Cost-Effectiveness of Knee Injections: Corticosteroids Lead the Way

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INTRODUCTION: Nearly half of the US population will develop some degree of knee osteoarthritis in their lifetime. Before undergoing total knee replacement, nearly 50% of patients trial intra-articular knee injections. However, there are various types of injections including corticosteroid (CS), high molecular weight hyaluronic acid (HMW-HA), and intermediate molecular weight hyaluronic acid (IMW-HA). No clear consensus exists regarding which injection type delivers the greatest value to patients. Therefore, the purpose of this study is to compare the value of each injection type using comprehensive cost accounting and patient-reported outcomes. We hypothesize that CS injections will demonstrate the greatest value, represented by the lowest average cost-effectiveness ratio (ACER), compared to the other injection types.

METHODS:

Prospective data from patients undergoing CS, HMW-HA, and IMW-HA injections were recruited from a Midwestern, tertiary-care academic health center. Total costs were categorized into the following groups:

Direct Labor (DL): Average per-minute personnel cost

Direct Supply (DS): Equipment used during visit

Direct Fixed (DF): Maintenance and utilities

Indirect: Marketing, administration

Using time-driven activity-based costing (TDABC), process maps outlining the steps that a patient takes from check-in until discharge were created. Time allocated by personnel at each step was used to determine DL costs. DS costs were calculated using activity-based costing (ABC). DF costs were calculated using claims-based technical fee data. Indirect costs were approximated based on a fixed proportion of the total direct costs; this proportion was derived from existing literature.

Differences between pre-injection and 3-month post-injection PROMIS PI and PF scores were multiplied by the average length of effectiveness of each injection type for each patient to calculate PROMIS adjusted life years for each type of injection ($PALY_{PI}$ and $PALY_{PF}$). Total costs were divided by PALYs calculate the average cost effectiveness ratio ($ACER_{PI}$ and $ACER_{PF}$) per patient. Cohorts with lower, non-negative, ACER values are interpreted as more cost-effective than those with greater or negative ACER values. One-way ANOVA tests were performed to assess differences in DL and total costs, in addition to PALYs and ACERs between cohorts.

RESULTS: 25 patients receiving CS, 25 receiving HMW-HA, and 25 receiving IMW-HA were collected. On average, CS, HMW-HA, and IMW-HA cost $223.83, $848.31, and $412.32, respectively, with CS demonstrating significantly lower total costs ($p<0.001$) (Figure 1). DL costs were not significantly different between cohorts (CS: $14.50; HMW-HA: $11.10; IMW-HA: $16.39; $p<0.01$). $PALY_{PI}$ was significantly greater than the other cohorts (CS: 0.88; HMW-HA: 0.48; IMW-HA: 0.24; $p=0.346$). No difference was observed for $PALY_{PF}$ between cohorts (CS: 0.20; HMW-HA: 0.03; IMW-HA: -0.58; $p=0.215$). Lower $ACER_{PI}$ values were observed for CS when compared to HMW-HA and IMW-HA (CS: \$254.35/$PALY_{PI}$; HMW-HA: \$1,767.32/$PALY_{PI}$; IMW-HA: \$1,717.99/$PALY_{PI}$; $p=0.023$) (Figure 2). A similar, although statistically insignificant trend was observed for $ACER_{PF}$ values (CS: \$1,119.15/$PALY_{PF}$; HMW-HA: \$28,277.12/$PALY_{PF}$; IMW-HA: -\$710.89/$PALY_{PF}$; $p=0.654$) (Figure 3).

DISCUSSION AND CONCLUSION: The substantially lower average $ACER_{PI}$ for patients undergoing CS injections compared to HMW-HA and IMW-HA injections indicate greater cost-effectiveness and value for CS injections. A similar trend, although statistically insignificant, was observed when evaluating patients using PROMIS PF. Much of the difference in value that we calculated is likely attributable to significant differences in our costs, however the effects of patient-reported outcomes on the calculation of value cannot be ignored. Optimizing the value of non-operative treatment options for knee osteoarthritis can strengthen patient-physician shared decision making and potentially curb excessive spending on low-value treatments.

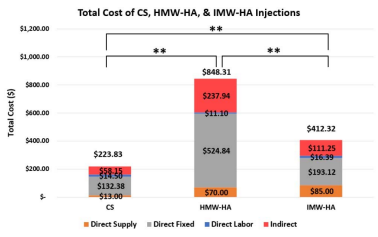

Figure 1. Comparison between the average cost of CS, HMW-HA, and IMW-HA injections. Total costs for each procedure are categorized into direct labor, direct supply, direct fixed, and indirect costs. n= 25 CS, 25 HMW-HA, 25 IMW-HA. ** = $p<0.05$

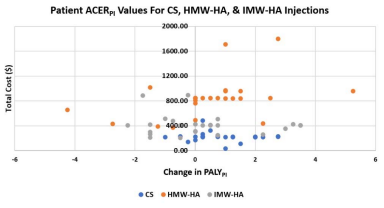

Figure 2. Cost-effectiveness analysis plane simultaneously comparing the total cost and $PALY_{PI}$ of each patient. n=25 CS, 25 HMW-HA, 25 IMW-HA.

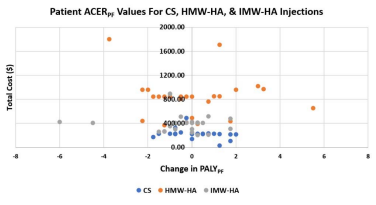

Figure 3. Cost-effectiveness analysis plane simultaneously comparing the total cost and $PALY_{PF}$ of each patient. n= 25 CS, 25 HMW-HA, 25 HMW-IA.