



■ SPINE

A Preoperative Spinal Education intervention for spinal fusion surgery designed using the Rehabilitation Treatment Specification System is safe and could reduce hospital length of stay, normalize expectations, and reduce anxiety

A PROSPECTIVE COHORT STUDY

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Aims

Psychoeducative prehabilitation to optimize surgical outcomes is relatively novel in spinal fusion surgery and, like most rehabilitation treatments, they are rarely well specified. Spinal fusion patients experience anxieties perioperatively about pain and immobility, which might prolong hospital length of stay (LOS). The aim of this prospective cohort study was to determine if a Pre-operative Spinal Education (POSE) programme, specified using the Rehabilitation Treatment Specification System (RTSS) and designed to normalize expectations and reduce anxieties, was safe and reduced LOS.

Methods

POSE was offered to 150 prospective patients over ten months (December 2018 to November 2019). Some chose to attend (Attend-POSE) and some did not attend (DNA-POSE). A third independent retrospective group of 150 patients (mean age 57.9 years (SD 14.8), 50.6% female) received surgery prior to POSE (pre-POSE). POSE consisted of an in-person 60-minute education with accompanying literature, specified using the RTSS as psychoeducative treatment components designed to optimize cognitive/affective representations of thoughts/feelings, and normalize anxieties about surgery and its aftermath. Across-group age, sex, median LOS, perioperative complications, and readmission rates were assessed using appropriate statistical tests.

Results

In all, 65 (43%) patients (mean age 57.4 years (SD 18.2), 58.8% female) comprised the Attend-POSE, and 85 (57%) DNA-POSE (mean age 54.9 years (SD 15.8), 65.8% female). There were no significant between-group differences in age, sex, surgery type, complications, or readmission rates. Median LOS was statistically different across Pre-POSE (5 days ((interquartile range (IQR) 3 to 7)), Attend-POSE (3 (2 to 5)), and DNA-POSE (4 (3 to 7)), ($p = 0.014$). Pairwise comparisons showed statistically significant differences between Pre-POSE and Attend-POSE LOS ($p = 0.011$), but not between any other group comparison. In the Attend-POSE group, there was significant change toward greater surgical preparation, procedural familiarity, and less anxiety.

Conclusion

POSE was associated with a significant reduction in LOS for patients undergoing spinal fusion surgery. Patients reported being better prepared for, more familiar, and less anxious about their surgery. POSE did not affect complication or readmission rates, meaning its inclusion was safe. However, uptake (43%) was disappointing and future work should explore potential barriers and challenges to attending POSE.

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Introduction

Improving surgical outcomes by bundling together perioperative procedures under a concept name (Fast-Track Surgery) in the 1990s demonstrated favourable length of stay (LOS) reductions.¹ Subsequent studies confirmed LOS reductions,² but also reported reductions in complications by modifying surgical organic stress responses (e.g. optimizing nutrition/analgesia).³ These efforts advanced the formation of the Enhanced Recovery After Surgery (ERAS) study group in 2001. They developed an evidence-based ERAS protocol for colorectal surgery, optimizing outcomes by perioperative care, not solely by the operation.⁴ ERAS programmes have subsequently evolved in nearly all major specialties including thoracic,⁵ urological,⁶ gynaecologic,⁷ gastric,⁸ oesophageal,⁹ liver resections,¹⁰ emergency,¹¹ and elective orthopaedic hip/knee arthroplasty surgery.¹²

The ERAS Society has yet to publish official proposals for spine surgery,¹³ although there is a lumbar spinal fusion consensus statement.¹⁴ The slow evolution may be due to heterogeneous spinal surgery interventions at different surgical fusion level(s) (open or minimally invasive cervical or thoracolumbar spinal surgery) for varied pathologies (degenerative spondylosis, disc herniation, infection, metastatic tumours, spinal deformity, spondylolisthesis, and trauma), and patient characteristics (preoperative symptom chronicity, comorbidity, and lived experience).¹⁵ While postoperative recovery has historically been informed by individualized consultant surgeon decisions, recent developments are likely driven by increasing rates of spinal procedures due to an ageing population, improved imaging diagnostics, technical advances in implants and minimally invasive procedures, and better training for orthopaedic and neurosurgeons.¹⁴

ERAS studies that exist for elective spinal surgery recommend preoperative education and counselling as a core element.¹⁵ This psychoeducative approach combines systematic education with discourse designed to support management and mitigate current and future problems.¹⁶ It is similar to joint arthroplasty surgery where expectations are managed by preoperative education of the surgical procedure, normal iatrogenic immobility/discomfort, and recovery timescales. The approach is ultimately designed to increase intraoperative use of neuraxial rather than general anaesthesia,¹⁷ reduce postoperative opioid use¹⁸ and associated nausea and vomiting rates,¹⁹ optimize adherence to postoperative rehabilitation, and reduce LOS by modulating stress/anxiety responses.²⁰

The latest ERAS Society consensus for hip/knee arthroplasty recommends preoperative education, targeted for the right people at the right time.²¹ Their decision was based on observations that preoperative education is low-risk yet exhibits equivocal efficacy, which might be influenced by how the preoperative education is specified and

whether it is psychoeducative. It ranges from the simple issuing of written material (highly desirable, cheap, and fulfils ethical obligations to inform patients about procedures) to interactive classes with supporting written or video information.²² Unspecified treatments where intervention is merely considered a black-box is not unusual in any field of rehabilitation,²³ although the recent Rehabilitation Treatment Specification System (RTSS) offers a theoretical framework to address this.²⁴ Nonetheless, an optimal psychoeducative approach for elective hip/knee arthroplasties that satisfies patients, clinicians, researchers, health economists, and ethicists remains to be determined.

While the development of psychoeducative approaches in spinal surgery is even more nascent, a recent protocol using an ERAS approach justified preoperative education and patient activation to modulate outcomes including LOS,²⁵ and empowered patients to take responsibility for their postoperative recovery.²⁶ It is possible that psychoeducative approaches might need to be more targeted for spinal surgery patients because they are likely to be more complex in contrast to hip/knee arthroplasty. Preoperative anxiety and depression are prevalent in approximately 30% of spinal surgery patients with chronic pain,²⁷ and a decision to treat surgically can exacerbate anxiety and pain perception.²⁰ Yet, despite these developments, our local spinal service relies on two consultant-led presurgical clinics where shared decisions and consent to surgery, guided by the Montgomery ruling,²⁸ are made. It is unclear if any psychoeducative approaches are used, and whether patients retain or react to all the information shared at these consultations.

The purpose of this study was to incorporate and evaluate a psychoeducative Preoperative Spinal Education (POSE) intervention for spinal fusion patients. The aims were to assess patient uptake of POSE, and to compare post-surgical LOS between patients who accepted the intervention and a retrospective group of patients whose surgery was completed prior to POSE. Our secondary aims were to assess the effect of POSE on normalizing patients' self-assessed expectations and anxieties related to their planned surgery, and compare complication rates before and after the introduction of POSE. The results will provide insights into the structure of the psychoeducation in this complex population and inform experimental testing of its efficacy. This paper was prepared in accordance with the guidance set forth by the STROBE statement.²⁹

Methods

Design and ethics. This was an observational cohort study ethically approved by the local directorate governance committee (ref: 10759) which provides oversight in compliance with the Helsinki Declaration.³⁰

Participants. Adults listed for degenerative spinal fusion or idiopathic scoliosis correctional surgery over a calendar year (2019) were eligible, and were offered POSE by health professionals or admissions managers following, and independently of, the shared patient-consultant decision and consent process to proceed to surgery. Relatives were encouraged to attend POSE to support language/communication barriers. Data for the first stage admission in those requiring separate stage procedures were collected. An independent retrospective case-controlled group represented consecutive patients who underwent similar surgery prior to the implementation of POSE (Pre-POSE) over the previous (2018) year. We aimed to capture a calendar year to account for seasonal variations.

Intervention. POSE is a single, psychoeducative, preparatory intervention (60 minutes) designed to normalize expectations (pain and function associated with surgical, physical rehabilitation, and hospital procedures), minimize anxieties, and support post-surgical recovery. It is delivered by two experienced, senior clinicians (physiotherapist and nurse-specialist) in a live group (n = 10 including carers) including a pre-recorded spinal consultant video presentation. Verbal information is shared, discourse encouraged, and accompanying written literature is provided. Content was based on ERAS examples and the opinions of 15 multidisciplinary staff (consultant spinal surgeons, therapists, nurses, and administrators; conveyed in semi-structured interviews) and 15 patients (conveyed at focus groups organized as part of steering-group meetings).

The rehabilitation content was specified using the RTSS's standard nomenclature to assure rehabilitative clinical reasoning and repeatability (Table I). Most treatment targets were specified as Representations. These optimize cognitive/affective representations of written/verbal information, thoughts/feelings or anxieties about procedures and their aftermath, or optimize representations that target an individual's propensity to act (e.g. participating in planned physical rehabilitation despite postoperative pain).²⁴

Postoperative discharge criteria. It is established practice at the study hospital site that discharge is not considered until patients are compliant with achieving standard criteria which include suitable analgesia, extensive postoperative ambulatory physiotherapy, and a thorough functional independence assessment (Table II). POSE was introduced independently of this standard practice. Goals of electing to have spinal surgery included, for most patients, relief from a significant duration (at least a year) of isolated axial pain, radicular pain, referred pain, or combinations thereof. Patients listed for surgery often therefore presented with existing complex and varied analgesia regimes to manage their pain syndromes. While each patient received a standardized postoperative analgesia regime independently of POSE, they varied

considerably depending on the patient's preoperative requirements. Postoperative regimes initially comprised opiate-based patient controlled analgesia (PCA), a step-down ladder of oral analgesia as required, and an individualized oral analgesia regime to go home with. This was accompanied by an individualized postoperative nausea and vomiting (PONV) prophylaxis and rescue medication programme. The determination as to whether patients met the discharge criteria was made by achieving agreement between the patient and ward nursing staff, physiotherapist, occupational therapist, and operating surgeon.

Statistical analysis. Data were analyzed on a complete-case basis. Prospective patients were divided into those who did not attend POSE (DNA-POSE), and those who attended POSE (Attend-POSE), with retrospective patients (Pre-POSE) representing a third group for comparison. Age was determined at the date of surgery. Postoperative LOS (days) was delineated between the surgery and hospital discharge dates. Surgery type was categorized into four types - all 1 spinal-level fusions (1-level fusion), all 2 spinal-level (2-level fusion), all 3 or 4 spinal-level fusions (3 or 4-level fusion), and all scoliosis correction procedures (scoliosis-correction). Each category was inclusive of additional decompressions or laminectomies, revisions, or stages of fusion.^{32,33}

Descriptive data are presented as either mean (standard deviation (SD)) or median (IQR) for continuous/ordinal data, or as proportions for categorical data. Across the three groups, the difference in median LOS was assessed using an independent Kruskal-Wallis H Test, and the difference in mean age, using an independent one-way analysis of variance (ANOVA) with homogeneity of variances assessed using a Levene's test. If any statistical differences across the three groups were detected, post-hoc pairwise comparisons using a Dunn's procedure,³⁴ with a Bonferroni correction for multiple comparisons, were used, with adjusted p-values presented.

Differences across groups in proportions of sex distribution, proportions of surgery type, and proportional rates of hospital readmission (to the surgical hospital or any other) within six months of discharge were assessed using chi-squared tests of homogeneity. The number of recorded post-surgical complications (based on the International Classification of Disease (ICD-10)³⁵ requiring medical intervention, as a percentage of signature spinal surgeries undertaken during the acute hospital stay up to six months post discharge, were collected using electronic patient records. If a patient experienced a secondary independent complication according to the patient record during their inpatient stay, this was recorded separately. Across-groups differences in proportions of complications during the acute hospital stay (primary complication rate and secondary complication rate) and post-discharge were assessed using chi-squared tests of homogeneity. If statistical differences in proportions

Table 1. Specification of preoperative spinal education based on the rehabilitation treatment specification system.

Description of clinical interaction	Target			Ingredients		
	What / In what way	Group	Volition type	MOA	Ingredient	Dosing parameter
The surgical consultant imparts knowledge about expected recovery timelines and reiterates information about the effects of early mobilization and importance of patient responsibility in rehab	Positive beliefs toward participation in rehabilitation / increase	R	DV	Cognitive and affective information processing	Video presentation from consultant promoting benefits of early postop physical rehabilitation	N/A
	Knowledge about expected recovery and timeline of recovery/ increase	R	DV	Cognitive and affective information processing	Video presentation from consultant conveying information on expected timeline of recovery and rehabilitation	N/A
The healthcare professional instructs patients to take actions prior to admission to aid recovery and discharge planning	Assignment to populate furniture height form prior to admission/ complete	R	V	Cognitive and affective information processing	Verbal and written instruction to populate furniture height form before presenting to hospital; verbal explanation of rationale	N/A
	Assignment to optimize home environment for discharge, prior to admission/ complete	R	V	Cognitive and affective information processing	Verbal and written instruction to complete pre-admission purchase of ready meals, laundering of clothes, and movement of chair to bathroom; verbal explanation of rationale	N/A
The healthcare professional imparts knowledge about the pre-admission and day-to-day expected hospital routine to reassure and familiarize	Knowledge about expected hospital pre- and post-surgical routine / increase	R	DV	Cognitive and affective information processing	Verbal and written information on what to bring to hospital; verbal and written information about dietary restrictions pre-arrival; verbal and written information on normal ward activities (e.g. routine diagnostics, ward rounds, physiotherapy); reassurance that equipment attached (e.g. drips) are normal and scheduled	N/A
	Knowledge about the role of the ward OT / increase	R	DV	Cognitive and affective information processing	Verbal and written information on role of OT	N/A
The healthcare professional imparts knowledge about causes of pain and expectation of postoperative pain	Knowledge about surgical procedure's influence on pain mechanisms / increase	R	DV	Cognitive and affective information processing	Verbal and written reassurance that experiencing postoperative pain is normal; reassurance of typical duration of postop pain Verbal and written information on effects and side effects of pain medication; provide opportunity for questions to be fielded.	N/A
The healthcare professional enables information about the effects of early mobilization and importance of patient responsibility in rehab	Negative beliefs toward early mobilization post-surgery/ decrease	R	DV	Cognitive and affective information processing	Verbal and written information about the expected movement milestones after surgery and their progression; reassurance that being fearful of moving is normal, but disadvantageous	N/A
	Positive beliefs toward participation in rehabilitation/ increase	R	DV	Cognitive and affective information processing	Verbal and written information on benefits of early postop physical rehabilitation; reassurance that physical rehabilitation will not cause damage	N/A

Continued

Table 1. Continued

Description of clinical interaction	Target			Ingredients		
	What / In what way	Group	Volition type	MOA	Ingredient	Dosing parameter
The healthcare professional facilitates the patient to understand their preferred method of transferring in and out of bed and then offers adjustments to the sequence to determine a comfortable configuration to use postoperatively. The physiotherapist then provides written information as a reminder of the sequence.	Knowledge of postop methods of transferring in and out of bed sequence/ increase	R	DV	Cognitive and affective information processing	Verbal and written information on alternative transfer methods; therapist demonstration of alternative transfer methods; provision of images of transfer method	N/A
	Independent performance of postop method of transferring in and out of bed/ achieve	Skills and habits	DV	Learning by doing	Provide opportunity to practice postop method of transfer; verbal feedback on correct sequencing and performance	Until independent performance achieved
The healthcare professional imparts knowledge about setting attainable, progressive, small, movement and functional goals that lead to a larger and more long-term personalized goal to optimize postop movement recovery	Positive attitude towards goal setting in rehabilitation/ increase	R	DV	Cognitive and affective information processing	Verbal and written information that patient/therapist negotiated movement goals at optimal level of challenge within the normal recovery profile are advantageous	N/A
The healthcare professional imparts knowledge about rare, but important, untoward signs of surgical infection and what to do if they emerge	Knowledge about signs of wound infection/ increase	R	DV	Cognitive and affective information processing	Example images of infected site; written examples of untoward physical symptoms; provide opportunity for questions to be fielded	N/A
	Knowledge about actions to take if suspect signs of wound infection/ increase	R	DV	Cognitive and affective information processing	Verbal and written instruction to contact. Orthopaedic dept, GP, 111, or A&E if suspect infection	N/A
The healthcare professional fields typical questions and anxieties and offers contact details for future questions	Anxieties about attending hospital for surgery/ reduce	R	DV	Cognitive and affective information processing	Provide opportunity to consult FAQs and answers; provide opportunity for questions to be fielded; provide written further contact detail information	N/A

As per RTSS guidance, the table includes a dosing column. Note however that for the majority of treatment components, dosing was notated as not applicable. This is due to there being no quantifiable significance in the delivery of ingredients that could be hypothesized to affect the outcome of the specified treatment targets.

Non-rehabilitative custodial tasks were omitted from the RTSS (e.g. instruction to apply antibacterial Oectenisan scrub prior to surgery). Volition was considered during POSE using the capability, opportunity, motivation and behaviour (COM-B) framework (e.g. volition is compromised if a patient believes they lack either the physical Capabilities, or the home-life Opportunity, or the Motivation to deploy the treatment because they do not believe it is advantageous).³¹

A&E, Accident and Emergency; DV, direct target for volitional; FAQ, frequently asked questions; GP, general practitioner; MOA, mechanism of action; N/A, not applicable; OT, occupational therapist; R, Representations group; RTSS, rehabilitation treatment specification system; V, volitional.

across the three groups were detected, post-hoc pairwise comparisons with using multiple Fisher’s exact tests were used with a Bonferroni correction.

Pre- to post-POSE differences in prospective patients’ expectations (preparedness toward surgical procedures, procedural familiarization with post-surgical pain/movement), and their anxiety about surgery were measured using three separate, self-reported five-point ordinal Likert scales (1, not at all prepared/familiar/anxious; to 5, very prepared/familiar/anxious). The

scales were administered in written format for patients to self-report on arrival at the POSE intervention, and then again immediately after the POSE intervention had finished. Differences between pre-POSE and post-POSE preparedness, familiarization, and anxiety were assessed based on the written scale responses using Wilcoxon signed-ranked tests independently for each factor. All statistical analyses were undertaken using SPSS (v 26.0; IBM, USA), with $p \leq 0.05$ assumed to be statistically significant.

Table II. Multidisciplinary ward discharge criteria for postoperative spinal fusion patients. Standardized and established multidisciplinary criteria to be achieved for spinal surgery patients before discharge from the acute hospital ward.

Postoperative domain	Intervention	MDT primary responsibility
Wound care	Confirm patient's wound dry with evidence of healing; confirm absent signs of infection or oozing	Nursing team
Return of bowel function and urinary drainage	Confirm patient's bowels have opened and passing urine	
PONV	Confirm PONV resolved or managed within acceptable range for patient with rescue pharmacology	
Pain management	Confirm patient's pain controlled with individualized analgesia regime, with or without liaison with acute pain physician colleagues for individual needs	Surgeon team
Neurovascular iatrogenesis	Confirm patient absence of worsening or unexplained neurovascular deficits	
Surgical site imaging	Confirm patient's postoperative imaging reviewed for any untoward studies	
Blood chemistry and clinical observations	Confirm absence of untoward routine blood chemistry results or routine clinical observations	
External axial support of surgical site	Confirm patient or formal/informal care giver competent to don, doff, and tolerate period of application of appropriately prescribed postoperative spinal brace or corset.	PT team
Activities of daily living	Confirm patient's capability with or without assistance of formal/informal care giver to wash and dress with or without adaptive aids Confirm patient's capability and/or assistance of formal/informal care giver to make light meals/drinks and/or adaptive aids	OT team
Mobility	Confirm patient's ambulatory milestone ability and/or assistance of formal/informal care giver: <ul style="list-style-type: none"> ■ Tolerate periods of sitting in a chair for ≥ 30 minutes ■ Transition to/from bed/toilet/chair with or without adaptive aids ■ Forward ambulation ≥ 10 m with or without appropriate mobility aid ■ Ascend and descend discharge destination-appropriate step(s)/flight of stairs with or without mobility aids 	PT team
Post-discharge rehabilitation and custodial care	Confirmation of decision by OT and PT of patient's safety to go home based on completed assessments with or without confirmation of additional social or nursing support arranged through local services, with or without confirmation of additional goal-orientated domiciliary or community therapy arranged	OT and PT teams; nursing team; social work team

MDT, multidisciplinary team; OT, occupational therapy; PONV, postoperative nausea and vomiting; PT, physiotherapy.

Table III. Group age and sex characteristics. Mean age and proportionate sex are shown per group.

Group	Number (%)	Mean age on surgery date, yrs (SD; 95% CI)	Sex, n (%)	
			Female	Male
Pre-POSE	150 (100)	56.4 (16.3; 53.7 to 59.0)	82 (55)	68 (45)
Attend-POSE	65 (43)	57.3 (18.8; 52.6 to 61.9)	35 (54)	30 (46)
DNA-POSE	85 (57)	55.9 (17.4; 52.1 to 59.6)	58 (68)	27 (32)

CI, confidence interval; DNA, did not attend; POSE, preoperative spinal education; SD, standard deviation.

Results

Between December 2018 and November 2019, 150 prospective patients were offered POSE, with 150 retrospective patients (Pre-POSE) reviewed between November 2017 and December 2018. There were 65 (43%) Attend-POSE, and 85 (57%) DNA-POSE patients. After confirming no significant homogeneity of variances existed ($p = 0.342$, Levene's test), we observed no statistical difference in mean age across Pre-POSE (56.4 years (SD 16.3)), Attend-POSE (57.3 (SD 18.8)), and DNA-POSE (55.9 (SD 17.4)) ($F(2, 297) = 0.127$; $p = 0.881$), and no statistical difference in proportions of sex ($\chi^2(2) = 4.797$; $p = 0.091$) (Table III) or surgery type ($\chi^2(6) = 8.258$; $p = 0.220$) (Table IV).

Median LOS was statistically different across Pre-POSE (5 days (IQR 3 to 7)), Attend-POSE (3 (IQR 2 to 5)), and DNA-POSE (4 (IQR 3 to 7)) ($\chi^2(2) = 8.511$; $p = 0.014$). Pairwise comparisons showed statistically significant differences in median LOS between Pre-POSE and Attend-POSE ($p = 0.011$), but not between any other group comparison (Figure 1).

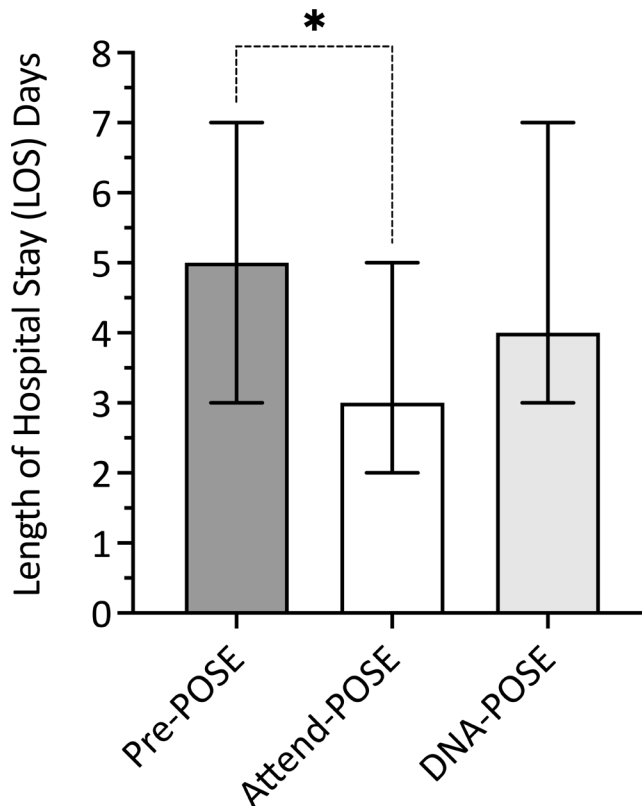
Of the 65 Attend-POSE patients, 55 (85%) completed pre-/post-POSE Likert scales. For surgical preparedness, 31 (56%) patients felt to some extent more prepared, 22 (40%) felt no different, and 2 (4%) felt to some extent less prepared post-POSE. There was a statistically significant median difference in self-assessed rating towards being more-prepared (1 scale point (IQR 0 to 1)) post-POSE (4 (IQR 4 to 5)) compared to pre-POSE (4 (IQR 3 to 4)), ($z = -4.786$; $p < 0.001$).

Similarly for familiarization, 37 (67%) patients felt to some extent more familiar, 14 (26%) felt no different, and (7%) felt to some extent less familiar with post-surgical pain/movement procedures post-POSE. There was a statistically significant difference towards being more procedurally familiar (1 scale point (IQR 0 to 2)) post-POSE (4 (IQR 4 to 5)) compared to pre-POSE (3 (IQR 2 to 4)) ($z = -5.074$; $p < 0.001$).

Table IV. Group surgery type characteristics. Proportions of four surgery type categories are shown, and each category is inclusive of all types of surgical procedure.

Group	n	Surgery type, n (%)			
		1-level fusion	2-level fusion	3 or 4-level fusion	Scoliosis-correction
Pre-POSE	150	61 (41)	48 (32)	18 (12)	23 (15)
Attend-POSE	65	36 (55)	15 (23)	3 (5)	11 (17)
DNA-POSE	85	42 (49)	19 (22)	7 (8)	17 (20)

POSE, preoperative spinal education.

**Fig. 1**

Median length of hospital stay (LOS) by group. Error bars show the interquartile range; *indicates significant pairwise comparison difference at the $p < 0.05$ level. DNA, did not attend; POSE, preoperative spinal education.

For anxiety, 21 (38%) patients felt to some extent less anxious, 29 (53%) felt no different, and five (9%) felt to some extent more anxious about their surgery post-POSE. There was a statistically significant difference towards being less anxious about the surgery and its aftermath (0 scale point (IQR 0 to 1)) post-POSE (3 (IQR 2 to 4)) compared to pre-POSE (3 (IQR 3 to 4)) ($z = -2.709$; $p = 0.007$).

There were no differences in hospital readmission rates across Pre-POSE ($n = 10$ (7%)), Attend-POSE (6 (9%)), and DNA-POSE (11 (13%)) ($\chi^2(2) = 2.613$; $p = 0.271$). Furthermore, there were no statistical differences in inpatient primary complication rates (Pre-POSE ($n = 48$), Attend-POSE (19), and DNA-POSE (17) ($\chi^2(2) = 3.938$; $p = 0.140$)), inpatient secondary complications (Pre-POSE (17), Attend-POSE (7), and DNA-POSE (6) ($\chi^2(2) = 1.156$;

$p = 0.561$), or post-discharge complications (Pre-POSE (25), Attend-POSE (7), and DNA-POSE (18) ($\chi^2(2) = 2.872$; $p = 0.238$)) (Supplementary Table i).

Discussion

Our main finding was a significant two-day reduction in median LOS in Attend-POSE compared to pre-POSE. There was also a non-statistically significant one-day reduction compared to DNA-POSE. A one-day reduction represents obvious cost benefits for hospital bed flow, and reduces complication risks e.g. hospital-acquired infections,³⁶ so these differences are clinically meaningful. While our results are encouraging, these LOS data should be interpreted with caution given that only 43% of patients who were offered POSE chose to participate. Despite this, we are confident that LOS reductions did not affect patients' discharge function, nor their downstream health or social care burden, because discharge procedures remained unchanged irrespective of POSE. We are also confident that LOS reductions did not affect post-surgical complications because there were no significant differences in between-group complication or readmission rates. Our data therefore confirm that patient safety was unaffected by any LOS reductions POSE conferred.

In contrast to our study, a smaller recently published North American spinal fusion surgery study compared an ERAS group (2017 to 2018; mean age 69 years (SD 9); $n = 67$) with a historical group pre-ERAS (2016 to 2017; 70 years (SD 8); $n = 57$) and observed a significant increase in mean LOS (by one day) in the ERAS group.³² The authors explain that the finding was probably due to the introduction of social assessment, and nutritional and rehabilitation education sessions, and allude to these being additional requirements to established practice in their ERAS protocol. During our study, established discharge processes and criteria (Table II) remained stable. Therefore, it is likely that LOS was more sensitive to change by the inclusion of POSE in our study. Nonetheless, an increase in LOS in the more recent paper was surprising because ERAS led to significant improvements in other factors.³² For example, they observed lower readmission rates post-discharge, less urinary retention and constipation, and less inpatient opioid intake as a supplement to intravenous or epidural analgesia. We do not present the effect POSE had on additional inpatient opioid intake in our study, nor whether opioid-sparing reduced PONV

rates.¹⁸ This is because we predicted a large inter-subject variance among analgesia and PONV prophylaxis and rescue treatment uptake by virtue of our established practice in individualizing it. We did not therefore think it likely to be a useful indicator of the effect of POSE in this observational study.

POSE integrated written information about spinal surgery expectations with interactive patient education in line with ERAS standards.²¹ Most treatment components were specified (using the RTSS) within the Representations group. POSE treatment ingredients included written and verbal education/counselling predicted to affect cognitive/affective representations (e.g. acquiring reassuring knowledge about post-surgical pain) and propensity to act (encouraging peri-surgical behaviours by changing attitudes, motivations, or beliefs toward therapeutic activities) via the mechanism of altering mental processing of cognitive/affective information.²⁴ This study is, as far as we know, the first time a psychoeducative intervention comprising Representations treatment components has been specified a priori using the RTSS.

There are two fundamental reasons why specified rehabilitation treatments are ultimately unsuccessful. First, the treatment ingredient does not modulate the target or is specified at an insufficient dose. Second, the patient fails to perform the activity as directed if volition is required independently of the therapist. Factors affecting volition in the RTSS are considered within the Capability, Opportunity, Motivation and Behaviour (COM-B) framework.³⁷ This meant that POSE was not designed as a simple information-sharing programme with which to increase patients' knowledge, but was instead designed to influence volitional behaviours postoperatively as well as influence attitudes, beliefs, and the achievement of functional tasks perioperatively. We were judicious in our considerations of volition, the constructs of knowledge acquisition, and of modulating attitudes/beliefs. Despite our efforts, specifying POSE interventions was challenging and we acknowledge their imperfections, not least in the lack of POSE uptake. Yet, because we have attempted to carefully specify POSE, research opportunities now exist to improve it as an intervention (for instance, experimentally manipulating POSE-specified targets and treatment ingredients, and then measuring their effect on post-surgical outcomes). Alternatively, it could be improved by measuring individual health changes in response to POSE using, for example, item response theory (Rasch models) to better tailor the approach.³⁸ These opportunities are only possible by virtue of POSE being specified, which is precisely one of the reasons why the RTSS was developed.³⁹

It was disappointing that 57% (n = 85) of participants did not attend POSE. However, our observation is in keeping with another recent observational study of

229 patients listed for spinal surgery where 116 (51%) did not attend an optional, unspecified, preoperative education session.⁴⁰ Instead of offering a binary choice of attendance, tailoring psychoeducation by sub-grouping patients depending on their predispositions could enable and affect uptake. For example, joint arthroplasty surgery patients can be categorized into those who desire information to handle uncertainly (monitors)³¹ or stress (sensitizers),⁴¹ those who avoid information about surgery (avoiders),⁴² those fearful about surgery (anxious),⁴³ and those who avoid considering unpleasant events (deniers).⁴⁴ However, the interaction among these groups with responses to psychoeducation are complex.⁴⁵ Since spinal fusion surgery confers more uncertain outcomes than total hip/knee arthroplasties,²⁶ elective spinal surgery patients are no less complex. Therefore, reliance on self-selected attendance might be counterproductive when individual predispositions are considered. For example, while deniers will avoid psychoeducation, they benefit from it, especially if they are lowly-anxious. In contrast, highly anxious patients with low denial could desire information that exacerbates their anxiety, and highly anxious patients with high denial might benefit from cognitive adaptation techniques like relaxation.⁴⁵ By letting patients make a binary choice in attending, and not specifying how and by whom POSE was offered to patients with respect to predispositions, we might have inadvertently led most patients not to attend POSE.

Among patients who attended POSE, most (85%) were able to provide feedback, with statistically significant change toward greater surgical preparedness, procedural familiarity, and less anxiety, confirming that self-assessed expectations and anxieties are normalized in patients who choose to attend POSE. There was however a minority who expressed being less prepared, less familiar, or more anxious to some extent post-POSE. Thus, reliance on self-selected attendance not only meant that most patients did not accept POSE, but also that expectations and anxieties were not uniformly normalized in those who did. Therefore, it is important to determine if a more tailored POSE approach specified using the RTSS, which includes an assessment of predisposition, or vulnerability to psychological ill health, influences POSE acceptability rates. Previous studies have included preoperative cognitive behavioural therapy (CBT) in addition to spinal surgery education,^{46,47} and another triangulated an assessment of psychological vulnerability with autonomic nervous system activity as a biological marker of stress reactivity.⁴⁸ Tailored approaches like these are candidates to improve POSE acceptability compared to its current omnibus form, and supports the literature's assertion that if rehabilitation targets include psychosocial factors, then identifying subgroups is advantageous.⁴⁶

There are some operational reasons which might have affected uptake of POSE, which we acknowledge

as limitations. It is possible that some patients listed for surgery were not offered POSE in clinic due to process limitations. Any future work will maximize opportunity for all patients. Of the 85 patients who did not accept POSE, only 25 (29%) lived within one borough of our hospital. Excessive travel time may have therefore influenced patients' attendance. Additionally, if patients with chronic pain or immobility comorbidities interpret POSE as another burdensome hospital appointment, then prioritizing attendance will be a challenge. We did not explore hospital-based healthcare use in this study, but offering remote technology options for spinal surgery patient appointments, including POSE, could improve uptake given the acceleration towards telehealth NHS targets in response to the COVID-19 pandemic.^{49,50}

In conclusion, we have successfully developed and deployed a POSE programme for spinal fusion patients that includes specified treatments using the RTSS. Our data suggest that for those patients who accept it, POSE is safe and influences factors perioperatively, resulting in a significant reduction in LOS in line with the ERAS approach. However, 43% uptake for POSE means it is not yet optimal. We plan to make operational changes to the preoperative clinic burden for patients, and test if POSE can be tailored for sub-grouped patients to optimize uptake.



Take home message

- It is possible to specify and deploy a psychoeducative preoperative spinal education (POSE) programme for spinal fusion patients using the Rehabilitation Treatment Specification System.

- For those patients who choose to accept it when offered, POSE is safe and influences factors perioperatively, resulting in a significant reduction in length of stay in line with the Enhanced Recovery After Surgery approach.

- However, we have an obligation to understand why POSE was only accepted by 43% of spinal surgical patients.

Supplementary material



Table summarizing surgical complication rates: counts of patients per preoperative spinal education group organized into inpatient and post-discharge (up to six months) periods are provided.

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