A Modern Advanced Analytic Approach to Cost Analysis of UCL Surgery in Major League Baseball Pitchers

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INTRODUCTION:

Ulnar collateral ligament (UCL) surgery has become increasingly prevalent among Major League Baseball (MLB) pitchers. The economic impact on MLB teams remains incompletely understood, especially in the era of modern advanced analytics.

METHODS:

Cost analysis on all MLB pitchers who underwent UCL surgery between 2014 and 2024 was conducted. Pitchers were identified and data was collected using public databases affiliated with MLB and used in previous studies. Economic losses were calculated using two primary components: salary Cost of Recovery (COR), which quantified salaries paid to injured players during recovery (adjusted for inflation), and Performance Cost, a metric we defined using a common wins above replacement (fWAR) conversion to estimate lost player value. fWAR lost during recovery and fWAR loss secondary to performance decline following return to play were recorded.

RESULTS: During the study period, a total of 276 UCL surgeries were performed from 2014 to 2024. Over the past five seasons (2020-2024), the number of UCL surgeries in MLB pitchers has markedly increased to an average of 29.0 ± 4.7 surgeries per year compared to 21.8 ± 4.3 surgeries per year the six seasons prior (2014-2019; $p < 0.05$). The COR salary losses adjusted for inflation totaled over $1.25 billion. The total cumulative fWAR loss across all players was 452.8 with an estimated $3.4 billion worth of performance value was lost for the entire study period.

DISCUSSION AND CONCLUSION:

UCL surgery imposes an increasingly significant financial burden on MLB teams, leading to a loss of $1.25 billion dollars in salary and $3.4 billion dollars worth of performance value from the beginning of the 2014 season to the end of the 2024 season. The financial impact of UCL injuries continues even after the player returns from injury, as players struggle to provide the same value as prior to injury. There is significant incentive for teams and players to urgently adopt measures to combat UCL injuries.

Table I. Demographics (n= 271)

Age (years)*	27.5 ± 3.2	(21-40)
Position †		
Starter	125	(46.1)
Reliever	133	(49.1
Closer	13	(4.8)
Throwing Hand †		
Right	199	(73.4)
Left	72	(26.6)
League †		
American	135	(49.8)
National	136	(50.2)

* Values are expressed as mean ± sd (min–max).
† Values are expressed as number (percentage).

Table 2. UCLR by position and year

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total
Starter	11	10	11	6	12	7	13	7	11	23	17	**128**
Reliever	16	13	9	10	11	8	17	17	14	10	10	**135**
Closer	0	3	1	1	0	2	3	1	0	2	0	**13**
Total	**27**	**26**	**21**	**17**	**23**	**17**	**33**	**25**	**25**	**35**	**27**	**276**

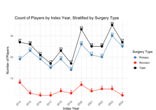

Table 3. Yearly Salary Loss Secondary to Cost of Return by Position and Year

Position		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total
	Starter	65.5	113.6	26.1	50.3	62.5	28.7	112.6	36.5	51.6	200.4	101.8	**849.4**
	Reliever	38.3	44.2	10.5	21.9	11.3	10.8	24.3	21.3	33.2	14.0	40.3	**270.2**
	Closer	0.0	31.3	2.0	8.6	0.0	26.6	32.6	6.1	0.0	30.9	0.0	**138.1**
	Total	**103.7**	**189.0**	**38.6**	**80.8**	**73.8**	**66.1**	**169.5**	**63.9**	**84.8**	**245.3**	**142.1**	**1,257.7**

Values are reported as millions of US dollars, adjusted for inflation

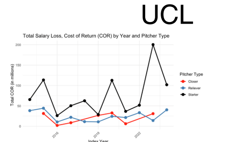

Figure 3: Distribution of salary loss secondary to cost of recovery following UCL surgery in Major League Baseball Pitchers.

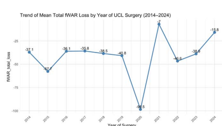

Figure 6. Yearly trend of mean fWAR lost per season.