifty-three (13.1%) episodes of TJR examined retrospectively had a BMI of 38 kg/m² or greater. This is a relevant finding as the incidence of obesity and indeed morbid obesity continues to rise. Interestingly, BMI was not a significant predictor of delayed physiotherapy discharge. This may indicate that obesity in and of itself does not have an impact on a patient's ability to achieve physiotherapy rehabilitation goals in a timely fashion, but does have an impact on non-physiotherapy related causes of delay such as medical complications and wound issues. This is supported by Amin et al (45) who found a significant increase in post-operative complications in the morbidly obese. Sadr Azodi et al (46) and Parvizi et al (41) also found an increased risk of post-operative complications with increasing BMI.

Patients with a high ASA score and patients with cardiac comorbidity were almost twice as likely to have extended LOS and delayed physiotherapy clearance for discharge compared to those without. This indicates that these factors, as measures of comorbidity in patients, may have an impact on a patient's ability to participate and progress in rehabilitation processes, perhaps due to medical complications which have been shown in the literature to be related to increased LOS (5, 21, 38, 39, 43). However, it is acknowledged that with LRs below two, this interpretation must be made with caution. Diabetes was not found to have a statistically significant association with LOS. Existence of other comorbidities investigated in this study (hypertension and hypercholesterolaemia), although significant were unlikely to result in delayed discharge with likelihood ratios well below two.

Age greater than 72.4 years was found to be 1.6 times more likely to have extended LOS and 2.2 times more likely to have delayed physiotherapy clearance for discharge compared to those younger suggesting that as expected, older age impacts on the speed of recovery of mobility and function following a major operation more than in younger patients.

The results of this study show that the RAPT is an even stronger predictor of delayed physiotherapy clearance for discharge indicating the impact of pre-operative function and patient social support on achievement of post-operative physiotherapy goals.

6.2.4 Improving the predictive capacity of the RAPT

One of the aims of this study was to determine whether the predictive capacity of the RAPT could be increased by examining it in combination with comorbidity. As described previously, in this study a high risk RAPT score of less than six was associated with 2.6 times more risk of extended LOS. In general, there was a large increase in risk when the selected variables were considered with high risk RAPT compared to when they were considered individually. However, for most of the variables the combined risk was not greater than the risk for a RAPT score of less than six by itself, providing no advantage to clinical planning.

Age over 72.4 years when considered with a high risk RAPT score was associated with 3.4 times more risk of extended LOS and 5.6 times more risk for delayed physiotherapy clearance for discharge compared to those younger. This is greater risk than a high risk RAPT score on its own and has implications for clinical practice as the population ages.

When combined with high risk RAPT score, BMI of 38 kg/m² or greater was associated with more than eleven times greater risk of discharge delay. Only seven episodes of TJR fit both these criteria, meaning these findings were only clinically relevant for a small proportion of patients. However, given that life expectancy is increasing and the incidence of obesity and indeed morbid obesity is also increasing, these results are an important consideration for the future.

The results of this study identify patients with a high risk RAPT score and who are also older than 72.4 years or morbidly obese as being at greater risk of extended LOS following elective TJR surgery. The older patients are also more likely to struggle with physiotherapy rehabilitation goals.

6.2.5 Prospective analysis of failure to achieve minimum daily physiotherapy goals

Daily review of patient compliance with physiotherapy goals during the post-operative period has not been reported in the literature previously. This research found that no particular post-operative day was predictive of LOS at any level of risk. Certainly on post-operative day one the primary reason for failure to achieve daily physiotherapy goals was

neurological deficit due to epidural or regional blocks. Not surprisingly, this affected TKR to a greater extent than THR (TKR accounted for 54% of the prospective cohort yet over 89% of total patients failing to achieve physiotherapy goals on post-operative day were TKR), reflecting the effect of regional blocks on the knee region and the ability to safely stand on that limb. As these interventions were ceased and their temporary effect on muscle function resolved, this issue reduced by 90% on post-operative day two and was not a factor at all by post-operative day three. Patients who underwent TKR also fell off the pathway more frequently on post-operative day two due to pain (75% of failures due to pain) and on post-operative day three due to general poor mobility (66% of all failures due to poor mobility), however none of these differences were statistically significant. For all other reasons and on subsequent days the incidence of failure between THR and TKR was much the same. These results show there are still improvements to be made in terms of optimal pain management strategies in the first two days post operation as previously discussed.

The data does show that if patients do not achieve daily physiotherapy targets on any two days they are very likely to have an extended LOS. As a very gross measure of patient progress, this information is intuitive, has limited clinical relevance and would not be an efficient method of determining when and how physiotherapy services are best utilised.

Interesting results from the study showed that patients with a high risk RAPT score were much more likely to fail to achieve minimum daily physiotherapy goals on post-operative day six compared to those at medium and low risk. In fact, this was the only day to show significant differences between the levels of risk. Failure for those at high risk on day six also represented a sudden increase in failures compared to day five. As a reflection of patient pre-admission function and social status, this dramatic rise in failures on post-operative day six is probably less related to specific failure to achieve daily physiotherapy targets (especially as many of those who failed on day six were not failing on day five) and more related to other confounding factors, such as clinician reluctance to discharge a patient whose mobility is suboptimal (despite the fact that their RAPT score indicates a pre-existing level of suboptimal mobility), or lack of appropriate supportive services in the home environment, again creating a lack of clinician confidence in discharging the patient home.

The results of the prospective phase of this study show that after post-operative day two the most prevalent reason for failure to achieve daily physiotherapy targets is related to mobility specific issues. It also shows that patient failure to achieve physiotherapy goals is greater on the final day of the clinical pathway which is likely a reflection of the physiotherapist's reluctance to discharge. These findings highlight the impact that individual clinical decision making can have on hospital LOS and the need for clinical pathways that more effectively and objectively support clinical decision making with regards to timely patient discharge.

6.3 Research hypotheses

The retrospective hypotheses for this study were as follows:

H_1: Delays in achieving physiotherapy related rehabilitation goals will be the most prevalent reason for discharge delay following TJR surgery.

H_2: The presence of comorbid diseases and a high risk RAPT score will significantly increase the risk of discharge delay.

Regarding **H_1**, 100 episodes of TJR experienced discharge delay due to delayed physiotherapy clearance for discharge, and 79 episodes experienced discharge delay after physiotherapy clearance due to non-physiotherapy related discharge delay. Thus **H_1** was supported. However, 37 episodes that experienced delayed physiotherapy clearance were related to medical or surgical complications (e.g. pulmonary embolus) which directly resulted in reduced participation in physiotherapy rehabilitation. If these episodes are grouped with the other medical and surgical complications (resulting in non-physiotherapy related discharge delay) it means the most prevalent reason for discharge delay was actually related to medical and surgical complications.

Comorbidity when considered with a high risk RAPT score increased the risk of extended LOS, thus supporting **H_3**. Morbid obesity had a LR that would be considered as having a profound influence on the probability of delayed discharge (however, with low sensitivity). Older age was also found to have considerable probability, with better sensitivity compared to increased BMI.

The prospective hypotheses for this study were as follows:

H_1: Failure to achieve minimum physiotherapy goals on a specific post-operative day will be predictive of overall discharge delay;

H_2: The reasons for and prevalence of failure to achieve minimum daily physiotherapy goals will be different for TKR and THR;

H_3: Patients at high risk of discharge delay (as per RAPT score) are more likely to fail to meet minimum daily physiotherapy targets on each post-operative day.

H_1 was not supported by the results of this study as no particular day was found to be predictive of falling off the clinical pathway.

Failure to achieve daily physiotherapy goals due to motor block caused by epidural or regional anaesthetic techniques on post-operative day one was more prevalent following TKR compared to THR, supporting **H_2**.

The only day on which patients with a high risk RAPT score had a higher prevalence of failure to achieve minimum daily physiotherapy goals compared to medium and low risk was post-operative day six, therefore proving **H_3** to be unsupported.

6.4 Implications for clinical practice

This study was observational and its considerable limitations are acknowledged. However, it does provide a fascinating and comprehensive "snapshot in time" of a reputable, high throughput public tertiary hospital elective TJR service. This point prevalence snap shot of data provided valuable insight into aspects of the service which are modifiable or have potential to function more optimally. This information was key in the development of a new and improved model of care for this service on it's transition to the acute campus in 2014.

As discussed, physiotherapy service provision as a direct cause of discharge delay has never been reported before. The results around non-specific failure to achieve physiotherapy goals and medical (specifically wound) monitoring resulting in extended LOS tend to reveal a culture of conservatism with regards to discharge criteria, from both a physiotherapy and non-physiotherapy perspective. It is understandable that clinicians may decide to err on the side of caution when making decisions about a patient's safety or appropriateness for discharge. In a litigious society, this cost/benefit analysis made by clinicians on a daily basis may often swing in favour of delaying discharge (no immediate

detrimental outcome, no incentive) versus discharging (perceived potential detrimental outcome for patient and subsequent clinician reluctance to make final decision for discharge). However, when we consider the impact of 'culture' on hospital LOS consider the average LOS of 35 days in Japan (28). Increasing evidence that LOS can be achieved safely in two to three days for many patients (5, 16, 20) increases the pressure on hospitals to create and implement clinical pathways that more effectively direct clinician decision making to ensure timely discharge. Of course, LOS 'culture' also reflects financial pressures and many changes in this regard have undoubtedly been and will continue to be driven by the funding of the health system itself. This means that as competition for resources continues to increase, any reduction in unnecessary discharge delay will mean more access to healthcare for all individuals supported by that system. This study advocates for rigorous review of current clinical pathways based on the growing evidence base for shorter LOS.

6.4.1 Creating an expectation of short LOS

Every day that a patient spends in hospital is costly to the health system and to the population who need access to that particular service. It is also costly to the patient in terms of wellbeing, reduced productivity and increased risk of hospital acquired complications. Across all medical specialties there is an increasing awareness of the need to reduce or eliminate unnecessary time spent in hospital.

Many minor elective surgical procedures involve patients being discharged on the day of or the day following surgery. Patient discharge in these cases is timely and efficient because it is expected, and appropriately planned for by the patient and their family/carers and the hospital staff. Discharge delay in these cases is rare and generally only occurs if there is a medical complication. Total joint replacement of the hip or knee involves longer, more complex operative and anaesthetic procedures compared to these minor elective procedures. However, it is not unreasonable to aim for consistent achievement of short LOS (i.e. three days) in the absence of acute post-operative medical complications. For this to occur, a culture of early discharge would need to be fostered based more around medical fitness for discharge, rather than meeting highly specific mobility based criteria. Particularly for those patients who have someone at home who can assist them (a factor assessed on the RAPT), mobility targets should be tailored to their level of support. The expectation that rehabilitation and full functional recovery occurs in the home environment with community health service support needs to be normalised, and patients empowered to take responsibility for achieving rehabilitation goals in their own best interest as part of

consenting to the procedure. The physiotherapy role in the acute setting should be focussed on giving patients ownership of their own recovery and rehabilitation, motivating them and organising appropriate community follow up. This would also need to involve a cultural shift towards increased patient autonomy (where appropriate) with regards to rehabilitation, rather than patient reliance on one-on-one didactic physiotherapy guided rehabilitation.

Creating an expectation of short LOS needs to start in the pre-operative setting and it needs to be reinforced by all members of the health care team, especially the surgeons/medical consultants. Specific education in the pre-operative setting should be aimed at empowering patients to "choose" early discharge over a longer hospital stay. Clinical pathway design would need to reflect this expectation, supporting staff to facilitate timely discharge. This approach is supported by previous research findings (22, 32, 33) that patient preference has a significant impact on discharge destination (i.e. home or to a rehabilitation facility for ongoing inpatient care). If a specific discharge date was decided on, all involved including the patient and their family, would work towards achieving this. This approach would also eliminate discharge delay relating to awaiting medical review, or family members being available to assist.

6.4.2 Community based wound monitoring

Given the large proportion of discharge delay attributed to wound monitoring, further research in this area is needed to ascertain whether delaying discharge to monitor wound issues is clinically useful in prevention or early detection of post-operative complications. Review of the discharge criteria with regards to wound status, and a review of compliance with these criteria, has the potential to reveal that HITH wound management services could be more effectively utilised without any increase in adverse outcomes for patients. Effective communication between inpatient and dedicated HITH 'wound specialists' could facilitate more timely discharge of patients with wound issues more appropriately managed in the community setting rather than the tertiary hospital environment. Further research in this area is needed to support this from an evidence based perspective. In addition, further research into the incidence and cause of post-operative 'wound ooze' is warranted.

6.4.3 Predicting length of stay

This study advocates for the ongoing pre-operative use of the RAPT and the identification of specific comorbidity to assist with the discharge planning process.

However, rather than focusing on identifying patients likely to have extended LOS (and thus reinforcing this belief with staff and patients), RAPT scores should be used to facilitate shorter LOS by modifying and resolving barriers to discharge identified by the tool. This process should be initiated in the pre-operative period to avoid set up delays post-operatively e.g. identification of the need for specialised equipment, home modifications or assistive services. It is essential that this approach also involves the patient and their family/carers in this 'patient centred' discharge planning process which includes agreeing upon a specific discharge date. A pre-operative case manager/coordinator should be responsible for communicating this agreement with all members of the health care team to ensure this discharge date was reinforced by all relevant staff, and to ensure that HITH/RITH and any other assistive services would be ready to commence as per the planned discharge date. All relevant staff, including medical, nursing and allied health, would be aware from admission when the patient was due for discharge and would be encouraged to reinforce this information regularly. A chart system above patient beds could be utilised, with each patient's daily goals and planned discharge date clearly visible. Planning around patient pick up for discharge would need to be specific to prevent delays in transport availability. In addition a 'transit lounge' area should be utilised for those patients where variance between ward discharge and pick up time is unavoidable. These changes could be very easily implemented and evaluated with minimal increases in cost.

The results of this study show that patients with a RAPT score of less than six who are older than 72.4 years or have a BMI greater than 38kg/m² have a higher risk of non-physiotherapy related delays such as wound and medical issues. These patients could be identified and flagged to medical staff in the pre-operative assessment clinic setting for more rigorous post-operative monitoring and early identification of issues that could be managed with HITH services.

6.5 Limitations of the study

This study is entirely observational thus is limited by its methodology. Potential for significant bias during prospective observation and data collection is recognised as a considerable weakness of this study. As discussed in detail in the Research Methods, both the research and treating physiotherapists were aware and directly involved in patient treatment and data collection which may have influenced their practice. The lack of blinding and associated potential for bias to present physiotherapy in a more or less favourable light is acknowledged. Additionally, the considerable gap in time between

completion of data collection for the high risk cohort (compared to the low and medium risk cohorts) represents a further opportunity for the introduction of bias into the study design, with the potential for evolution of practice and learning during this time.

It is also acknowledged that the likelihood ratios (LR) presented in both the retrospective and prospective phases of the study are quite low, impacted by the low sensitivity of many of the variables analysed. Only high risk RAPT score with BMI above critical threshold achieved a LR greater than ten which may be interpreted as being able to "generate large and often conclusive shifts in probability" Jaeschke et al (55) (1994). Other factors, such as RAPT score less than six, were 3.6 times more likely to have delayed physiotherapy clearance. However, this was mainly influenced by the higher specificity rather than sensitivity of the RAPT. Therefore, the value of these data perhaps relates more to identifying those who are less likely to experience delayed physiotherapy clearance or delayed discharge rather than 'predicting' who will.

Another limitation of this study is its applicability to other institutions nationally and internationally. The clinical pathway and systems in situ at Royal Perth Hospital may differ from those at other institutions.

Despite the important limitations of this study, it is hoped that the findings, particularly the confirmation of physiotherapy service provision as a direct cause of discharge delay following TJR surgery (given the consistency of post-operative management reported in the literature), are worthwhile in the context of providing best practice in a hospital setting.

6.6 Recommendations for future research

It is not always realistic to change the characteristics of patients that present for surgery. If health care systems are motivated towards reducing unnecessary discharge delay, reconsideration of current clinical pathways and discharge criteria is warranted. This means creating clinical pathways and discharge criteria that facilitate short LOS and discharge from hospital as soon as medically fit, with a focus on giving patients responsibility for their rehabilitation goals in the home and community setting. Based on this, a recommendation for future research is to implement changes to clinical practice, and continue to examine and investigate barriers to discharge and causes of discharge delay in a constantly evolving environment. A prospective study of discharge outcomes following implementation of these recommendations would provide interesting results against the

premise that hospital stay is a direct result of systems, culture and both staff and patient expectations. Qualitative research identifying staff and patient beliefs, expectations and behaviours around hospital LOS in the TJR setting would also be valuable.

Further research into the relationship between wound ooze and infection rates, and the characteristics of those who develop infection would allow for easier identification of those patients more appropriate for discharge with HITH follow up. Ideally, a trial where all patients with wound ooze are routinely discharged home with HITH follow up would be implemented, and incidence of re-admission and adverse events identified. This would potentially require review of current HITH staffing and service provision practices. Further research into the causes of wound ooze, reasons why it is greater in some patients compared to others, and medical and surgical techniques to prevent or reduce it, is warranted given its association with costly discharge delay.

This study provided some interesting results with regards to morbid obesity and increased risk of extended LOS, particularly when considered in combination with the RAPT. Given the small proportion of patients who fit this criterion in the study, a larger prospective study is recommended to validate these results.

As previously described, there are no evidence based guidelines for physiotherapy management post TJR surgery. However, as hospital LOS gets shorter the time spent with a physiotherapist in the inpatient setting is limited. Further research into the impact of earlier discharge is recommended. This may indicate the need for increased investment in the provision of community and home based physiotherapy services.

6.7 Summary

This research has been the first to retrospectively and prospectively examine the TJR inpatient rehabilitation period in such depth from a physiotherapy perspective. It is the first to report physiotherapy service provision as a direct cause of discharge delay from hospital. It is also the first to identify the variance between discharge from a physiotherapy perspective (based on achievement of physiotherapy rehabilitation goals) and actual discharge (being the day the patient leaves the hospital). By identifying the various physiotherapy and non-physiotherapy related reasons for discharge delay, several important factors amenable to systems change were identified. This information was invaluable in developing an evolved model of care for the new elective TJR service at RPH,

the implementation of which is detailed in the next chapter of this thesis. Overall, this study emphasises the impact of hospital systems and processes on hospital LOS and recommends rigorous ongoing quality improvement processes in order to continue to work towards reducing unnecessary costly hospital stay.

CHAPTER 7. IMPLEMENTATION

7.1 Introduction

Full retrospective and prospective data collection and collation for this thesis was completed by the end of 2012 by the Research Physiotherapist, who continued to work full time as a clinical physiotherapist throughout the completion of this thesis. The collation of results and the majority of the thesis was written by early 2014 and became an essential resource to the Research Physiotherapist who was directly involved in the development of the new elective TJR service clinical pathway for Royal Perth Hospital (RPH).

The opening of the new State Rehabilitation Service at Fiona Stanley Hospital was scheduled for October 2014. RPH began preparing for the closure of its rehabilitation campus including the transition of TJR services to the acute campus in early 2014. This marked the end of a highly-regarded institution with more than 100 years of rehabilitation history. Elective orthopaedic surgery services were redistributed across the Perth metropolitan hospitals. Fifteen of the 28 existing beds were allocated to RPH. The new RPH TJR service commenced with eight beds from October 2014 and in February 2015 an additional seven beds were opened.

The new model of care developed for the new RPH service was based on best practice as described in the literature, liaison with and benchmarking against similar services throughout Australia, as well as the results of this thesis. Four key concepts derived from the results of this research project were considered to have the greatest implications for changing clinical practice:

1. Create an expectation of short length of hospital stay with both patients and clinical staff.
2. Identify high risk patients and resolve barriers to discharge in the pre-admission setting.
3. Reform the clinical pathway, particularly with regards to more flexible discharge criteria and physiotherapy rehabilitation goals.
4. Facilitate community based wound monitoring.

Based on these findings, the primary goal was:

"To achieve a three day hospital length of stay for most patients, during which they receive comprehensive, high quality, multi-disciplinary care that meets their acute, tertiary care needs and facilitates safe return to their home environment."

This was considered to be safe and achievable within existing budgetary and staffing constraints (i.e. no increases in funding or staffing were allocated for the implementation of the new model of care). However it was also a considerable challenge, as this represented a substantial reduction in average LOS from six days and a crucial change to the expectations of the clinical pathway and relevant health profession team members. This chapter details the strategies developed for implementing the new clinical pathway and summarises the results so far.

7.2 Strategies for implementation

The strategies developed and implemented at Royal Perth Hospital in 2014 to achieve the new model of care goals were:

1. Commitment to the new clinical pathway from medical, nursing and allied health teams at Royal Perth Hospital via senior leadership.
    - The implementation of a new model of care and elective joint replacement clinical pathway would not have been possible or successful without the commitment, investment and belief of the key stakeholders. Collaboration with the Head of Orthopaedics Department, the Director of Allied Health, Head of Physiotherapy Department and both ward and PAAS clinic based senior medical, allied health and nursing staff was essential.
2. The development of a new streamlined, intensive physiotherapy clinical pathway (described in detail in section 7.3).
3. Comprehensive pre-admission planning for discharge.
    - Key senior multi-disciplinary staff involved in the pre-admission assessment services (PAAS) clinic were fully briefed on the new clinical pathway prior to implementation. The importance of patients receiving consistent information was emphasised, particularly from the medical staff who have a strong influence on patient behaviour.
4. Seven day service provision.
    - It was considered essential for patients to receive the same service regardless of the day of the week. Key senior medical, nursing and allied health staff were charged with facilitating this within their services.

5. Development of resources advocating the new model of care for both staff and patients.
    - Information resources were developed for patients to take home from the PAAS Clinic. Patient "Daily Goal Setting" posters were also developed to be kept by the patient bed-sides which provide a visual aid to the daily rehabilitation expectations (see Appendix 1).
    - Information resources and treatment guidelines were also developed for physiotherapy staff.
6. Development of clear discharge pathways for patients identified as likely to require a longer hospital stay.
    - The clinical pathway advocates that patients identified as being at risk of requiring longer than a three day hospital stay are flagged early to the treating medical team to facilitate timely transfer to the surgical step-down unit or rehabilitation facility once medically stable. The identification process is facilitated by the PAAS physiotherapist utilising the RAPT score, presence of key factors identified via the research clinical audit (i.e. age over 72.4 years and obesity) as well as a thorough subjective assessment of patients pre-operative functional and social support status. This was considered important from a bed planning and surgical throughput perspective. A clear pathway to the surgical step down unit at Bentley Health Service was established in collaboration with the orthopaedic medical teams for patients requiring longer than three days hospital stay. Patients requiring extended rehabilitation would be reviewed by a rehabilitation physician for transfer to Fiona Stanley State Rehabilitation Service. Other rehabilitation options (such as regional hospitals where appropriate) were to be identified and initiated in the PAAS clinic setting.
    - For the new RPH pathway it was decided to retain referrals to RITH for all discharges prior to post-operative day six to provide confidence for early discharge to the clinical staff.
7. Highlighting the scope of HITH services with regards to community based post-operative wound monitoring with medical staff.
    - The results of this research study were presented to senior medical (including the Orthopaedic Head of Department) and nursing (including Orthopaedic Clinical Nurse Specialist) staff. Medical staff were encouraged to consider early discharge to HITH for all appropriate post-operative patients. However, it was

acknowledged that this decision ultimately remains that of the treating medical team.

8. Comprehensive education regarding the new model of care with key clinical staff.
    - Education focused on fostering the belief that high quality care could be delivered within a shorter hospital stay. The practicalities of how this would work on a day to day basis were mapped and the importance of the rehabilitation ethos and promoting 'wellness behaviour' was emphasised.
9. Thorough post-implementation monitoring and trouble-shooting.
    - Initial post-implementation monitoring allowed for the identification of issues requiring trouble-shooting and working through to achieve a resolution or management strategy. Longer term monitoring and data collection will allow for ongoing evaluation of service provision.

7.3 The new elective joint replacement clinical pathway

Physiotherapy was considered to play a key role in the new model of care. The new physiotherapy clinical pathway that was implemented in October 2014 can be summarised in Figure 7-1 below.

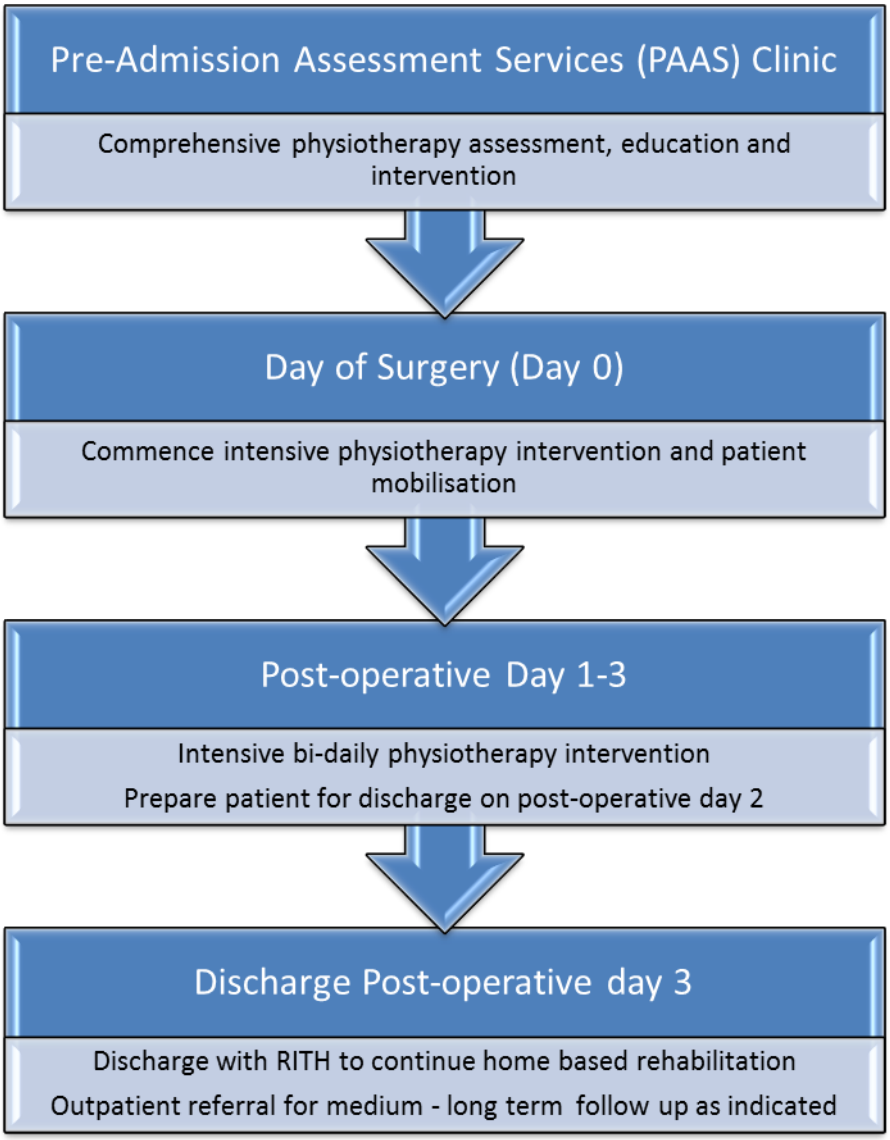

Figure 7-1: Elective TJR physiotherapy clinical pathway (October 2014)

7.3.1 Pre-admission assessment services (PAAS) Clinic

As previously described in the Research Setting section of this thesis, the Elective Services Taskforce developed in 2013 commenced work on improving the quality and efficiency of pre-admission services for patients undergoing elective procedures at RPH. One of the key strategies implemented was the creation of a full time physiotherapy role which commenced in PAAS Clinic in March 2014. It should be noted that this role with filled within existing departmental staffing i.e. this did not represent an increase in FTE (full time equivalent) within the physiotherapy department. This role was essential to the new elective joint replacement clinical pathway. The practice guidelines for the role, developed in collaboration with the PAAS Senior Physiotherapist, are as per Table 7.1. These guidelines

describe current practice and are available as hard and electronic resources for staff at Royal Perth Hospital.

Table 7.1: PAAS Clinic Physiotherapist Guidelines

Elective Joint Replacement Service – PAAS Clinic Physiotherapist Guidelines

General Principles:

- All staff at PAAS Clinic have a role in encouraging an expectation of short LOS based on a non-complicated procedure;
- Existing research suggests that patients who have an expectation of a shorter LOS are more likely to have a shorter LOS than those patients who expect to have a longer LOS. This expectation is potentially modifiable in the pre-operative setting via appropriate education about expected LOS and post-operative service availability if required to support early discharge;
- The goal is for patients to be discharged on post-operative Day 3;
- Day of discharge must be discussed and agreed upon with the patient. Transport on discharge must be discussed and organised.

Assessment:

- All patients undergoing an elective hip or knee joint replacement procedure will attend PAAS Clinic and must be reviewed by the PAAS Physiotherapist;
- All patients will be reviewed in person by the PAAS physiotherapist using the 'Elective Joint Replacement PAAS Clinic Allied Health Screen'. This form is designed to not repeat collection of information that has already been gained via other sources/health professionals, but to specifically focus on issues that will require pre/post-operative intervention to prevent discharge delay following the procedure. Therefore, ideally the physiotherapy review will occur after the anaesthetist review. This form goes into the patients integrated medical records for ease of access by inpatient clinicians;
- The form incorporates the Risk Assessment Prediction Tool (RAPT) which has been validated as predictive of extended LOS for total joint replacement patients at Royal Perth Hospital (RPH). The RAPT Predictor Key on the back of the AHS form gives an indication of a patient's risk of extended LOS and a general management guideline;
- Factors identified as potential a to discharge must be addressed where possible in the pre-admission setting, including referral to appropriate health professionals such as Occupational Therapy or Social Work;
- If barriers to early discharge are identified (e.g. due to pre-existing burden of disability) patients should be flagged for rehabilitation on post-operative day 1 to facilitate timely transfer to a surgical step-down or rehabilitation facility. This information must be handed over from the PAAS physiotherapist to the treating ward physiotherapist;
- If the estimated day of discharge falls on a Saturday or Sunday it is important that this is highlighted on the form as a flag to ward staff to ensure appropriate planning for weekend discharge occurs;
- The final section of the form requires the screening physiotherapist to indicate which referrals have been made and to whom and what the overall action plan is e.g. no further pre-operative intervention required, or referral to occupational therapist for home review due to likely difficulty negotiating bathroom in wheelchair;
- It is the screening physiotherapist's responsibility to ensure all appropriate referrals are made in a timely fashion to ensure any essential pre-operative intervention also occurs in a timely fashion;
- The PAAS physiotherapist must flag whether the patient's post discharge address is within the RITH catchment area. The PAAS physiotherapist will be responsible for compiling a list of all RITH eligible patients and emailing to the relevant staff prior to their week of surgery;
- Patients identified as being within the HITH/RITH catchment area are eligible for blanket referral on or before post-operative day 6. This is to facilitate discharge on day 3, with

ongoing wound management and physiotherapy in the patient's home environment. All patients will also be referred to their appropriate catchment area outpatient physiotherapy service post discharge. Ward staff are responsible for following up on referrals for patients at risk of deterioration without timely outpatient follow up, to ensure the referral is received and an appointment is made at the appropriate facility within an appropriate time frame.

Education

- The PAAS physiotherapist must provide information/education to the patient regarding post-operative rehabilitation including commencing mobilisation on the day of surgery, sitting out of bed for all meals, walking to the toilet/shower and early discharge with RITH follow up (where eligible);
- The PAAS physiotherapist must teach the patients the Home Exercise Program that they will be expected to continue with post operation. The expectation will be that the patient has an excellent understanding of these exercises by the time they come to surgery;
- The PAAS physiotherapist will teach the patient how to ambulate with their expected post-operative walking aid (elbow crutches unless this is deemed inappropriate due to pre-existing mobility/balance issues). If possible/indicated the patient may be asked to practice walking with their aid prior to admission for surgery;
- The PAAS physiotherapist will teach the patient the correct technique for going up and down a step (steps if appropriate to home environment). The expectation will be that the patient has a good understanding of this technique by the time they come to surgery.

Comprehensive pre-operative assessment and education in PAAS is performed by a Senior Physiotherapist. Education focuses on empowering patients to be active participants in a process designed ultimately to improve their quality of life, which commences from the pre-admission setting and ends when they have achieved their lifestyle goals (e.g. be able to return to work, sport, active lifestyle etc.). It is emphasised that the short period in hospital is only a very small component of the rehabilitation process designed to ensure they are medically well enough to return home. The importance of pre-operative preparation and a commitment to post-discharge rehabilitation is emphasised. Discharge on post-operative day three is discussed and agreed upon with the patient who is provided with a specific date on which they are to organise their own transport home before 10am in the morning. Patients are taught their exercise programs, instructed to commence daily practice immediately and are charged with knowing it off by heart by the time they are admitted for surgery. Patients are trained in the use of their chosen post-operative gait aid, including the technique for going up and down stairs. Where appropriate, the chosen gait aid is provided to the patient to take home in order to practice these skills in which they are expected to be proficient by the time they go to surgery. Patients are comprehensively assessed with regards to pre-admission function and home environment. Assessment includes obtaining the RAPT score. Key information from the pre-admission clinic assessment is entered into a database accessible to all physiotherapy staff. This information is also emailed to all involved clinical staff (including HITH/RITH staff) in the week prior to

surgery. Date of discharge is predicted as three days after surgery, however based on pre-admission assessment, RAPT score, age and BMI, the PAAS physiotherapist makes recommendations to facilitate this, or to facilitate timely transfer to a more appropriate facility where appropriate. An important role of the PAAS clinic physiotherapist is to identify potential barriers to discharge in the pre-admission setting and intervene accordingly to manage these barriers e.g. by ensuring patients have considered their post-operative situation thoroughly and charging them with organising appropriate accommodation options and family support, or by liaising with other health professionals, such as occupational therapy, social work, discharge co-ordinators, regional hospitals and other care facilities as appropriate to facilitate a smooth discharge from hospital back into the community. Patients with identified barriers to early discharge are flagged to ward medical, nursing and allied health staff for post-operative planning and timely transfer to either a short stay surgical step down unit (for patients requiring a few extra days of hospital service) or a rehabilitation unit (for those requiring longer). The PAAS Physiotherapy Assessment form (Table 7.2 – a back and front single page document as it appears at RPH) goes into the patient's integrated medical records as a resource available to all relevant staff, reducing the need for information 'double handling' by allied health professionals.

Table 7.2: The PAAS Physiotherapy Assessment form

Elective Joint Replacement Surgery – PAAS Allied Health Screen

Procedure: TKR / THR
Indication for surgery:
Day & Date of Surgery:
Consultant/Surgical Division:

Risk Assessment Prediction Tool (RAPT)

1. Age Group	50 – 65 Actual Age: _____ 66 – 75 >75	=2 =1 =0
2. Gender	Male Female	=2 =1
3. How far, on average, can you walk? (a block is about 200m)	Two blocks or more (incl rests) 1-2 blocks (shopping centre) Housebound (most of the time)	=2 =1 =0
4. Which gait aid do you use? (more often than not)	None Single-point stick Crutches/frame	=2 =1 =0
5. Do you use community supports? (home help, MOW, silver chain)	None or 1 per week Two or more per week	=1 =0
6. Will you live with someone who can care for you after your operation?	Yes No	=3 =0

Score out of 12	

- Record any potential issues that may impact on post-operative function/mobility post-procedure in the table below

Past Medical History/Pre-existing co-morbidity	**Social History/Support/Service Requirements**
Referral to other AHP indicated? ☐	Referral to other AHP indicated? ☐
Home Environment/Equipment Needs/ADLs	**Functional/Mobility Status**
Referral to other AHP indicated? ☐	Referral to other AHP indicated? ☐

Post-operative Delirium Risk Score:

☐ Visual Impairment	SCORE: _____
☐ Severe Illness	0 = Low Risk
☐ Cognitive Impairment (PMHx or AMTS <7/10 or MMSE <25/30)	1-2 = Medium Risk
☐ Dehydration	≥3 = High Risk

TUG Score: _____ Mobility Aid Used: _____

Joint Objective Assessment:

KNEE	**HIP**
Flexion ROM: to	**Flexion ROM:** to
Extension Lag: □ None □ Less than 10 deg □ More than 20 deg	**Trendelenburg Test: +ve / -ve**

Referral Organised:

☐ Physiotherapy ☐ Occupational Therapy

☐ Social Work ☐ General Practitioner

☐ Other: _____

- Discharge Date: _____ (Discharge Day 3. Must be discussed with patient)

- In HITH/RITH catchment area? Yes ☐ No ☐
- Potential Saturday/Sunday Discharge? Yes ☐ No ☐

Evaluation/Recommendations:

_____
_____
_____
_____
_____

RAPT Predictor Key:
Score <6
- Increased risk of extended LOS
- Pre-operative optimisation of mobility/functional status, social support and home environment required.
- Highly likely to require pre-operative multi-disciplinary allied health input.

Score 6-9
- Moderate risk of extended LOS.
- Pre-operative optimisation of mobility/functional status, social support and home environment required for issues likely to impact on post-operative stay.
- May require referral to other allied health professionals.

Score >9
- Low risk of extended LOS.
- Pre-operative education regarding short LOS +/- RITH follow up on discharge is required.
- Discharge date must be discussed and agreed upon.
- Pick up and transport from hospital must be confirmed

7.3.2 Routine day of surgery physiotherapy intervention

Routine day of surgery (day zero) physiotherapy intervention was considered an essential component of the new clinical pathway. Having patients expecting and participating in exercises and mobilisation immediately following surgery reduces the likelihood of patients developing any 'illness' or dependency behaviours and strongly encourages the rehabilitation ethos. Routine day of surgery physiotherapy review and intervention includes exercise programs and appropriate functional mobilisation e.g. walking and sitting out of bed with the ward staff during normal working hours. If the patient returns to the ward from surgery after 4.30pm, this intervention is provided by the late shift critical care physiotherapy staff (Royal Perth Hospital rosters a 24 hour seven day critical care physiotherapy service).

7.3.3 Intensive bi-daily physiotherapy intervention

Intensive, tailored physiotherapy intervention consisting of education, oedema management, exercises, functional training and mobilisation is performed bi-daily with all patients. The goal of these sessions is not to develop dependence on the therapist but to motivate and facilitate independence with all aspects of rehabilitation in preparation for ongoing rehabilitation post-discharge. The aim of each session is to make a meaningful progression (e.g. progress from ambulating with assistance to independently), not to repeat

the previous session. Patients are encouraged and expected to continue independently with their exercise and mobilisation programs throughout the course of the day, and not just during their allocated physiotherapy sessions. Nursing staff also play a key role in ensuring patients are performing their activities of daily living independently, dressing in their own clothes during the day, sitting out of bed for all meals and walking to the toilet and shower (not using urine bottles, wheeled commodes or having bed washes) every day consistently.

7.3.4 Preparing for discharge

Patients have a clear plan for discharge based on pre-admission planning and should have a specific discharge date with specific transport and accommodation planned. All involved health care professionals have a key role in re-enforcing this message and a responsibility to ensure the patient is prepared for discharge as planned. This includes timely review (e.g. medical review on post-operative day two or early on post-operative day three to prevent delays caused by waiting for medical clearance for discharge), provision and issuing of all appropriate equipment and medications, and ensuring post-discharge social support, HITH and RITH services are organised and ready to commence as required. The importance of having a 'goal' or expected discharge date from a staff planning perspective is considered essential to place the responsibility of timely review with the relevant health professionals.

7.3.5 Discharge day

Patients should be dressed, packed and ready to leave hospital prior to 10am on their day of discharge. The treating physiotherapist is responsible for referrals to RITH and nursing staff are responsible for referrals to HITH. Best practice includes both a verbal (over the phone) and written handover (via standardised RITH referral form paperwork). RITH commences on either the day of discharge or the following day. Patients considered to be at risk of deteriorating from a mobility, strength or range of motion perspective post-discharge are referred to their catchment area public hospital musculoskeletal outpatient physiotherapy for ongoing management in the community setting. Ward staff are responsible for handing over this information to ensure timely review and that these patients do not 'slip through the cracks'.

7.3.6 Seven day service provision

Hospital ward weekend physiotherapy services at Royal Perth Hospital underwent reformation in March 2014. A new 'rolling roster' pattern was introduced and staff work patterns such as Tuesday to Saturday or Sunday to Thursday. The aim of this change was to augment weekend staffing to better facilitate standardised services, execute discharge plans, and to improve continuity of care regardless of the day of the week by having the same staff working into every weekend. An additional benefit was the rostering of experienced staff each weekend.

7.4 Outcomes

The following outcomes refer to all elective total joint replacements that occurred at Royal Perth Hospital from the commencement of the new post transition model of care on 2nd October 2014 until 17th Oct 2015 (arbitrarily selected to provide approximately twelve months of data). A total of 255 procedures were carried out during this twelve month period. Note this total included revision surgery, some of which were highly complex. These patients were non-selected, in fact the initial cohort were identified as complex and had been selected to undergo surgery specifically at the acute campus (for ICU access) rather than at the rehabilitation campus during the period leading to closure. Of 255 procedures, 116 patients (45.5%) were discharged on post-operative day three or earlier, 171 (67.1%) were discharged on post-operative day four or earlier and 215 (84.3%) were discharged on post-operative day six or earlier. The median LOS was four days (IQR: 3 to 5). Two hundred and sixteen (84.7%) patients were discharged directly home. Thirty two patients (12.5%) were transferred to the surgical step down ward at Bentley Health Service for ongoing care. Six patients (2.4%) were transferred to a regional hospital for ongoing care. One patient (0.4%) was transferred to Fiona Stanley State Rehabilitation Service for ongoing rehabilitation. One hundred and fifty two (59.6%) patients commenced physiotherapy on post-operative day zero, with the remaining commencing on post-operative day one or later due to late return from surgery the previous day or medical complications delaying mobilisation. These basic data represent a considerable change compared to the results from the 2010 cohort where only 3.4% of patients were discharged on or before post-operative day three, 16% on or before post-operative day four and 55.7% on or before post-operative day six and with a median LOS of six days (IQR: 5 to 8). Day zero physiotherapy input was also not routine practice prior to implementation of the new clinical pathway. It should be noted that although comprehensive LOS outcomes for 2011

to 2014 are not included in this thesis, LOS data were very stable throughout this period with an ongoing average LOS of six days.

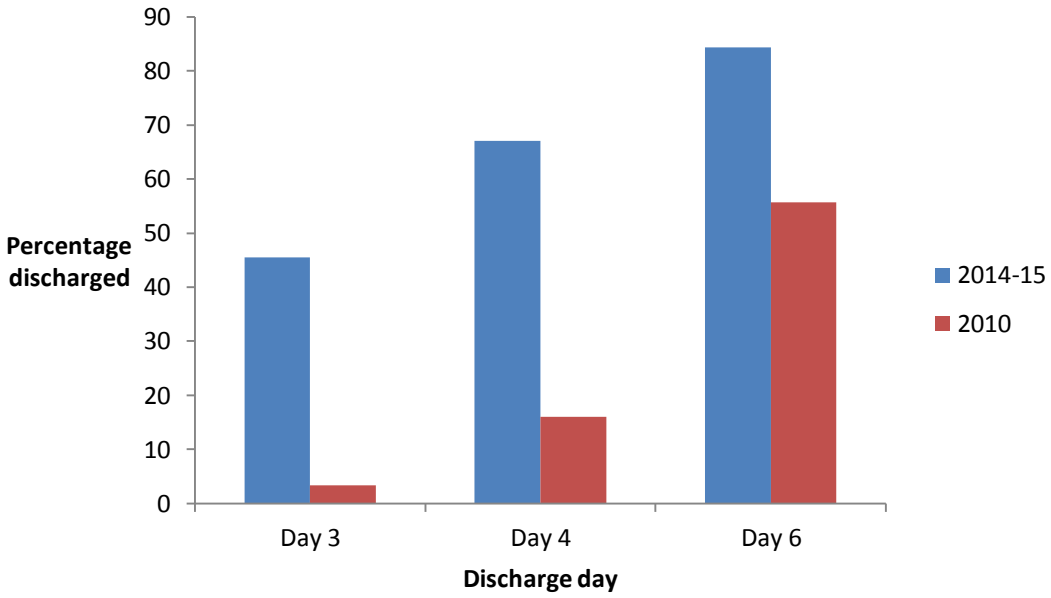

Figure7-2: Percentage of patients discharged by post-operative days three, four and six – 2010 data compared to post implementation of the new model of care in 2014.

Eight of the 255 episodes experienced a LOS of greater than ten days. Outliers in the data provide an interesting insight into why some patients require a considerably longer hospital stay. Table 7.3 provides some case examples of these outliers and the reasons for their extended LOS. These examples highlight that major medical complications will almost inevitably delay discharge and that clinical pathways are designed to reflect a non-complicated patient journey.

Table 7.3: Some examples of patient outliers who required hospital LOS greater than ten days (2014-2015 data)

Hospital LOS	Details
16 days	47 year old male with a RAPT score of nine identified in PAAS as at risk of post-operative complications due to a past medical history that included bilateral lung transplants in May 2014 and associated immunosuppression. Discharged from a physiotherapy perspective on post-operative day 4 but remained an inpatient until 16 days due to development of a deep vein thrombosis (DVT) requiring medical management. This patient was mobilised on post-operative day zero and was discharged directly home.
13 days	62 year old female with a RAPT score of eleven with no significant past medical history or identified barriers to discharge identified in the pre-admission setting. Developed acute pulmonary embolus post-operatively resulting in delayed recovery and requiring medical management. The patient was mobilised on day zero, cleared from a physiotherapy perspective on day six and was discharged directly home once medically fit.
12 days	67 year old female with a RAPT score of six who had been wheelchair bound since removal of a joint spacer in July 2014. Underwent a revision procedure complicated by a major intra-operative bleed requiring an ICU bed for six days post procedure. The patient was too medically unstable to be mobilised until post-operative day two. The patient was transferred to Fiona Stanley State Rehabilitation Service for ongoing rehabilitation on day twelve.

7.5 Challenges

Overall, the implementation of the new model of care and clinical pathway has been a success in that it is now "business as usual" and consistently achieving a high quality shorter LOS compared to pre-implementation. On review, thanks to considerable preparation the transition occurred relatively smoothly with no major issues. Obviously there were some challenges. Some of the main identified challenges were:

- Resistance to change – a key aspect of implementation was inspiring staff to believe that positive change was possible and empowering them to effect that change. This was particularly relevant for those staff who transitioned with the service.
- Staff concerns about staffing levels, particularly on weekends – this was managed by closely monitoring caseloads and outcomes. Ultimately no changes to staffing numbers were required post-implementation. However, patient caseload

allocations were modified to ensure one staff member was specifically allocated to the elective orthopaedic surgery unit on weekends.

- Flexibility of the clinical pathway – within the first three weeks of implementation feedback was provided that there were patients fit and ready for discharge on post-operative day two. However, as they had been told to prepare for pick up on the morning of post-operative day three, the discharge process was delayed until then (e.g. due to pick up coming from a country town three hours drive away). This highlighted the fact that there had been so much focus on aiming for discharge on post-operative day three that we had in fact reduced the flexibility for discharge earlier! This was fed back to the PAAS Clinic staff who changed their approach to discharge planning discussions with patients ensuring flexibility for discharge earlier than day three was possible.
- Medical staff blocking patient transfer to surgical step-down facility – for various reasons some patients are deemed to require a longer hospital stay than three days. Part of the clinical pathway involves timely transfer of patients who fit this criteria to a surgical step down unit to ensure tertiary beds at RPH are available to patients who need them. This transition has not always occurred due to medical staff preferring patients to remain at RPH for various reasons. This is a throughput and bed planning challenge. However, the physiotherapy focus is to continue to provide high level care to facilitate discharge as early as possible for these patients.
- Lack of availability of surgical step down beds – this has been an intermittent and ongoing challenge for various reasons and has resulted in some patients remaining an inpatient at RPH longer than planned.

7.6 Limitations

To date, no increase in patient re-admissions or adverse surgical outcomes have been reported. However, the impact of this considerable decrease in average LOS may yet to be identified and will require longer term review and analysis by the hospital.

Data on the subjective impact on patients from an experience point of view was unfortunately not collected. It is acknowledged that this information is required to endorse a truly patient centred model of care.

7.7 Summary

In essence, this chapter describes the implementation of change in a government funded public health care system without changes to existing funding or staffing levels. The goal of evolving an existing high quality health care service within a shorter hospital stay was implemented during a unique period of considerable change within Western Australia's health services. Although this change created many challenges, particularly for staff experiencing it first hand, for elective TJR services it created a unique opportunity to "start afresh" with a new approach to the model of care following transition. The new model of care has been in place for just over twelve months at the time of writing this chapter. However, implementation has overall been considered a success with data showing a two day reduction in median LOS.

CHAPTER 8. CONCLUSIONS

This is the first study to specifically investigate physiotherapy service provision and its association with extended inpatient hospital stay following elective total joint replacement surgery. The results show that staff culture and hospital processes such as clinical pathways have an impact on patient length of stay. As these processes are modifiable, they should be subjected to regular and ongoing critical review in the quest for quality improvement and optimal patient care. The results also show that change within hospital systems is possible, aligned with high quality care, and all within a shorter hospital stay.

This study was also the first to consider patient comorbidity combined with the Risk Assessment and Prediction Tool. The results indicate that selective comorbidity plus a high risk RAPT score increases patient risk of longer hospital stay. This reflects the increased risk of post-operative complications following major surgery, exacerbated by pre-existing social and/or functional issues. The results also show that predicting high risk patients is useful in allowing appropriate preparation of pre and post-operative patient care. However, medical complications will continue to delay patient discharge.

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APPENDICES

Appendix 1: Royal Perth Hospital daily goal setting poster for patients undergoing elective total hip or knee replacement surgery (2014)

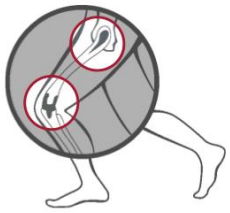
Government of **Western Australia**
Department of **Health**
South Metropolitan Health Service

Royal Perth Hospital

The **new**

Total Hip/Knee Replacement

Daily goal setting post-surgery:



Name: _____

_____

Day 0 - Post op

1. Pain adequately controlled post- op. ☐
2. Tell your nurse if you are feeling sick. ☐
3. You will have a post-op x-ray of your hip/knee and a blood test. ☐
4. Stand with the physiotherapist 2-4 hours post operation. ☐
5. Stockings and calf/foot garments to be worn. ☐

Day 1

1. You will have a shower today, remember you are not sick but have had an operation to your hip or knee. ☐
2. You will sit out of bed for your meals and dress in day clothes. ☐
3. You will be encouraged to walk with the physiotherapist and nurses. ☐
4. You will have your catheter removed at midnight. ☐
5. Your pain relief machines will be removed or replaced with pain tablets. ☐
6. Medical staff will review you for possible discharge on day 3. ☐

Have you achieved your daily goals?

If not why? _____

_____

_____

Day 2

1. Let the nurse know if you have passed urine and she will assess you as required. ☐
2. You will be up walking to the shower. ☐
3. Sitting out of bed for all meals. ☐
4. You should be walking around the ward with walking aids. ☐
5. You may also be referred for rehabilitation if you are not ready for discharge, this may happen today. ☐

Are you reaching your daily goals?

If not why? _____

_____

_____

Day 3

You will be discharged and need to leave the ward by 10am

If you have property in the hospital trust or brought your own medications in please tell your nurse.

Things to be organised for discharge:

1. Transport ☐
2. Medications ☐
3. Equipment for home ☐
4. Outpatient appointments ☐
5. External community services arranged to assist you to manage at home ☐
6. Hospital in the home/rehabilitation in the home ☐

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