

Use of interrupted time-series analyses in evaluating health economic outcomes following implementation of multilayer water-tight wound closure in a primary total joint arthroplasty population

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OBJECTIVE

- Conventional sutures and staples are most used for total hip and knee arthroplasty (TJA)
- Wound closure method that incorporates multi-layer, watertight closure (MLWC) could increase the preventative effectiveness against joint prosthetic adverse events [1].
- Interrupted time series (ITS) analysis is a more robust design for evaluating healthcare quality improvement given its ability to control for biases [2].
- This study compare clinical and economic outcomes after TJA when implementing MLWC using Stratafix™ Knotless Barbed Suture and 2-octyl cyanoacrylate plus polymer mesh tape (Dermabond® Prineo®) to conventional closure (CC) with Vicryl sutures and staples.

METHODS

Data sources

- This retrospective observational registry study identified consecutive patients undergoing TJA from a single surgeon at a US hospital (CC group: 2011 to 2013; MLWC group: 2015 to 2020).

Population

Subjects were included if they met the following conditions:

- THA or TKA as elective, primary procedure with an inpatient admission between January 1, 2011 and March 31, 2020
- >18 ys old and a minimum 30 day follow-up information from index procedure

Endpoint

The primary and secondary endpoints were listed in Table 1.

Table 1: Primary and secondary endpoints

Primary	90-Day Readmission Rate
Secondary	Length of Stay (LOS)
	Discharge Status
	Operating Room (OR) Time
	90-Day Emergency Department (ED) Visit Rate
	90-Day Complications Rate

Statistical Analyses

- All cases from 2014 were excluded due to a transitioning period from CC to MLWC.
- Descriptive analyses were performed comparing the MLWC and CC cohorts on baseline characteristics as well as on the clinical outcomes of interest.
- Baseline characteristics (age, sex, race/ethnicity, American Society of Anesthesiology score, presence of urinary tract infection, obesity, or dementia, and year of surgery) were adjusted for multivariate analyses

ITS Analyses

- Adjusted ITS analyses were conducted to account for decreasing trends in LOS and shift in discharge status over the study period
- The monthly mean of adjusted LOS and discharge rate to skilled care facilities were calculated for CC and MLWC cohorts, respectively, and then were fitted into linear regression models to show the level and slope changes before and after the introduction of MLWC

RESULTS

Unadjusted (Bivariate) Analyses

- Compared to patients with MLWC, a greater proportion of patients with CC had a 90-day readmission (3.8% vs. 1.5%; p<0.05; Table 2).
- Mean LOS was longer among patients with CC (2.5 vs. 1.4 days; p<0.05)
- A smaller proportion of patients with CC were discharged to home following their TJA procedures (85.9% vs. 91.5%; p<0.05; Table 2).

Adjusted (Multivariate) Analyses

- CC patients were shown to be 2.45 times more likely to be readmitted within 90 days than MLWC patients.
- CC patients were 1.88 times more likely to be discharged to skilled care facilities compared to patients with MLWC.
- Patients with CC had 1.67 times longer LOS compared to patients with MLWC.
- The likelihood of ER visits and OR time did not significantly differ between patients with MLWC and CC.

Adjusted ITS Analysis

Differences in LOS and discharge status were statistically significant based on the ITS analyses. The results showed:

- A sharp decline in LOS (0.9 days) and in incidence of discharge status to a skilled care facility (5.6% incidence) after the implementation of MLWC (Figures 1 and 2).
- A leveling of the data with no further changes in LOS or discharge status was observed for the remainder of the study period.

Table 2: Unadjusted (Bivariate) Analyses

		CC (N=906)	MLWC (N=1261)	p-value
90-Day Readmission Rate	Yes	3.8%	1.5%	<0.05
Length of Stay (LOS)	Mean	2.5 (±0.9)	1.4 (±0.9)	<0.05
	Median	2.0	1.0	
Discharge Status	Home	85.9%	91.5%	<0.05
	Skilled Care	14.1%	8.5%	
Operating Room (OR) Time (minutes)	Mean	79.9 (±25.1)	80.7 (±16.8)	0.44
	Median	76.0	78.0	
90-Day Emergency Department (ED) Visit	Yes	0.4%	0.6%	0.71

Figure 1. ITS analysis, adjusted LOS (by month)

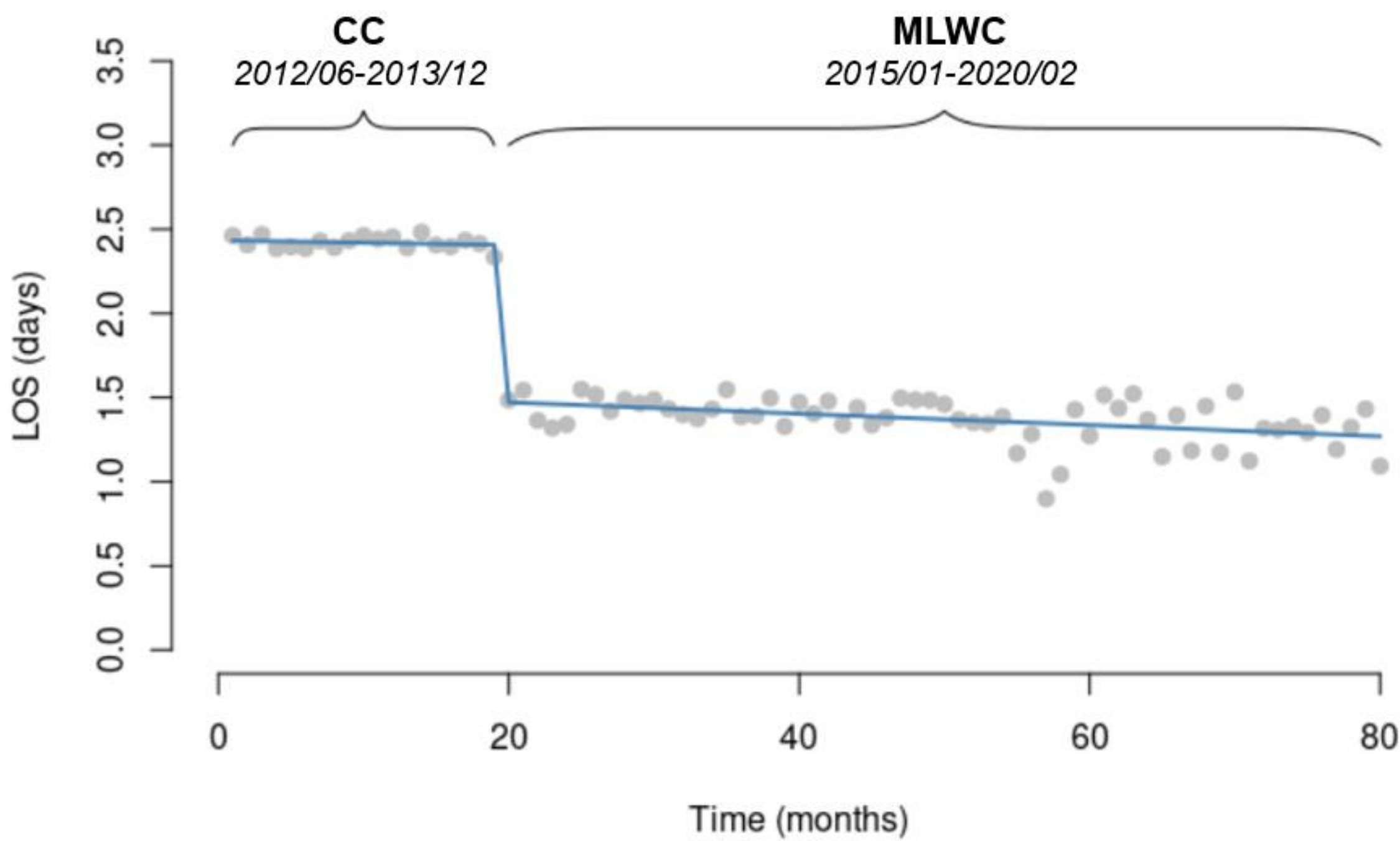
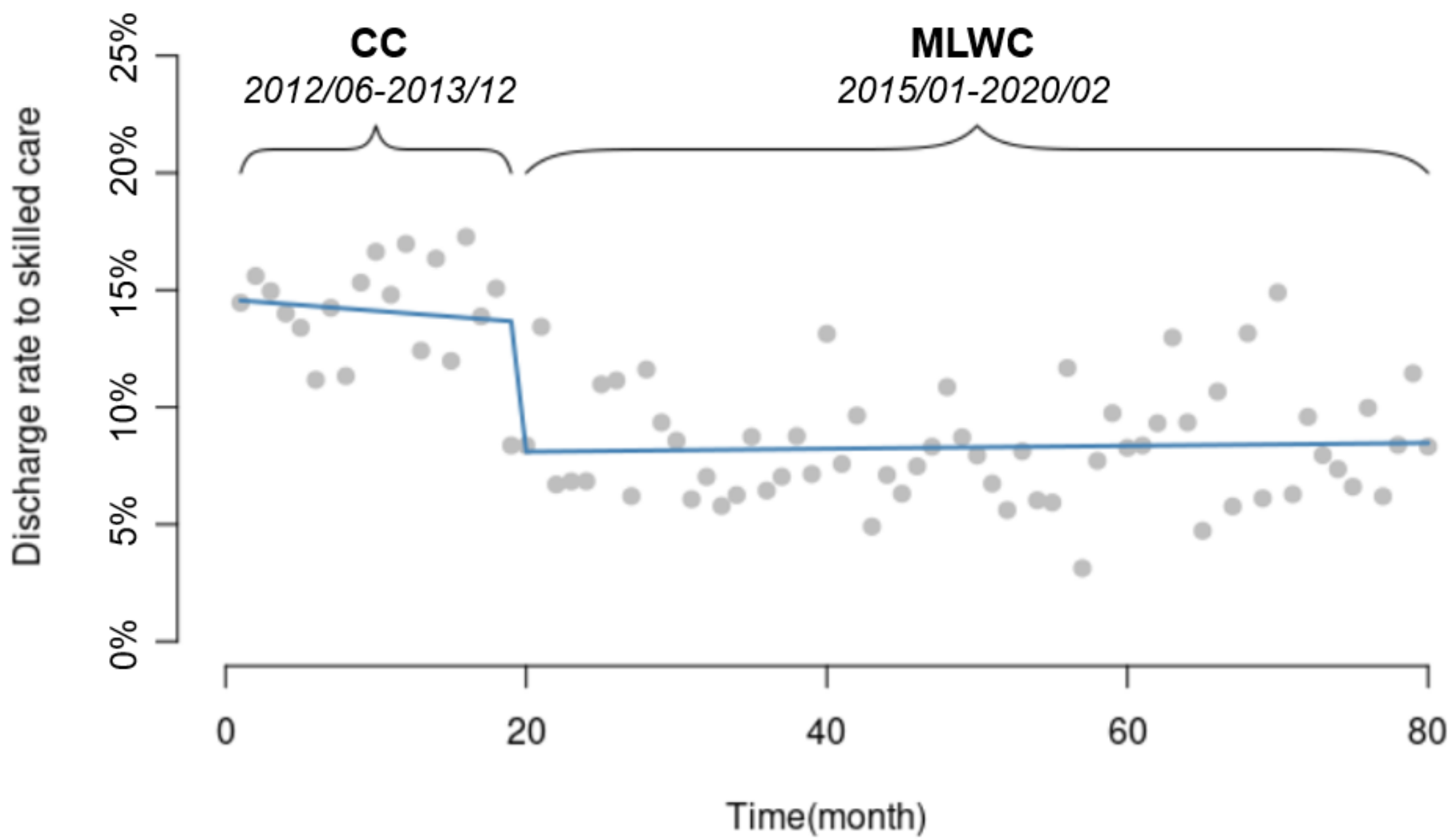


Figure 2. ITS analysis, adjusted discharge status to a skilled care facility (by month)



CONCLUSIONS

- MLWC was associated with at least 40% reduction in 90-day readmission rates, LOS, and discharge to a skilled facility compared to CC in TJA patients.
- ITS confirmed the impact of introducing a MLWC approach despite shifting trends in LOS and discharge status.
- MLWC may facilitate shorter LOS and the ability to discharge to home and may result in fewer readmission after THA and TKA.
- Further studies with larger cohorts of patients at multiple sites are warranted.

REFERENCES

1. Snyder MA, Sympson AN, Wurzelbacher SJ, Brian Chen PH, Ernst FR: Integrated clinical pathways with watertight, multi-layer closure to improve patient outcomes in total hip and knee joint arthroplasty. J Orthop 2020, 18:191-196.
2. Cummins S, Gasparrini A: Interrupted time series regression for the evaluation of public health interventions: a tutorial. Int J Epidemiol 2017, 46:348-355.