

Implementing a Standardized Pathway in Spine Surgery: Impact on Variability and Outcomes

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INTRODUCTION: Spine surgery currently lacks standardization despite numerous clinical guidelines, resulting in variability in treatments and outcomes. To address this, our center implemented a structured spine pathway for elective surgeries. The pathway included predefined targets for physical/occupational therapy (PT/OT) initiation, case management, bed type, and hospital length of stay (LOS) (Tables 01). This study aimed to evaluate adherence to these pathway targets and their effect on LOS.

METHODS: A retrospective, single-center study was performed on patients undergoing lumbar or thoraco-lumbar surgery from May 2022 to December 2024. Outcome measures included the first PT/OT visit, case management visit, bed type, discharge disposition, and LOS. Adherence to pathway guidelines was quantified overall and across 0-6+ categories. Adherence data were analyzed using Chi-square, Fisher's exact, and Kruskal-Wallis tests. Multivariate logistic regression, adjusted for adverse events (AE), was used to evaluate the impact of pathway adherence on LOS. Temporal adherence trends were assessed by stratifying patients into four surgical date-based groups, analyzed with Kruskal-Wallis and Brown-Forsythe tests.

RESULTS:

460 patients (66 years [IQR 57–73], 55.2% F, BMI: 28.7 ± 5.8 kg/m²) were included. Pathway 3 (single-level fusion) was the most common (~30%), while Pathway 6+ (long deformity fusions) was the least common. The distribution of patients by pathway and adherence rates is provided in Tables 02 and 03. Overall, 91.5% of patients met PT/OT visit targets, with lower adherence in the setting of intra-op AE (94.9% vs. 64.0%, p<0.001). A total of 68.7% of the patients met the predefined bed type criteria, with significant differences across pathways (p<0.001). Adherence did not vary based on intra-op AE (p=0.353), except for Pathways 3 and 4 (p=0.022 and p=0.037, respectively). A total of 76.7% of patients were discharged home; 64.2% of those not home discharged were seen on POD1, resulting in an overall case management compliance rate of 93.4%. As for the LOS, 48.9% of the patients met LOS targets, without significant difference across pathway 0 to 6 (p=0.07). The occurrence of AE (70.4% overall), increased with pathway severity (0–1: 25%, 2–3: 64.3%, 4–6+: 86.2%, p<0.001) and the presence of an AE was associated with significantly lower LOS adherence (40.1% vs. 70.4%, p < 0.001). Overall, 59.1% of patients met all three pathway targets (PT/OT, bed type, case management), 77.4% of those also met LOS targets (p<0.001) an association that remained significant after adjusting for adverse events.

Temporal analysis revealed an improvement in case management adherence (88.3% to 98.3%, p=0.025), while no significant changes were observed in PT/OT adherence (p=0.303), bed type adherence (p=0.752), or LOS adherence after adjusting for AE (p=0.357). LOS median values and variance did not significantly change over time (p=0.137, p=0.192, respectively).

DISCUSSION AND CONCLUSION: The pathway guidelines reflect current practice, however, certain guidelines may require adjustment to better align with clinical realities. Despite increasing communication and adherence to each individual metric, the overall LOS remains unchanged. However, patients who fully adhered to all three pathway criteria (PT/OT, bed type, and case management) demonstrated significantly higher LOS target adherence (77.4%), highlighting the potential impact of comprehensive compliance. Prospective interventions are necessary to drive meaningful improvements in LOS and patient outcomes.

Table 1: Categorization based on procedure and standardization targets, including PT / OT first post-operative visit, type of bed, Case management first visit (*patient expected to be discharged not home), and length of stay (LOS) expected

PW	SURGICAL DATA PROCEDURE	PT / OT TARGETS	BED TYPE	CASE M.*	LOS TARGETS
0	Discectomy / Laminectomy 1 level	2-4 hours after 5a	Same Day Discharge Regional Floor	If not disch: Home	≤ 12h
1	Discectomy / Laminectomy multi-levels / Laminectomy 1 level	2-4 hours after 5a	Regional Floor	Before POD1 6pm*	≤ 1 day
2	Laminectomy multi-levels	2-4 hours after 5a	Regional Floor	Before POD1 6pm*	≤ 2 days
3	Fusion 1 level (all types)	Before POD1 12pm	Regional Floor	Before POD1 6pm*	≤ 3 days
4	Fusion 2 levels (all types)	Before POD1 12pm	Regional Floor	Before POD1 6pm*	≤ 4 days
5	Fusion 3-4 levels (all types)	Before POD1 12pm	Telemetry	Before POD1 6pm*	≤ 5 days
6	Fusion 5 to 12 levels	Before POD1 12pm	Telemetry ICU	Before POD1 6pm*	≤ 6 days
6+	Fusion > 12 levels	Before POD1 12pm	Telemetry ICU	Before POD1 6pm*	≤ 8 days

Table 2: Outcomes and adherence rates to pathway guidelines: median time (with interquartile range, IQR) between surgery completion (Since SA) or order placement (Since Order) and the first PT/OT visit, adherence rates to PT/OT targets, Bed Type utilization and adherence rates to bed type targets.

PW	N (%)	PT/OT (HOURS)	PT/OT TARGET?	BED TYPE	BED TYPE TARGET?
0	29 (6.3%)	Since SA: 2 IQR 2 to 3	27 (93.1%)	Discharge: 58.6% Regional floor: 34.5%	27 (93.1%)
1	27 (5.9%)	Since SA: 3 IQR 2 to 6	18 (66.7%)	Regional floor: 48.1% Tele / Stepdown: 33.3%	18 (66.7%)
2	36 (7.8%)	Since SA: 3 IQR 2 to 4	30 (83.3%)	Regional floor: 52.8% Tele / Stepdown: 33.4%	22 (61.1%)
3	135 (29.3%)	Since SA: 2 IQR 2 to 4	131 (97.0%)	Regional floor: 57.8% Tele / Stepdown: 40.0%	78 (57.8%)
4	69 (15.0%)	Since SA: 2 IQR 1.5 to 4	64 (92.8%)	Regional floor: 39.1% Tele / Stepdown: 59.4%	27 (39.1%)
5	58 (12.6%)	Since SA: 2 IQR 1 to 4.25	55 (94.8%)	Tele / Stepdown: 70.7% ICU: 3.4%	55 (94.8%)
6	89 (19.3%)	Since SA: 2 IQR 1 to 3	83 (93.3%)	Tele / Stepdown: 64.1% ICU: 12.4%	72 (86.5%)
6+	17 (3.7%)	Since SA: 3 IQR 0.5 to 17.5	13 (76.5%)	Tele / Stepdown: 52.9% ICU: 29.4%	12 (70.6%)

Table 3: Outcomes and adherence rates to pathway guidelines (PW): adherence rates to Case Management guidelines, median length of stay (with interquartile range, IQR) stratified by presence or absence of AE, and adherence to LOS targets.

PW	N (%)	CASE M. TARGET?	LENGTH OF STAY (DAY)	MET LOS TARGETS?
0	29 (6.3%)	27 (93.1%)	No AE (86.2%): 0 IQR 0 to 1 AE (13.8%): 2.5 IQR 0.5 to 3.75	18 (62.1%)
1	27 (5.9%)	23 (85.2%)	No AE (63.0%): 1 IQR 0 to 1 AE (37.0%): 2.5 IQR 1.75 to 8.25	16 (59.3%)
2	36 (7.8%)	35 (97.2%)	No AE (44.4%): 1 IQR 1 to 3 Event (55.6%): 4 IQR 2.25 to 7.5	16 (44.4%)
3	135 (29.3%)	129 (95.6%)	No AE (53.3%): 3 IQR 2 to 4 Event (66.7%): 4 IQR 3 to 6	56 (41.5%)
4	69 (15.0%)	65 (94.2%)	No AE (15.9%): 4 IQR 3 to 5 AE (84.1%): 5 IQR 3 to 6.25	33 (47.8%)
5	58 (12.6%)	56 (96.6%)	No AE (17.2%): 3.5 IQR 2 to 5.5 AE (82.8%): 5 IQR 4 to 7	37 (63.8%)
6	89 (19.3%)	72 (80.9%)	No AE (12.5%): 4 IQR 3 to 4 Event (87.5%): 7 IQR 5 to 9	44 (49.4%)
6+	17 (3.7%)	13 (76.5%)	No AE (0%) AE (100%): 11 IQR 7.5 to 16	5 (29.4%)