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ARTHROPLASTY

Prolonged length of stay (PLOS) in a high-volume arthroplasty unit

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Introduction

The enhanced recovery after surgery (ERAS) concept in arthroplasty surgery has led to a reduction in postoperative length of stay in recent years. Patients with prolonged length of stay (PLOS) add to the burden of a strained NHS. Our aim was to identify the main reasons.

Methods

A PLOS was arbitrarily defined as an inpatient hospital stay of four days or longer from admission date. A total of 2,000 consecutive arthroplasty patients between September 2017 and July 2018 were reviewed. Of these, 1,878 patients were included after exclusion criteria were applied. Notes for 524 PLOS patients were audited to determine predominant reasons for PLOS.

Results

The mean total length of stay was 4 days (1 to 42). The top three reasons for PLOS were social services, day-before-surgery admission, and slow to mobilize. Social services accounted for 1,224 excess bed days, almost half (49.2%, 1,224/2,489) of the sum of excess bed days.

Conclusion

A preadmission discharge plan, plus day of surgery admission and mobilization on the day of surgery, would have the potential to significantly reduce length of stay without compromising patient care.

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Introduction

Primary hip and knee arthroplasties are increasingly common orthopaedic surgical interventions that improve patients' quality of life.[1] The UK National Joint Registry (NJR) reported over 200,000 primary hip and knee arthroplasties carried out in England, Wales, Northern Ireland and Isle of Man in 2018, with further increases predicted with time.[2] In the USA, a similar trend is observed with a projected increase of 145% and 147% for total hip arthroplasties (THAs) and total knee arthroplasties (TKAs) respectively by the year 2030.[3]

Henrik Kehlet, a Danish surgeon, introduced the enhanced recovery after surgery (ERAS) concept and its successful application in gastrointestinal surgery in the 1990s.[4] This concept, when implemented in orthopaedic surgery, has repeatedly led to improved early outcomes, with both reduced length of stay (LOS) and readmission rates in what is frequently an elderly population undergoing joint arthroplasty.[5] These systematic improvements in process have been implemented across various specialties and healthcare systems worldwide, including the NHS in the UK, and have resulted in reduced costs and improved efficiency.[6-13]

Our orthopaedic unit has previously shown that patients can be safely discharged early and that a supported discharge results in fewer reattendances at GPs or emergency departments (ED).[6] Early discharge does have several obstacles, which we have previously identified.[14] One major issue is the delay in setting up supported discharge when social services are required.[14] This often leads to patients having a prolonged length of stay (PLOS). The primary purpose of this audit was to identify the main reasons for patients having a PLOS.

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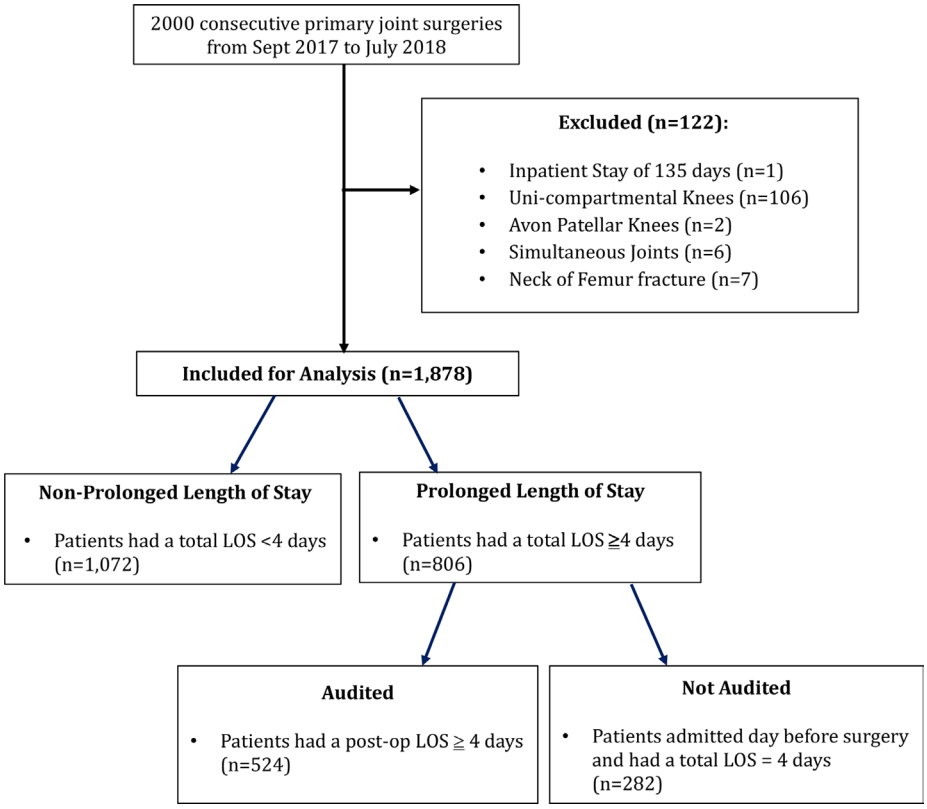

Fig. 1

Patient selection Consolidated Standards of Reporting Trials (CONSORT) diagram. LOS, length of stay.

Methods

This audit was registered with our institution's Standards, Quality and Audit Department (reference number 5810). A PLOS was arbitrarily defined as an in-hospital stay of four days or longer from the date of admission. A total of 2,000 consecutive patients undergoing primary THA or TKA were included, with the surgeries taking place between September 2017 and July 2018. PLOS patients were identified using the hospital patient information system. The Consolidated Standards of Reporting Trials (CONSORT) diagram (Figure 1) outlines the patient selection, reasons for exclusion and analysis process. Patients with unicompartmental and patellofemoral knee arthroplasty, bilateral joint arthroplasty, arthroplasty for hip fractures, and a prolonged inpatient stay of > 100 days were excluded. After exclusion, 1,878 patients were included for analysis and of those, 806 patients had a PLOS based on our arbitrary definition. Among the 806 PLOS patients there was a subgroup of 282 patients who, despite having an in-hospital stay of four days, were not audited because they were admitted the day before their surgery. This admission the day before surgery led to their PLOS and without it, in-hospital stay would have been three days. This observation is further explored later on in the discussion. That left a cohort of 524 patients where the reason for PLOS was unknown. In these 524 patients, their notes were audited to determine the predominant reason for their PLOS.

All THAs were performed via a posterior approach and all patients were allowed to mobilize weight-bearing as tolerated from postoperative day 1. Wound drains were not used. There were a multitude of different protocols with respect to pre- and postoperative pain medications, the use of a tourniquet in TKA, local anaesthetic infiltration or blocks, and the use of steroids and tranexamic acid.

Discharge criteria required that the patient had no medical issues, had a normal medical early warning score (NEWS), were tolerating their postoperative pain, could do stairs and mobilize independently. There were no set targets for range of movement for TKA prior to discharge.

Information collected on all 1,878 patients included; age, sex, body mass index (BMI), American Society of Anaesthesiologists (ASA) grade, day of the week surgery was performed, the surgeon and consultant in charge.

Within the audit population of 1,878, 57.7% (n = 1,083) were female, with 52.5% (n = 986) undergoing primary THA and the remainder primary TKA. The median age of the audit population was 69 years (interquartile range (IQR) 62 to 76), where female patients were significantly older than male patients (median 69 years (IQR 63 to 77) vs 66 years (IQR 60 to 74), respectively; $p < 0.001$,

Table I. Predominant reasons for prolonged length of stay (PLOS).

Rank	Reasons for PLOS	Patients, n (%)	Sum excess bed days	Range (days)
1	Social Services	171 (21.2)	1,224 (49.2%)	1 to 39
2	Non-day of surgery admission	282 (34.9)	283 (11.4%)	1 to 2
3	Slow to Mobilize	111 (13.8)	261 (10.5%)	1 to 6
4	Rewarfarinization	26 (3.2)	139 (5.6%)	1 to 12
5	Waiting on OT/OT equipment	26 (3.2)	74 (3.0%)	1 to 5
6	Hyponatremia	33 (4.1)	74 (3.0%)	1 to 6
7	Deranged bloods	22 (2.7)	62 (2.5%)	1 to 14
8	Infection	13 (1.6)	46 (1.9%)	1 to 5
9	Wound problems	9 (1.1)	40 (1.6%)	2 to 14
10	All other reasons	113 (14.1)	286 (11.5%)	1 to 14
	Overall	806 (100)	2489 (100%)	1 to 39

*Other reasons are outlined in the Supplementary Material.
OT, occupational therapy.

Mann-Whitney U test). TKA patients were significantly older than THA patients (median 69 years (IQR 63 to 76) vs 67 years (IQR 60 to 75), respectively; p = 0.001, Mann-Whitney U test). The median total LOS was 3.0 days (IQR 2.0 to 4.0) and the mean total LOS was 4.0 days (1 to 42), with the total number of bed days used being 7,597. The median postoperative LOS was also 3.0 days (IQR 2.0 to 4.0); however, the mean postoperative LOS was 3.5 days (1 to 41), with the number of postoperative bed days used being 6,553.

Statistical analysis. Statistical analysis was carried out using SPSS v. 22 (IBM, Armonk, New York, USA). All data was assessed for normality using Shapiro-Wilk test. Chi-squared tests were used to compare categorical variables. For non-parametric continuous variables, Kruskal-Wallis tests were used. Stepwise multiple regression analysis was used to determine if any preoperative factor(s) could predict a PLOS. Statistical significance level was set at $p < 0.05$.

Results

Of the 1,878 patients included in the audit, 806 (42.9%) had a prolonged in-hospital stay. The 806 PLOS patients (≥ 4 days after admission) accounted for 4,907 (64.6%) total bed days, or 2,489 excess bed days. The audit of 806 patients determined the predominant reason for PLOS with the top nine being documented in Table I. The tenth reason includes all remaining reasons, which amounted to 11.5% of excess bed days.

Of the 524 whose notes were audited, 200 (38.2%) had requested social services, equating to 10.6% of the total patient cohort. However, of the 200 requesting services, 29 (14.5%) went home without services. We have assumed that patients discharged before postoperative day 4 had not requested services. To the best of our knowledge there were no cases where services were arranged prior to admission.

Of the 806 patients who had a PLOS, 64.9% (532/806) were female, which is a significantly greater proportion compared to 52.2% non-PLOS female patients (560/1072; $p < 0.001$, chi-squared test). When investigating the reasons for PLOS, the only difference between male and female patients was for social services reasons, where significantly more female patients (72.5%) had a PLOS compared to male patients (27.5%, odds ratio (OR) 1.6 (95% CI 1.1 to 2.3); p = 0.019, chi-squared test).

The distribution of PLOS episodes was similar when comparing THA (45.5%) and TKA (54.5%). However, when comparing to non-PLOS episodes, significantly fewer TKA patients were non-PLOS (42.3%, $p < 0.001$, chi-squared test). Despite the greater proportion of TKA patients with a PLOS, THA patients were more likely to have a PLOS for social services (OR 1.82 (95% CI 1.3 to 2.6); $p < 0.001$, chi-squared test), as well as occupational therapy (OT)/OT equipment (OR 3.37 (95% CI 1.4 to 8.1); p = 0.004, chi-squared test) as compared to TKA patients. Conversely, TKA patients were more likely to have PLOS due to mobilization problems (OR 2.82 (95% CI 1.8 to 4.4); $p < 0.001$, chi-squared test).

Multiple regression analysis was carried out to determine which preoperative factor(s) could predict a PLOS (Table II). The following eight preoperative variables were assessed; sex, joint replaced, age at procedure, American Society of Anesthesiologists (ASA) grade,[15] day-before-surgery admission, marital status, body mass index (BMI), and consultant in charge.

The greatest preoperative predictor of PLOS is day-before-surgery admission, which accounts for 16% of all predicted PLOS, followed by; age at procedure, joint, ASA grade and sex. Overall, these five preoperative predictors only account for 23% of PLOS, meaning that 77% of the reasons for PLOS is accounted for after admission to hospital.

Discussion

The average LOS following arthroplasty surgery is used as a quality metric for assessing the efficiency of a healthcare unit. Since the adoption of ERAS protocols two decades ago in orthopaedics, mean LOS in arthroplasty surgery worldwide has fallen considerably. In the UK, expected postoperative LOS is now five days,[2,16] improving from a mean of eight days[17] and 11 days[18] previously. The mean total LOS from our unit in this study of 1,878 patients was 4.0 days (1 to 42) but the mean postoperative LOS was 3.5 days (1 to 41), which is much lower than the reported UK mean of 5.0 days.[2,16] Our counterparts in Scotland reported a recent mean postoperative LOS of 4.0 days from their Scottish Arthroplasty Project 2019.[19] In the USA, Mayer et al[20] highlighted recent data from the National Surgical Quality Improvement Program (NSQIP), showing mean postoperative LOS to be 2.7 days and 2.9

Table II. Preoperative ranked predictors of prolonged length of stay following stepwise multiple regression

Rank	Predictor variable	Regression (r^2)	Pearson correlation	Odds ratio (95% CI)	p-value†
1	Day-before-surgery admission	0.160	0.400	6.4 (5.2 to 7.9)	< 0.001
2	Aged 75 yrs or older at procedure	0.199	0.264	3.2 (2.6 to 3.9)	< 0.001
3	Arthroplasty of knee joint	0.212	0.121	1.6 (1.4 to 2.0)	< 0.001
4	ASA grades 3 and 4*	0.225	0.194	3.5 (2.6 to 4.6)	< 0.001
5	Female sex	0.232	0.127	1.7 (1.4 to 2.0)	< 0.001

*Within the PLOS cohort, the proportion of ASA grade 3 or 4 patients over 75 yrs was significantly greater compared to patients under 75 yrs; 29% (101/346) vs 18% (81/460); p < 0.001. No difference was observed in the proportion of PLOS male patients vs female patients within ASA grade 3 or 4; 23% (65/283) vs 22% (117/523); p = 0.847. Marital status, BMI and consultant were found not to be predictors of PLOS.
†Multuple regression analysis.
ASA, American Society of Anesthesiologists; CI, confidence interval.

days for THAs and TKAs respectively.[20] A similar mean postoperative LOS of 3.1 days were reported by Winther et al[21] in Norway and Pamilo et al[22] reported median LOS of 2.0 days based on the Finnish Arthroplasty Register.[22] The focus on ERAS protocols and reduction in postoperative LOS not only benefit patients' recovery in reducing complications and mortality rates, it also helps reduce the cost of joint arthroplasty in the NHS.[23]

In the current climate of tighter NHS budgeting with constraints on additional funding, cost efficiency is important. LOS is a key component of cost and reducing it without compromising care should deliver cost-savings. For almost two decades, the UK Department of Health through the National Audit Office has been urging NHS Trusts and managers to reduce postoperative LOS, mainly due to health economics of running the NHS.[18,24]

In this audit, PLOS was defined as total LOS of four or more days from admission to discharge. Discharge criteria require that the patient has no medical issues, can do stairs, and mobilize independently. However, if referred for any services following discharge, a formal assessment is required by physiotherapy, OT, and social services. This assessment process does not commence until after surgery, which adds to the delay. Of the 1,878 patients included in the study, 806 (42.9%) had a PLOS using 4,907 (64.6%) bed days, equating to 2,489 excess bed days. Upon data analysis, the top three reasons for PLOS are social services (1,224 excess bed days, 49.2%), day before surgery admission (283 excess bed days, 11.4%) and patients being slow to mobilize (261 excess bed days, 10.5%).

Of the 806 patients with a PLOS, 200 (38.2%) requested services on admission and of those, 179 (89.5%) received services. These patients fitted our discharge criteria but often the patient or family felt there was a need for additional support on discharge. The delay while waiting for social services as an inpatient generated 1,224 excess bed days, representing 49.2% of the sum excess bed days of this study. There were no cases where services were arranged prior to admission. At present, there is no facility within our local health services to assess an individual's need for support services following discharge until after they have had their surgery. These results echo findings from a previous study of 535 arthroplasty patients carried out in our unit eight years ago, with "social reasons" being accountable for half of delayed discharges in THA patients, and a third in TKA patients.[14] Robust postoperative care, early mobilization, and discharge protocols laid down over the past decade have resulted in considerable reduction of our unit's postoperative LOS, which is now comparable to LOS in the UK private sector[25] and also the mostly privately-funded healthcare system in the USA.[20] Future enhanced recovery programs must include a preadmission discharge plan if they are to avoid the common scenario of patients who are otherwise ready to go home having to wait in hospital for a discharge package. In reality many of these patients, if given the appropriate information, are able to make their own arrangements.

Despite integration of health and social care systems in Northern Ireland, reports still indicate that difficulties exist in that interface.[26] At present, needs assessment with regard to a care package following discharge cannot begin until after surgery. In accordance with principles of the Care Act 2014, local community and social services should get involved in the patient journey as early as possible, either at preassessment or consent clinics, to identify patients who may require help at home post-surgery. One option would be to have a written discharge plan or agreement with the patient and/or the patient's family. This should help identify those patients that are unable to put in place a safe discharge plan for themselves and feel that they would benefit from social services input.

The second reason for PLOS in our institution is day-before-surgery admission. Within the overall cohort, 282 (34.9%) patients came in on the day before surgery. This is a local issue of custom and practice and may now be unnecessary given that all our patients have a rigorous preoperative assessment. This has been shown to allow for safe day-of-surgery admission.[27,28] This resulted in 283 excess bed days (11.4% of total excess bed days). Generally, arthroplasty patients in the rest of the UK come in on the day of surgery and this is a targeted area of improvement for our service.

In our study, 111 patients were slow to mobilize, accounting for 261 or 10.5% of our excess bed days. In many units today, patients are mobilized on the day of surgery, whereas for this cohort of patients that would have been the exception. Adopting mobilization on the day of surgery combined with better patient education preoperatively are key areas we can focus on to help address this. Early mobilization has been shown to reduce LOS and morbidities in arthroplasty patients.[29] A focus group study in Norway also showed that with correct education, patients responded better with confidence and took more responsibility for their own rehabilitation process.[30]

This was a retrospective study. However, various measures were taken to ensure its reliability. Clear inclusion and exclusion criteria and objective variables were defined early on to investigate PLOS in arthroplasty patients. A sample size of 1,878 patients, while not large compared to national registries, is a pragmatic number and reflects the real-world experience of a busy arthroplasty unit prior to introduction of a formal ERAS service and protocols. Review of all patient notes was carried out by a single qualified research nurse, ensuring consistency during data abstraction in a standardized manner. It is worth mentioning that over the years our unit has adopted aspects of enhanced recovery resulting in a mean LOS of 4.0 days, which compares well with the rest of the UK.[31,32] Our work highlights the burden of delayed social services on the health system, the need for a preadmission discharge plan and a standardized protocol and patient pathway for our arthroplasty patients.

Social service referral (49.2%), day-before-surgery admission (11.4%) and slow to mobilize (10.5%) together accounted for 71.1% of our prolonged bed stays. A preadmission discharge plan, day-of-surgery admission and mobilization on the day of surgery would have the potential to significantly reduce LOS without compromising patient care. Integration of these improvements into an enhanced recovery and standardized protocol would be highly beneficial.

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Supplementary material

Tables showing final reasons for PLOS (complete lists).

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- L. Bryce: Collected, analyzed, and interpreted the data, Edited the manuscript.
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- J. C. Hill: Analyzed and interpreted the data, Edited the manuscript.
- O. Diamond: Analyzed and interpreted the data, Edited the manuscript.
- D. Beverland: Conceived and supervised the study, Prepared and edited the manuscript.

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