The Effectiveness, Safety and Cost-Effectiveness of An Intervention Bundle for Reducing Length of Stay in Laparoscopic Cholecyctectomy Patients

E. Teo[1], Y. Ouyang[2], X.Y. Fong[3], N. Graves[4], H.R. Abdullah[5]
[1]Health Services Research Unit, Singapore General Hospital, [2]Investigational Medical Unit, SingHealth, [3]Office of Value Based Healthcare, Singapore General Hospital, [4]Health Services and Systems Research, Duke-NUS Medical School, [5]Department of Anaesthesiology, Singapore General Hospital

Background

A bundle of interventions was implemented for laparoscopic cholecystectomy (LC) in Singapore General Hospital to reduce post-operative length of stay (LoS). It was implemented in phases: a roadshow (RO) on 1st July 2020 to improve standardization of post-surgery care, default admissions to short-stay wards (SSW) from 1st March 2021 to reinforce LC as overnight-stay surgery and individual clinician reports (ICR) from 1st November 2021 for performance monitoring.

This study evaluates the effectiveness of the bundle in reducing LoS and costs without compromising patient safety.

Methods

This was an observational study of all patients undergoing LC from 1st October 2019 to 31st May 2022. Patients were grouped based on the intervention(s) that had been implemented when they had surgery (RO, RO + SSW, RO + SSW + ICR), with LC patients from 1st October 2019 to 30th June 2020 as historical control.

Negative binomial regression and chi-square tests were performed to compare LoS and safety outcomes (i.e., blood transfusion, complication, unplanned readmission, unplanned re-operation (RTOT) and unscheduled biliary intervention within 30 days of index surgery) respectively with the control group.

A cost-minimization analysis using a decision tree model was performed to evaluate the cost (hospital stay during index surgery, RTOT and hospital stay due to 30-day readmission after index discharge) reductions by the bundle, followed by probabilistic sensitivity analysis (PSA) using Monte Carlo simulations with 1,000 iterations.

Result

1) Characteristics of Patients in Study

Table 1. Socio-demographics and clinical characteristics of laparoscopic cholecystectomy patients within study period.

Characteristic	Pre-Intervention, n = 1971	Roadshow, n = 3121	Roadshow + SSW, n = 2511	Roadshow + SSW + ICR, n = 2791
Age, Years, mean (SD)	57 (14)	59 (15)	56 (16)	60 (14)
Female, n (%)	117 (59)	198 (63)	151 (60)	193 (69)
Race, n (%)				
Chinese	151 (77)	223 (71)	185 (74)	212 (76)
Malay	19 (9.6)	29 (9.3)	25 (10.0)	25 (9.0)
Indian	10 (5.1)	31 (9.9)	15 (6.0)	22 (7.9)
Others	17 (8.6)	29 (9.3)	26 (10)	20 (7.2)
ASA, n (%)				
1	37 (19)	22 (7.1)	19 (7.6)	12 (4.3)
2	132 (67)	223 (71)	205 (82)	220 (79)
3	28 (14)	67 (21)	27 (11)	47 (17)
Charlson Comorbidity Score, mean (SD)	1 (1)	1 (2)	1 (1)	1 (1)
DORSCON Orange Surgery, n (%)	82 (42)	312 (100)	251 (100)	221 (79)

2) Primary Outcome: Length of Stay

Table 2. Univariate and multivariable analysis of primary outcome (Length of Stay) comparing all study periods using negative binomial regression.

Variable	Univariate		Multivariable	
	IRR (95% CI)	*p*	IRR (95% CI)	*p*
Study Group				
Pre-Intervention	-	-	-	-
Roadshow	1.07 (0.92, 1.25)	0.400	1.01 (0.84, 1.22)	> 0.900
Roadshow + SSW	0.80 (0.67, 0.95)	0.009	0.81 (0.66, 0.99)	0.041
Roadshow + SSW + ICR	0.83 (0.71, 0.99)	0.032	0.79 (0.66, 0.95)	0.010
ASA	-	-	1.36 (1.21, 1.52)	< 0.001
Age	-	-	1.01 (1.01, 1.02)	< 0.001
DORSCON Orange Surgery	-	-	0.96 (0.80, 1.15)	0.600

3) Safety Outcomes

Table 3. Univariate analysis of safety outcomes comparing all study periods using Chi-square test. All safety outcomes were occurrence of outcome 30 days post-surgery except Blood Transfusion

Safety Outcome, n (%)	Study Grouping			
	Pre-Intervention	Roadshow	Roadshow + SSW	Roadshow + SSW + ICR
Blood Transfusion	2 (1.0)	3 (1.0)	3 (1.2)	0 (0)
Complications	5 (2.5)	11 (3.5)	2 (0.8)	7 (2.5)
Readmission	7 (3.6)	8 (2.4)	6 (2.4)	11 (3.9)
Return to OT	4 (2.0)	7 (2.2)	3 (1.2)	3 (1.1)
Unscheduled Biliary Intervention	4 (2.0)	1 (0.3)	2 (0.8)	3 (1.1)

4) Cost-Minimization Analysis

Table 4. Results of cost-minimization analysis and probabilistic sensitivity analysis comparing between Pre-Intervention and Roadshow + SSW + ICR periods.

	Pre-Intervention	Roadshow + SSW + ICR	Mean Change in Cost	Probability of Cost-Saving
Cost of Index Inpatient LOS, S$ (SD)	792,727 (119,640)	799,962 (110,164)	1,502	52.20%
Cost of Return to OT, S$ (SD)	12,002 (4,610)	5,404	-6,461	94.10%
Cost of Readmission inpatient, S$ (SD)	11,215 (7,974)	16,759 (10,253)	5,739	31.90%
Total Cost, S$	815,845 (120,248)	822,125 (110,869)	780	52.50%

Conclusion

Systematic changes in service structure and provider behaviors can safely reduce costs and LoS of LC patients.

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