

# The Cost Variability of Orthobiologics

Amit Mukesh Momaya, MD,<sup>\*†</sup> Andrew Sullivan McGee, BA,<sup>†</sup> Alexander R. Dombrowsky, BSc,<sup>†</sup> Alan Joshua Wild, BSc,<sup>‡</sup> Naqeeb M. Farooqi, BSc,<sup>§</sup> Raymond P. Waldrop, BSc,<sup>†</sup> Jun Kit He, BSc,<sup>†</sup> Eugene W. Brabston, MD,<sup>†</sup> and Brent Andrew Ponce, MD<sup>†</sup>

**Background:** Mixed results exist regarding the benefit of orthobiologic injections. The purpose of this study was to assess the variability in costs for platelet-rich plasma (PRP) and stem cell (SC) injections and evaluate for variables that influence pricing.

**Hypothesis:** There will be significant variability in the cost of PRP and SC injections throughout the United States.

**Study Design:** Descriptive epidemiology study.

**Level of Evidence:** Level 3.

**Methods:** Calls were made to 1345 orthopaedic sports medicine practices across the United States inquiring into the availability of PRP or SC knee injections and associated costs. In addition to pricing, the practice type, number of providers, and population and income demographics were recorded. Univariate statistical analyses were used to identify differences in availability and cost between variables.

**Results:** Of the contacted offices that provided information on both PRP and SC availability ( $n = 1325$ ), 268 (20.2%) offered both treatments, 550 (41.5%) offered only PRP injections, 20 (1.5%) offered only SC injections, and 487 (36.8%) did not offer either treatment. The mean  $\pm$  SD cost of a PRP injection was  $\$707 \pm \$388$  (range,  $\$175$ – $\$4973$ ), and the mean cost of an SC injection was  $\$2728 \pm \$1584$  (range,  $\$300$ – $\$12,000$ ). Practices offering PRP and SC injections tended to be larger (PRP, 12.0 physicians per practice vs. 8.1 [ $P < 0.001$ ]; SC, 13.6 vs 9.7 [ $P < 0.001$ ]). Practices that offered PRP injections were located in areas with higher median household income ( $P = 0.047$ ). Variables associated with higher cost of PRP injections included city population ( $P < 0.001$ ) and median income of residents ( $P < 0.001$ ).

**Conclusion:** While the majority of sports medicine practices across the United States offer some type of orthobiologic injection, there exists significant variability in the cost of these injections.

**Clinical Relevance:** This study demonstrates the significant variability in costs of orthobiologic injections throughout the country, which will allow sports medicine physicians to appreciate the value of these injections when counseling patients on available treatment options.

**Keywords:** orthobiologics; platelet-rich plasma; injections; cost; variability

Orthobiologic treatments such as stem cell (SC) and platelet-rich plasma (PRP) injections have been suggested to improve healing and pain subsequent to various cartilage, ligament, tendon, and bone pathologies. These treatments have been popularized on the basis of the inherent safety of autologous products, minimal regulatory obstacles, and strong marketing, despite mixed clinical data.

The literature yields mixed results on the benefits of both PRP and SC injections for various orthopaedic conditions. A

meta-analysis of 11 studies evaluating rotator cuff repair with or without PRP augmentation found no significant differences in patients' outcome scores.<sup>14</sup> Another review by Mlynarek et al<sup>6</sup> found several studies demonstrating improved symptomatic relief with PRP in patients with early stages of knee osteoarthritis and partial ulnar collateral ligament injuries. In addition, a systematic review of 6 studies evaluating knee osteoarthritis found greater improvement in outcome scores in patients receiving PRP compared with hyaluronic acid

From <sup>†</sup>Department of Orthopaedic Surgery, University of Alabama at Birmingham, Birmingham, Alabama, <sup>‡</sup>Alabama College of Osteopathic Medicine, Dothan, Alabama, and <sup>§</sup>Mercer University School of Medicine, Columbus, Georgia

\*Address correspondence to Amit Mukesh Momaya, MD, Department of Orthopaedic Surgery, School of Medicine, University of Alabama at Birmingham, 1313 13th Street South, Birmingham, AL 35205 (email: amit.momaya@gmail.com).

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injections.<sup>5</sup> With regard to SC injections, a systematic review of 6 studies evaluating SC injections for the treatment of knee osteoarthritis reported significant improvements in multiple patient-reported outcome scales, as well as superior radiological outcomes for those receiving SC injections compared with controls.<sup>8</sup> However, another systematic review of 8 studies found that while patients receiving SC injections for a variety of conditions had symptoms generally improve, no significant differences were observed compared with control groups.<sup>4</sup> In addition to the assortment of mixed results for various orthopaedic conditions, this area of study is further clouded by the inconsistency of reported preparation methods and subsequent therapeutic compositions.<sup>2</sup> Despite controversy over efficacy, both PRP and SC injections remain an area of research interest from a financial perspective given their substantial costs.

Orthobiologics fall under the regulation of the Food and Drug Administration's (FDA's) Center for Biologics Evaluation and Research and are exempt from animal studies and clinical trials prior to reaching the market.<sup>1</sup> These treatments are conducted with minimal oversight under the Public Health Service Act, Section 361, which allows for the use of human cells, tissues, and tissue-based products as long as they are minimally manipulated and for homologous use. Furthermore, PRP is FDA approved for use to aid in mixing bone graft materials but not currently approved for the many orthopaedic ailments that it is marketed toward.<sup>1</sup> In the absence of FDA approval for their current popular uses, insurance companies are not obligated to cover charges for off-label use of orthobiologic injections, leaving patients to carry the financial responsibility as out-of-pocket expenses. Without insurance companies paying for these therapies, the price point has a limited basis, often leading to large variations in cost to patients.

This study sought to determine the cost variability for PRP and SC injections in the knee across the United States as well as the factors that may influence pricing, such as population, median household income, geographic region, number of providers within the practice, and practice type.

## METHODS

A list of 1345 orthopaedic sports medicine practices across the United States was compiled from the AOSSM membership list. Scripted patient phone calls were made to these practices inquiring into the availability of PRP or SC knee injections and the associated cost to the patient for the procedure. It is important to note that this study specifically analyzed the cost incurred to the patient for an orthobiologic injection and not what the orthopaedic office pays to obtain the product or resources necessary to perform the procedure. The caller followed a script, posing as a middle-aged male with a nonspecific cartilage injury of the knee, stating he is being referred by another orthopaedic surgeon for either a PRP or an SC injection. In addition to cost, the caller inquired into the practice type (academic or private) and number of providers.

Inquiry into the preparation methods, specifications, and procedure details of the injections was attempted, but the inconsistent accessibility of this information to office staff made these data difficult to obtain and often unreliable. Using the *2012-2016 American Community Survey 5-Year Estimates* from the US Census Bureau,<sup>12</sup> population and median income demographics were recorded for each city in which the practices resided.<sup>12</sup> Additionally, practices were grouped into 4 regions (Midwest, Northeast, South, and West) as defined by the US Census Bureau to evaluate for regional variation in cost.<sup>13</sup> Univariate statistical analyses were used to identify differences in availability and cost between variables.

## RESULTS

Of the 1345 offices, 1325 provided information on both PRP and SC availability. Of these 1325, 268 (20.2%) offered both treatments, 550 (41.5%) offered only PRP injections, 20 (1.5%) offered only SC injections, and 487 (36.8%) did not offer either treatment. There were 725 (88.6%) offices that disclosed prices of PRP injections and 224 (77.8%) offices that disclosed prices of SC injections. The pricing statistics are summarized in Table 1.

Practices offering PRP and SC injections tended to be larger (PRP, 12.0 physicians per practice vs 8.1 [ $P < 0.001$ ]; SC, 13.6 vs 9.7 [ $P < 0.001$ ]). In addition, practices that offered PRP injections were located in areas with higher median household income (\$67,454 vs \$64,283;  $P = 0.047$ ). Practices that offered SC injections were also located in areas with higher median household income, but the association was not significant (\$69,020 vs \$65,427;  $P = 0.06$ ). Similarly, the availability of SC injections was higher in more populated areas (855,792 vs 510,347 people;  $P = 0.038$ ). However, the availability of PRP injections did not vary significantly based on population (669,071 vs 445,964 people;  $P = 0.113$ ). The availability of PRP and SC injections did not vary significantly between private and academic practices (PRP, 68.4% academic vs 60.8% private [ $P = 0.058$ ]; SC, 21.8% academic vs 21.7% private [ $P = 0.978$ ]). There was a significant association between median household income and cost of PRP injections, with a \$17.88 increase per every \$10,000 increase in income ( $P < 0.001$ ). Median household income did not have any significant association with the cost of SC injections ( $P = 0.062$ ). City population was significantly correlated with cost of PRP injections, with an additional \$18.90 per 1,000,000 people ( $P < 0.001$ ). City population did not have any significant association with the cost of SC injections. These variables associated with the cost of orthobiologic injections are summarized in Table 2.

When comparing orthobiologic cost by geographic region, the cost of PRP was significantly different among geographical regions ( $P = 0.01$ ). The greatest difference in cost of PRP among regions was found between the South (\$654 ± \$361) and the West (\$778 ± \$383). SC cost did not differ significantly between regions. Additionally, the availability of both PRP and SC injections varied significantly between regions (PRP,  $P = 0.018$ ;

Table 1. Pricing statistics of platelet-rich plasma injections and stem cell injections

Cost	Platelet-Rich Plasma, n = 818	Stem Cell, n = 288
Mean $\pm$ SD, \$	707 $\pm$ 388	2728 $\pm$ 1584
Median, \$	630	2500
Highest, \$	4973	12,000
Lowest, \$	175	300

Table 2. Variables associated with cost of orthobiologics

Variable	Platelet-Rich Plasma, n = 818	Stem Cell, n = 288
Group size		
Increase per physician, \$	0.39	2.92
<i>P</i>	0.72	0.69
Type of practice, mean $\pm$ SD		
Academic, \$	770 $\pm$ 484	3252 $\pm$ 1151
Private, \$	698 $\pm$ 370	2268 $\pm$ 1617
<i>P</i>	0.09	0.09
Median household income, mean $\pm$ SD		
Offered, \$	67,454 $\pm$ 969	69,020 $\pm$ 28,317
Not offered, \$	64,283 $\pm$ 1288	65,427 $\pm$ 27,956
<i>P</i>	0.047	0.06
Median household income		
Increase per \$10,000, \$	18	72
<i>P</i>	<0.001	0.06
City population		
Increase per 1 million people, \$	19	58
<i>P</i>	<0.001	0.16

SC,  $P < 0.001$ ). The greatest percentage of practices offering PRP was in the West (69.9%) and the lowest percentage was in the Midwest (58.6%), while the greatest percentage of practices offering SC injection was in the South (26.7%) and the lowest percentage was in the Northeast (15.6%). The regional variance statistics of PRP and SC injections are summarized in Tables 3 and 4.

## DISCUSSION

When compared with health care spending in other countries, the United States spends a considerably larger portion of its gross domestic product on health care, provides greater compensation for physicians of all types, and spends more per capita on medical retail and pharmaceuticals.<sup>7</sup> With the

Table 3. Cost of orthobiologics by region

Region	Mean Platelet-Rich Plasma Cost, n = 818	Mean Stem Cell Cost, n = 288
Midwest, \$	703 ± 346	3008 ± 1276
Northeast, \$	733 ± 466	2736 ± 1429
South, \$	654 ± 361	2462 ± 1470
West, \$	778 ± 383	3102 ± 2062
<i>P</i>	0.01	0.07

Table 4. Availability of orthobiologics by region

Region	Percentage of Practices Offering Platelet-Rich Plasma, n = 818	Percentage of Practices Offering Stem Cells, n = 288
Midwest (n = 301)	58.6	15.9
Northeast (n = 269)	60.8	15.6
South (n = 482)	59.6	26.7
West (n = 273)	69.9	25.2
<i>P</i>	0.02	<0.001

importance of regulating health care spending in conjunction with the minimal regulatory oversight, this study sought to determine the variation in cost for PRP and SC injections as well as the factors that might influence pricing.

A previous study by Piuze et al<sup>10</sup> assessed the cost of PRP injections across a much smaller sample of 153 centers. The study found a mean cost for a PRP injection of \$714 with a standard deviation of \$144.<sup>10</sup> The mean price is in line with our study, which found a mean price for a PRP injection of \$707. However, our study's standard deviation is more than 2.5 times that by Piuze et al,<sup>10</sup> indicating that the variation in pricing for PRP injections across the country is much larger than previously thought. Furthermore, the range of pricing in our study (\$175-\$4973) was substantially larger than that found in the previously published study (\$380-\$1390).

Another study by Piuze et al<sup>9</sup> found a mean ± SD price for SC injections of \$5156 ± \$2446 across 65 centers. Our study, with a larger sample size of 288 offices, found a mean ± SD price for SC injections of \$2728 ± \$1584. Although our study demonstrates a lower mean price for SC injections than previously reported, the large range in cost of \$300 to \$12,000 was similar to the findings of Piuze et al,<sup>9</sup> with a range of \$1150 to \$12,000.

A study by Zhang et al<sup>15</sup> utilizing PearlDiver, a nationwide database, found a per-patient average charge for PRP injections

to be \$1755 for various orthopaedic conditions involving the knee, shoulder, and elbow. This amount is larger than that found in our study, as the work by Zhang et al incorporated the perioperative costs and facility fees billed to insurance, whereas our study focused on the out-of-pocket cost for the patient. These additional charges will vary dramatically depending on the clinical setting in which the injections are performed and any associated procedure costs, further distorting the data. Additionally, Zhang et al looked at all conditions for PRP, including knee meniscus/plica conditions, unspecified shoulder disorders, rotator cuff pathology, and epicondylitis,<sup>15</sup> while our study specifically evaluated cost of injections in the knee, thus possibly accounting for some of the differences in our findings.

An area of medicine in which patients face the financial responsibilities of covering out-of-pocket expenses is cosmetic surgery. A study by Richardson et al<sup>11</sup> found that prices of common cosmetic surgery procedures correlated positively with city population size and financial metrics such as cost of living, average home value, and average monthly rent. These conclusions coincide with our study's findings of higher costs of PRP injections in cities with larger population sizes and higher median household incomes. However, our study did not find any positive correlation between larger population size or higher median household income and the prices of SC injections. Another study in cosmetic surgery evaluated the

factors that drive the price of elective inpatient rhytidectomy. In this study, Chattha et al<sup>3</sup> found that both teaching hospitals and the southern region were associated with reduced marginal costs to patients. They also found that procedures performed in the West Coast region were associated with higher marginal costs. These findings correspond to the variance we found, as the cost of PRP injections varied significantly among regions, with the least costly being the southern region and most costly being the West Coast. However, the cost of SC injections did not vary significantly among regions. Although our study of orthobiologic injections did assess differences in cost for academic or private practices, there was no significant variation for PRP or SC injections. One must also consider the ethical dilemma for orthopaedic practices when establishing out-of-pocket costs for patients in relation to market demands rather than proven efficacy.

We also found that larger practices were significantly more likely to offer PRP or SC injections. Larger practices are often found in more densely populated areas where the demand for and knowledge of orthobiologics is likely higher. Such practices may also have greater capability to house a centrifuge or ultrasonography, tools that are often used for orthobiologic injections.

### Limitations

This study has several limitations. The nature of the scripted phone call relies on the accuracy of information provided by office staff as compared with statistical data derived from billing databases. Similarly, offices were not able to reliably provide information on the type of PRP or SC preparation offered or the conditions in which the procedure is performed, both of which could potentially influence the overall cost that a patient is responsible for paying. Additionally, the term “stem cell” injection is a broad term often used to describe mesenchymal signaling cells harvested directly from the patient, but may also be erroneously used to refer to other pre-prepared donor tissue products. These various products all have different costs, and the misleading nomenclature could potentially confound the cost of SC injections reported by offices. Although the sample size was quite large in comparison with prior studies, the results do not encompass all practices offering injections across the country. The AOSSM directory is limited to orthopaedic sports medicine and does not include offices commonly referred to as “stem cell clinics” or “regenerative medicine clinics” often operated by primary care providers, chiropractors, nurse practitioners, or other personnel. Clinics such as these have proliferated in recent

years, and our exclusion of these clinics limits the true variability in cost that may be observed. Furthermore, the preparation methods and specifications of the injections were not included in the statistical analyses, which may significantly influence pricing.

## CONCLUSION

While the majority of sports medicine practices across the United States offer some type of orthobiologic injection, there exists significant variability in the cost of these injections.

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