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FOCUS ON: ENHANCED RECOVERY

An orthopaedic enhanced recovery pathway

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SUMMARY

The use of enhanced recovery pathways within elective surgery has increased in recent years but uptake outside of specialist centres is still slow, despite the growing evidence base to support their introduction. This article will briefly outline what is meant by an enhanced recovery pathway (ERP) and outline the central characteristics and features which make up an ERP. The procedural details and results of an orthopaedic ERP which has been used in 2391 consecutive hip and knee joint replacement patients at a NHS district general hospital within the United Kingdom will then be outlined.

The results of this unit illustrate that when a standardised, multi-disciplinary pathway is implemented and managed correctly, dramatic reductions to length of stay can be achieved. In combination, high levels of both staff and patient satisfaction are achieved along with good clinical outcomes. It is proposed that if such ways of working are implemented in other hospitals major economic and capacity savings could be realised at the same time as improving patient care.

1. Introduction

The introduction of enhanced recovery pathways within elective surgery has gained momentum over recent years since the concept of "enhanced recovery" was first described and promoted by Henrik Kehlet.[1] The technique was originally described as a method for treating patients following colonic surgery[1,2] with its principles centred on a multimodal rehabilitation program to reduce post-operative pain and accelerate rehabilitation. Whilst the principles of the pathway were originally developed and integrated into colorectal surgical pathways, they have also been utilised in numerous operative procedures such as general, visceral, vascular and thoracic surgery, as well as orthopaedic, urological and gynaecological operations.[3]

This article will briefly outline what is meant by an enhanced recovery pathway (ERP), discuss the use of enhanced recovery pathways within orthopaedic settings, and briefly outline the potential benefits and effect to the National Health Service (NHS) that adopting an ERP approach to hip and knee replacement patients may provide.

An example of an orthopaedic ERP will then be described. The setting for this pathway is a typical NHS district general hospital and the purpose of its explanation is to demonstrate that the introduction of an ERP is both possible and extremely beneficial for patient outcomes within an NHS orthopaedic setting. Results of the pathway and details of how it was implemented will be made throughout its description.

1.1. What is enhanced recovery?

At its core an ERP is about improving patient outcomes and speeding up patient recovery following surgery. An ERP focuses on optimising every aspect of a patient's journey and promoting the patient as an active participant in their recovery process and rehabilitation. Successful pathways are delivered by multi-disciplinary teams and are multimodal in their nature with the aim to optimise every step of a patients' pathway in order to accelerate post-operative recovery, and reduce complications, adverse events and general morbidity.

There is no formal definition of an ERP within the literature and pathways with the same characteristics as enhanced recovery have been described under various headings that include terms such as "Fast-track", "Rapid Recovery" and "Accelerated Rehabilitation".[4–6] Whilst there is an absence of a formal definition, when the literature is reviewed and the clinical practice at exemplar units is examined, there are a number of core aspects that appear to characterise an ERP. Depending on the surgical discipline some aspects of the pathway will be favoured more heavily, but in general the following steps characterise an ERP.

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1.2. Generic principles of enhanced recovery pathways

1.2.1. Pre-operative

- Thorough pre-operative intervention to optimise health and medical condition
- Management of patient expectation through pre-operative education and counselling
- Organisation of discharge arrangements

1.2.2. Intra-operative

- Atraumatic and minimally invasive surgical techniques
- Shortened surgical times
- Optimised anaesthesia – usually regional anaesthetic techniques with light sedation
- Promotion of normovolemia, normothermia and prevention of hypoxia

1.2.3. Post-operative

- Early physiotherapy intervention and promotion of ambulation
- Regular and effective analgesia with avoidance of opiates where possible
- Rapid introduction of normal hydration and feeding
- Promotion of a "wellness" model of care – catheter, drains and drips are removed as soon as possible, and independence with washing, dressing and socialisation is promoted.

1.2.4. Discharge

- Patients are discharged home
- Criteria-based discharge protocol managed by the multi-disciplinary team
- Patients have clear instructions on how to progress rehabilitation independently

1.3. Enhanced recovery in orthopaedics

Whilst the term enhanced recovery has originated from colorectal surgery, the use of multi-disciplinary clinical pathways (which have many similar aspects to an ERP) in orthopaedics is not new. Clinical pathways have been used to co-ordinate the care of hip and knee replacement patients across many units in the world and examples have been published in the literature for over 10 years.[7] The effect of introducing such pathways has been considered by systematic reviews and there is a consensus that the introduction of clinical pathways can significantly improve the quality of care for patients.[8,9]

The improvements to quality of care by using these pathways are largely thought to be due to the increased organisation of the care that is delivered. It has been noted that if the patient pathway is highly structured and standardised, and if the multi-disciplinary team are involved in the development and production of the pathway, then improvements to patient care are likely to be realised.[9]

As well as improvements to patient satisfaction and good clinical outcomes, ERP and fast-track approaches report reductions in length of hospital stay. The values reported are considerably lower than the national averages within the United Kingdom (UK) (Figs. 1 and 2) and so the approach appears to be "win-win". An ERP can deliver high quality and also provide efficiency gains. This is obviously

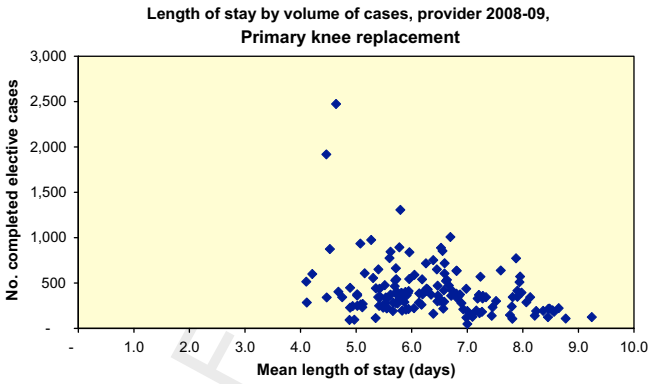

Fig. 1. Length of stay by volume of cases for primary knee replacement by NHS hospital, 2008–09. HES data.

desirable and the UK Department of Health is currently running an enhanced recovery programme to help support units wishing to introduce an ERP.

This is welcome because the widespread adoption of the principles of ERP amongst orthopaedic departments in the United Kingdom has not occurred. Reasons for this slow spread may be due to a lack of knowledge or a reluctance to introduce evidence-based pathways, but this seems unlikely given that most staff aspire to give their patients optimal care and are comfortable utilising best evidence.[10] The more likely reason is that units have difficulty organising and co-ordinating such pathways[11,12] and this is maybe why the pathways reported to date are often for selected populations and/or for series of single surgical teams.

In units where ERP has been administered successfully for colorectal patients, ERP nurses have led the co-ordination of care and have been instrumental in making these complex pathways work.[13] The implementation of ERP for colorectal patients may also have been more widespread comparatively to orthopaedics due to the relatively small numbers of patients undergoing these procedures (119,603 primary total hip and knee replacements were completed within the UK in 2008–09 compared to 19,753 colectomy and excision of rectum procedures).[14]

The largest colorectal units may perform around 300 procedures a year compared to 2000 procedures in the high volume joint replacement units. The organisation required in large orthopaedic units to implement ERP is, therefore, significant and is perhaps the principle reason why adoption of ERP principles has to-date been slow in orthopaedics.

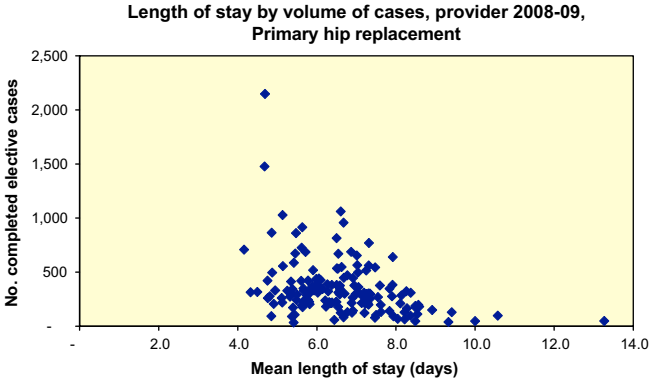

Fig. 2. Length of stay by volume of cases for primary hip replacement by NHS hospital, 2008–09. HES data.

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2. The Bournemouth experience

The Royal Bournemouth Hospital is an NHS district general hospital completing high numbers of hip and knee replacements each year. In 2007, a new ERP was introduced at the hospital with the aim to reduce length of stay, improving the quality of care provided to patients, and increasing capacity so that waiting time targets and economic savings could be made.

Most importantly, the introduction of the ERP was to ensure evidence-based and patient-centred care was delivered to all patients. At the time there were large variations in patient experience, post-operative rehabilitation, and clinical outcomes. Length of stay was also extended – the average stay for hip and knee replacement patients was 7.8 days and there was a large standard deviation of 5.5 days around this mean.

The following pathway was introduced and it has been successful in reducing length of stay and achieving high rates of patient and staff satisfaction. The pathway re-design was led by consultant surgeon and a pathway manager. The combined approach of a clinician and manager working together to implement the pathway was crucial due to the large volumes of patients to be treated and the complex organisational issues associated with introducing change and new ways of working.

The pathway was introduced in August 2007 and 2391 consecutive patients who followed the pathway are presented in this paper.

2.1. The pre-operative stage

2.1.1. A comprehensive pre-assessment processes

A comprehensive pre-assessment process was introduced and a consultant anaesthetist led the work. A clear protocol for assessing anaesthetic fitness, ordering pre-operative tests, and considering surgical suitability for the pathway was introduced where possible patients were pre-assessed at the same clinic visit on which they were listed for surgery. Patients were excluded from the pathway if they had a cognitive impairment, were ASA 4, had a medical co-morbidity requiring ongoing medical supervision during their in-patient stay, or if the patient was undergoing complex or revision surgery requiring special equipment or with an expected longer operative time.

This meant that patients with an ASA 3 score were included in the series and made up 8.4% of the total cohort. This group of patients has previously been excluded from reports of fast-track surgery[15] and makes up 13% of the total number of hip and knee replacements in the United Kingdom.[16] Whilst mean length of stay for this group of patients in our series (5.8 days – see Table 1 and Fig. 3) was slightly higher than the overall average (4.5 days) and it is still lower than the national average of 6.3 days for THR and 6.1 days for TKR[14] and, therefore, illustrates the positive effect a ERP can have on more complex patients.

The impact of a comprehensive anaesthetic pre-assessment also meant that cancellations on the day of surgery were minimised. This is important because one of patients' principle concerns is that

Table 1
Showing results of classification and regression tree analysis (CART) for ASA grade against length of stay. A higher ASA grade was associated with a longer length of stay.

ASA: impact on total LOS (Days)				
Group	Count	Mean	Standard deviation	ASA
All	2391	4.5	2.4	All
1	421	3.9	1.1	1
2	1767	4.5	2.3	2
3	203	5.8	4	3

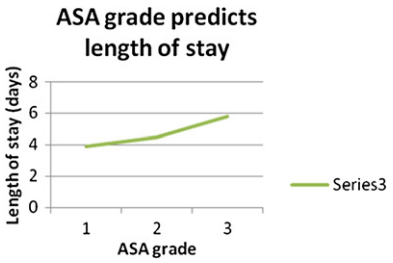

Fig. 3. Graph showing results of classification and regression tree (CART) analysis for ASA grade against length of stay. A higher ASA grade was associated with a longer length of stay.

their surgery will be cancelled.[17] Cancelling patients on the day of surgery not only results in a negative experience for patients but also highlights poor logistical processes and is costly in terms of lost capacity and revenue for a hospital. Last year 1 in 8 (220,000) elective spells (excluding day cases) were discharged without having any operative procedure within the NHS.[14] The potential efficiency savings in this area are, therefore, considerable.

2.1.2. Patient education and managing expectation

Effectively educating patients prior to surgery and managing their expectation with regard to length of hospital stay is one of the fundamental aspects of an ERP and it has been suggested to have a beneficial effect on pre-operative anxiety.[18]

In order to successfully manage patient expectation a co-ordinated approach from the entire team is needed and this must be supported by all of the letters and information patients receive. The pathway should also be highly standardised so that the information given will correlate with the experience the patient receives once they are in hospital. Removing the unexpected is the aim, and so if the pathway then doesn't happen as described, patient confidence can be lost and anxiety increased.

The hospital team must also invest time engaging with the wider local health community and especially the local GPs. In Bournemouth talks were given at local general practices, and primary care representatives were invited to observe the pathway. The pathway manager also engaged with the local population by speaking about the ERP at hospital open days.

The patients in this series were telephoned after completing their pre-assessment, and a mutually agreed date and time to come in for their operation was agreed. The process of asking the patient to help choose their operation date was a deliberate one. It not only made it easier for admissions staff (no changes or delays in responses after sending letters) but was also the first step in beginning to empower patients to take responsibility for their individual pathway.

The admission staff making the call were trained to inform the patient how long they were likely to stay in hospital. Specific training was given to ensure they began to prepare the patient appropriately for the ERP. A letter confirming the operation date was then sent out to each patient with an expected discharge date of 4 days after their operation, and specific instructions to attend the pre-operative class.

The pre-operative education class was run by a physiotherapist, occupational therapist and nurse who all worked on the ward where the ERP was delivered. The personal delivering the class regularly rotated and all new staff were trained to be able to teach the class. The process of delivering the class helped to reinforce the ERP principles to staff on an ongoing basis.

The aims of the session were to reduce anxiety and provide a detailed explanation of the pathway. Patients were encouraged to

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ask questions and to bring carers so that their expectations could also be managed. Managing patient expectation in ERP is regarded as an essential step.[18,20]

Within the class the specifics of what to bring and how to prepare pre-operatively were covered, along with exercises to start practicing before the operation, the opportunity to practice walking with crutches, and a chance to make sure that any equipment they required for their home was organised adequately. Specific instructions and advice was given about managing pain post-operatively and the anaesthetic and pain protocols used within the ERP.

2.1.3. Discharge planning

Planning for discharge has to begin at the pre-assessment stage in order to make an ERP work. The Risk Assessment and Prediction Tool (RAPT) scoring system was used as an indicator of likely delayed length of stay.[21] This system was developed in Australia in order to help predict the likely need for rehabilitation post-discharge but in this series because 99% of patients were discharged home it was used to predict patients who were likely to have a longer length of stay (see Table 2 and Fig. 4). The scoring system asks 6 questions relating to age, gender, pre-operative walking ability, use of community support, and whether they lived alone. Patients with a lower score who were likely to stay longer in hospital were targeted to ensure discharge arrangements had been made.

In order to facilitate improved access to social services and give patients help with organising packages of care, the unit also employed a local charitable organisation for one day a week that specialised in help and care packages. This was a very cost effective method to help ensure patients could be discharged when they had met discharge criteria. This is important because it has been found in some ERP reports that 87% of patients are not discharged on the day that ERP discharge criteria are fulfilled.[22] This highlights that whilst in-patient clinical protocols can be introduced successfully you need effective management of discharges to realise decreases to length of stay.

2.2. The operative stage

2.2.1. Admission on the day of surgery

A total of 99.9% of patients in the series were admitted on the day of surgery (Table 3) and staggered admission times were organised to minimise the wait between admission and going to theatre. This was done to reduce the time patients waited for surgery and, therefore, minimise anxiety. It allowed beds to be utilised efficiently within the ward. The average time between admission and walking to theatre for the cohort was just 2 h and 45 min (Table 3).

Admission times could be staggered with a degree of accuracy because all joint replacements were streamed onto dedicated joint replacement theatre lists with a structured timetable. This meant that sending times for patients could be predicted and so fasting

Table 2
Showing results of classification and regression tree analysis (CART) for RAPT score against length of stay. A lower RAPT score was associated with a longer length of stay.

RAPT: Impact on total LOS (Days)				
Group	Count	Mean	Standard deviation	RAPT
All	2391	4.5	2.4	All
1	53	7.42	6.7	1–3
2	84	5.86	4	4
3	302	5.23	2.7	5–6
4	1002	4.57	2.2	7–9
5	950	3.93	1.4	10–12

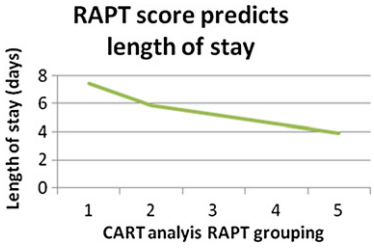

Fig. 4. Graph showing results of classification and regression tree (CART) analysis for RAPT score against length of stay. A lower RAPT score was associated with a longer length of stay.

instructions were optimally managed to ensure that patients had good levels of hydration and energy prior to surgery. The fasting guidelines allowed clear fluids up to 2 h prior to surgery and the cessation of food 6 h prior to surgery. These are commonly used guidelines[13] but can only be effectively administered if operative time is predictable. Whilst a carbohydrate loading drink was not given to patients in this series, research does suggest that a hypo-osmolar carbohydrate mixture 2–3 h prior to surgery can have beneficial effects in orthopaedic surgery.[23] Patients with specific needs such as diabetes were scheduled at the start of lists so that they had a guaranteed operating start time to ensure their blood sugar was optimally managed.

On admission all patients showered in the unit using chlorhexidine soap. This was not only to minimise chances of infection but also so that patients could get used to the bathroom facilities. Once showered all pre-operative checks and visits from the surgeon and anaesthetist would be completed and the patient

Table 3
Results table showing demographic and length of stay data for the Bournemouth ERP.

			Total
Demographics	Number of procedures	2391	
	Sex	Male	886
		Female	1505
	Age (Years)	Range	28–94
		Median	72
		Mean	71
	ASA grade	1	421
		2	1767
		3	203
	RAPT score	Range	1–12
		Mean	8.6
		Median	9
Outcomes	Length of stay (Days)	Range	2.1–46.1
		Mean	4.5
		Median	4.2
		Standard deviation	2.4
		Discharged day 2	195
		Discharged day 3	807
		Discharged day 4	909
		Discharged day 5	287
		Discharged day 6	120
		Discharged day 7	76
		Discharged day 8+	108
	Re-admission rate (28 days)		5.40%
	DOSA rate		99.90%
	Admission to operation time (hours)	Range	00:35–22:36
		Average	02:45
	Recovery exit to first physio (hours)	Range	00:10–256:42
		Mean	07:31
	Recovery exit to first walk (hours)	Range	00:15–262:25
		Mean	26:05:00
	Duration of Operation (hours)	Range	00:59–03:56
		Mean	01:51
		Standard deviation	00:18

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would be asked to wear a warming jacket over their gown to maintain body temperature. No pre-meds were given and the discharge plans were checked by the nurse with the patient. All patients walked to theatre.

2.2.2. Anaesthetic room

Intravenous (IV) antibiotics were given in the anaesthetic room and this was routinely the only dose given unless surgical time lasted over 2 h. In these cases doses were given 8 and 16 h after the first dose was given. Normothermia was also actively managed with actions such as warmed IV fluids and the use of upper body air-warming devices throughout surgery. Adherence to these measures and thorough screening pre-operatively meant that in 2391 cases there has been no cases of deep infection and low rates of wound problems within the 28 day post-operative period (Tables 4 and 5).

The default anaesthetic technique given to almost all patients was a spinal anaesthetic and a local nerve block. There were some exceptions due to patient preference or medical rationale but standard protocol for knee replacements was ITO diamorphine (0.25–0.4 mg) with a femoral (≤0.25%) and sciatic (≤0.25%) nerve block, and hip replacements received ITO diamorphine (0.25–0.4 mg) with a fascia iliaca (≤0.25%) nerve block. Excessive intravenous fluids were also avoided where possible and IV fluids were discontinued on day 1 or as soon as possible in the post-operative period.

Detailed accounts of ERP anaesthetic regimes are discussed elsewhere[13] and are not elaborated here due to this articles focus on organisation and orthopaedic aspects of an ERP.

2.2.3. Surgical technique

Twenty-eight different surgeons operated on patients in the series of 2391 patients. Surgical approach and technique was not prescribed. There is inconclusive evidence within the orthopaedic literature regarding which surgical approach is most effective for hip and knee replacement.[24,25] In studies looking at hip replacement it has been shown that there is no evidence that a mini-incision technique results in less bleeding or less trauma to the soft tissues of the hip,[26] and it may be suggested that the shorter lengths of stay reported in mini-incision series are as much to do with the pathway rather than the surgical incision. The use of surgical drains was also minimised, and when used they were removed as soon as possible post-operatively.

However, all other process within the theatre were optimised and standardised. The theatre scrub team had standardised logistical procedures so that the whole theatre environment was entirely predictable and always the same for the surgeons. The mean length of surgical case time (entry to anaesthetic room to exit from theatre) can be seen in Table 3 and compares favourably to other published data for joint replacement.[27] Shortened surgical times may be proposed as beneficial in an ERP due to the reduction in blood loss and surgical stress.

Table 4
Detailing complication rates for primary hip replacements within the Bournemouth ERP series.

	Number	Percentage of all hip cases
Dislocation	18	1.7%
DVT	3	0.3%
Infection/wound problem	16	1.5%
Medical	21	2.0%
Nerve palsy	4	0.4%
Intra-operative fracture	6	0.6%
Post-operative peri-prosthetic fracture	1	0.1%
Head liner mismatch	1	0.1%
Stem failure	1	0.1%

Table 5
Detailing complication rates for primary knee replacements within the Bournemouth ERP series.

Unicompartmental	Number	Percentage of all Uni cases
Infection/wound problem	2	3%
Total knee replacement	**Number**	**Percentage of all TKR cases**
Haemarthrosis	6	0.5%
Stiffness	21	1.6%
Dislocation of rotating bearing	4	0.3%
Infection/wound problem	17	1.3%
Medical	25	1.9%
DVT	13	1.0%
PE	7	0.5%
Nerve palsy	1	0.1%
Intra-operative fracture	2	0.2%
Vascular problem/compartment syndrome	3	0.2%

Perhaps more importantly, however, is the low degree of variation. The standard deviation around the mean is very low at just 18 min for the whole series. This is across 2391 different patients, with 28 different surgeons, for a range of joint replacement procedures. This shows that by removing unnecessary variation in theatre practices and by streaming joint replacements together in designated operating lists more predictable operating times can be achieved. This is a highly desirable outcome on an ERP where you are attempting to minimise all artificial or unnecessary variation within the delivery of care processes.

2.3. The post-operative stage

2.3.1. Pain control

post-operatively a standardise analgesic ladder is utilised to proactively manage pain. This has clear escalation procedures when pain scores are high so that pain is controlled. The key aspect of this approach is the concept of standardisation. There are varying examples of analgesic regimes in the literature report beneficial results, and whilst they have slight differences in what they consist of, the common theme is that one method is chosen and then consistently applied.

This analgesic ladder is displayed prominently throughout the ward and adherence is monitored daily by the hospital pain team through ongoing communication with the anaesthetists, surgeons, nursing staff and physiotherapists. Only by working as a team can pain be managed effectively for patients on ERPs.[13]

2.3.2. Promotion of independence and wellness

This is arguably the most important aspect that underpins the post-operative care from every member of the multi-disciplinary team, because increased short-term post-operative levels of self-efficacy are associated with improved long-term outcomes of joint replacement.[28] It is characterised by getting patients to return to normal activities such as eating, drinking, washing, dressing, walking and socialising as swiftly as possible.

Patients are given food and drink as soon as possible after they return from recovery and fluid balance is monitored closely in the initial stages. Measures to reduce feelings of nausea and vomiting are also employed. All patients who have a spinal anaesthetic return to the ward with a catheter and this is always removed by 6 am on the first post-operative day if not before. All drains and drips are also removed as soon as possible, and patients wash and dress in normal clothes on the first morning after surgery.

There has been no increase to nursing staff levels in order to deliver the ERP but nursing culture and the ways of working have

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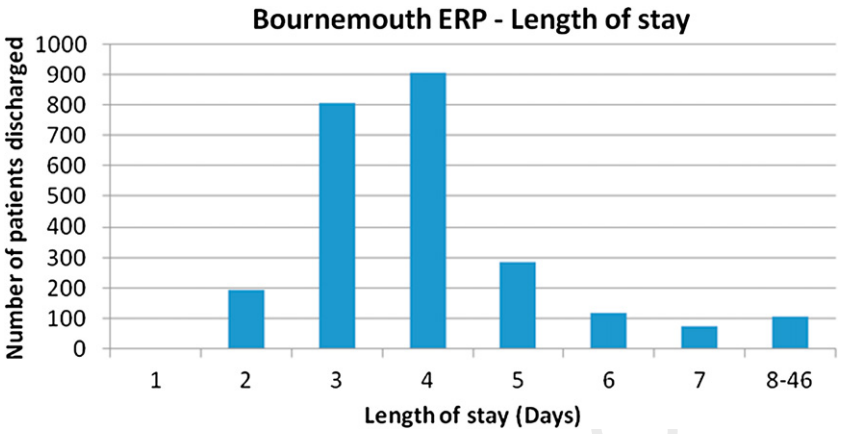

Fig. 5. Bournemouth ERP length of stay graph illustrating numbers of patients discharged on each post-operative day.

changed. Joint replacements are treated in a designated unit and the nurses work in specific pre-operative, post-operative and discharge teams with structured work plans. Due to the predictability of the staggered admission times, timetable for patients to go and return from theatre, and length of stay, the nurses have been able organise staffing for peak times with a high degree of accuracy whilst also making time for training, education and audit. This ensures high levels of productivity, consistent delivery of the ERP and high levels of staff satisfaction.

2.3.3. Physiotherapy

The role of physiotherapy within the pathway is extremely important. Patients were seen twice a day by the physio team until they achieved their discharge goals because this level of intervention has been associated with earlier achievement of functional milestones.[29] To ensure a consistency of care the physiotherapists worked on a seven-day rota with extended hours until 8 pm on operative days because not providing physiotherapy at weekends has been linked to longer lengths of hospital stay.[30]

The physiotherapy treatment focuses on early ambulation, active range of movement and strengthening exercises, and proactive management of swelling using ice and elevation. The regime components can be considered as standard for joint replacement[31,32] but the delivery is intensive. The mean time for patients to be seen post-operatively for their first physiotherapy treatment is 7 h 31 min and if appropriate patients will walk at this stage. If their anaesthetic blocks are still active, bed exercises will be commenced and the average time for first walk in the series was 26 h and 5 min.

Length of hospital stay is minimised with this physiotherapy approach and 80% of patients were discharged home on or before day 4 (Fig. 5). This length of stay compares very favourably with the United Kingdom national average, and also other fast-track series.[4]

2.3.4. Discharge

Arrangements for discharge were always prepared pre-operatively and almost all patients were discharged home. No extra or additional support was needed from primary care because discharge criteria were not altered. All patients went home with the support package required for their individual level of need. Specific advice was given in relation to continuing pain control and instructions for exercises and rehabilitation.

All patients were telephoned at 48 h to check progress and then again at 28 days for audit purposes. Rigorous audit was undertaken of re-admissions, complications and patient satisfaction. The re-admission rate of 5.4% for the series is lower than reported in other series of fast-track joint replacement surgery[4,15] and the complication rates are all within normal limits expected for joint replacement.

3. Summary

The pathway and outcomes experienced in Bournemouth are consistent with the findings of a recent study in Denmark.[11] Departments with short lengths of stay for hip and knee replacement have highly organised logistical features such as standardised procedures, specially trained staff, consistency in the management of patient expectation, comprehensive discharge planning, as well as multimodal analgesic protocols and early mobilisation. The Danish study found that there was no difference in patient demographics or staffing levels between units with short and long lengths of stay. This is again consistent with the results of the pathway described in this article.

Given the national results for hip and knee replacement length of stay it appears that there is a significant opportunity within the UK to improve patient outcomes and significantly increase hospital productivity if ERPs are implemented more widely. This article illustrates that it is possible to execute an ERP successfully within a typical NHS setting and on a large number of patients per year.

The key elements for this implementation are acknowledged as being strong clinical and managerial leadership, a team approach, standardised procedures and a highly organised logistical framework, with a strong commitment from all involved to change the pathway and improve patient outcomes.

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Conflict of interest statement

The authors have no conflict of interest.

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19.

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