Analysis of Drug and Administrative Costs Allowed by U.S. Private and Public Third-Party Payers for 3 Intravenous Biologic Agents for Rheumatoid Arthritis

Bruce J. Wong, MBChB, FRACP; Mary A. Cifaldi, PhD, MSHA, RPh; Sanjoy Roy, MS; Dean C. Skonieczny, MBA, BSE; and Spyros Stavrakas, PhD

ABSTRACT

BACKGROUND: Rheumatoid arthritis (RA) is a common chronic condition with substantial morbidity that can now be treated with disease-modifying biologic agents that target tumor necrosis factor (TNF) or related mechanisms. The anti-TNF biologic agents are available in either intravenous (IV) or subcutaneous dose forms. The biologic agents with an indication for rheumatoid arthritis and administered only by IV infusion in medical offices include abatacept, infliximab, and rituximab. Although the literature on RA treatments, their outcomes, and aspects of their costs is substantial, the costs of administration by the IV route have not been directly studied.

OBJECTIVE: To assess the detailed costs of administering IV biologic agents for the treatment of RA in relation to the total cost of the medication itself in the United States.

METHODS: The sample included all patients with at least 1 medical claim with an ICD-9-CM diagnosis code for RA (codes 714.XX) in any claim field and at least 1 claim for infliximab, abatacept, or rituximab (HCPCS codes J745, J0129, and J9310, respectively) at any time from January 1, 2006, through December 31, 2008, in a database associated with billing and claims administration for 72 U.S. medical clinics. Costs were determined using the payer allowed payment, which is the total contractual amount that the provider should receive, including the patient cost share. Costs were measured as the average cost per IV administration visit and in relation to the dose of medication billed. The authors verified that an RA diagnosis was present on 100% of infusion claims for the study drugs.

RESULTS: Over the study period for claims with dates of service from January 1, 2006, through December 31, 2008, 72 medical clinics had claims for a total of 4,248 unique patients with RA and a total of 33,354 clinic visits in which these patients received at least 1 infusion of 1 of 3 biologic agents (26,586 for infliximab, 4,807 for abatacept, and 1,961 for rituximab). Mean (SD) total payment for all drugs and other cost components was $2,874 ($1,515) per visit, of which IV administration costs were $226 (7.9%); the mean cost of the biologic agent itself was $2,616 (91.0%), and other visit-related services were $33 (1.1%). For individual agents, the total costs of visits were $2,828, $1,827, and $6,076; and the costs of IV administration were $224, $171, and $390, respectively, for infliximab, abatacept, and rituximab.

CONCLUSION: For patients who received an IV biologic agent to treat RA, IV administration costs accounted for 7.9% of the total cost of the visit.

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What is already known about this subject

- Therapeutic choice between different routes of administration is a common clinical decision. Infused therapies, such as infliximab, abatacept, and rituximab, are commonly used over long periods of time to treat rheumatoid arthritis (RA).
- Total costs for the leading RA treatments have been studied in the aggregate using analyses of administrative claims data. For example, mean annual costs for adalimumab, etanercept, and infliximab in the United States ranged from $12,692 to $16,013 in a retrospective analysis of claims data from January 2003 through June 2005. These studies used either private payer or Medicare data, but not both.
- Mean intravenous (IV) infusion time was found to differ significantly by biologic agent in a study of patients with RA by Yazici et al. (2009): abatacept (42 minutes), infliximab (131 minutes), and rituximab (274 minutes).
- Kruse et al. (2008) found that the costs for the administration of IV agents in metastatic breast cancer were 10.2% of the cost of a visit in which an infusion took place.

What this study adds

- The authors of the present study analyzed administrative data for private and government third-party payers obtained from a large contracting and claims management system representing 72 U.S. medical clinics in which 4,248 patients received at least 1 IV infusion of a biologic RA treatment (abatacept, infliximab, or rituximab) in a total of 33,354 clinic visits during the period from January 1, 2006, through December 31, 2008.
- The average cost of administering IV infusions for 3 biologic drugs for RA was 7.9% of the total cost of the clinic visit, or 8.6% of the cost of the drug.
- The mean cost of administration was significantly (P<0.001) higher for rituximab ($390) than for infliximab ($224) or abatacept ($171).
Rheumatoid arthritis (RA) is a debilitating chronic illness with a substantial impact on an individual’s cost of care and quality of life and a moderate impact on duration of life.1-3 In the United States, RA is estimated to affect 1.3 million adults.4 In 1998, the first tumor necrosis factor (TNF) antagonist, infliximab, was approved for the treatment of RA. TNF antagonists inhibit biochemical pathways thought to be directly involved in the pathogenesis of RA as opposed to prior disease-modifying agents, which had uncertain mechanisms of action.5,6

Prior to the introduction of TNF antagonists, both anti-inflammatory and disease-modifying agents to treat RA were given orally or by intramuscular injection in the case of gold. Biologic molecules, such as the new generation of TNF antagonists, are large protein molecules that are inactivated by gastric action and therefore need to be administered parenterally. Intravenous (IV) and subcutaneous routes of administration are variably available for existing agents. Specialized facilities and trained staff were developed to accommodate administration of the IV agents; for agents administered subcutaneously, patient training mechanisms were established. Although these technologies and procedures were already available for many therapies, they had not been deployed within a rheumatology practice.7,8 In addition to the traditional reasons for choosing a particular therapy, the type of physical infrastructure available to a prescribing physician may influence the choice of medication prescribed.

Traditional reasons for medication choice have been efficacy, effectiveness, and safety, with more recent additions of formulary availability and reimbursement status. Medication decisions based on formularies and reimbursement status are greatly influenced by the cost-effectiveness of a medication.9 Patient preference also can be a strong influence on medication choice in RA, with route of administration being an important factor in anti-TNF therapy and the IV route being the least preferred among patients currently receiving therapy.9

Previous research with administrative claims has estimated the mean costs of medications for various TNF infusion regimens.10-12 Mean (standard deviation [SD]) annual unadjusted costs, measured as plan reimbursed amount, for TNF antagonists in the United States (January 1, 2003, to June 30, 2005) were estimated to be $12,872 ($9,828); $12,692 ($11,899); and $16,013 ($12,770), respectively, for adalimumab, etanercept, and infliximab, in a retrospective analysis of a large managed care claims database.11 However, these studies typically only report the direct costs of the drugs. Costs of drug administration are calculated by multiplying clinical estimates of infusion frequency by costs from fee schedules rather than from collected data on the actual allowed costs,12 which could potentially underestimate an important cost component when cost-effectiveness is a factor in drug choice.

The objective of the present study was to assess the cost components of IV biologic therapy for RA with infliximab, abatacept, or rituximab from a payer perspective based on the actual amounts allowed by payers. Each of these agents has unique attributes and labeled administration instructions (Table 1) that affect both the duration and cost of administration.11,13-18 In addition to different costs of administration for label indications other than RA, these 3 drugs will likely be prescribed by different physician specialties and likely have different payer mix for indications other than RA.

**Methods**

**Data Source**

Data for this study were obtained from the database of Medical Present Value, Inc. (MPV, Austin, TX), a contract management company. This database was described previously in a *Journal of Managed Care Pharmacy* article on the subject of the costs associated with administration of IV drug therapies for metastatic breast cancer (Kruse et al. 2008).10 MPV maintains a contract and claims management system in approximately 200 clinics in the United States. For the present study, data were obtained from 72 clinics that treated patients with RA (identified by *International Classification of Diseases, Ninth Revision, Clinical Modification* [ICD-9-CM] codes 714.XX) and provided infusions for at least 1 of the target biologic agents at the clinic. The clinics were multispecialty clinics with at least 25 physicians per clinic, including both academic and private practices. The database contains diagnoses (ICD-9-CM codes), procedures, and drug therapies for care received by the patients in the clinics, as well as patient demographics (e.g., age, sex, and geographic region); insurance type (e.g., managed care, indemnity, Medicare, and Medicaid); insurance product type (e.g., health maintenance organization and preferred provider organization, including third-party payers for private insurance); and medical specialty of the physician. For every patient clinic visit, MPV maintains the service dates, total charged, and total actual payments, with individual services, procedures, and drugs broken out by line item (Current Procedural Terminology, Fourth Edition [CPT-4] and Healthcare Common Procedure Coding System [HCPCS] codes). Treatment costs were determined using the payer allowed payment, which is the total contractual amount that the provider should receive, including the patient cost share. Actual allowed payment is composed of insurer plus patient payments. This calculation does not account for potential patient portions that remain uncollected or bad debts, which are considered by MPV to be very small.

**Study Cohort**

The study extracted all claims for patients with at least 1 diagnosis code for RA (ICD-9-CM codes 714.XX) and at least 1 claim for infliximab, abatacept, or rituximab (HCPCS codes J1745, J0129, and J9310, respectively) at any time from

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*Analysis of Drug and Administrative Costs Allowed by U.S. Private and Public Third-Party Payers for 3 Intravenous Biologic Agents for Rheumatoid Arthritis*
Indications, Dosing, and Administration and Wholesale Acquisition Costs for Infliximab, Abatacept, and Rituximab

<table>
<thead>
<tr>
<th>Indication</th>
<th>Infliximab</th>
<th>Abatacept</th>
<th>Rituximab</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indication</td>
<td>For RA in combination with methotrexate for reducing signs and symptoms, inhibiting the progression of structural damage, and improving physical function in patients with moderately to severely active disease.</td>
<td>For moderately to severely active RA in adults. May be used as monotherapy or concomitantly with DMARDs other than TNF antagonists.</td>
<td>For RA in combination with methotrexate in adult patients with moderately to severely active RA who have inadequate response to 1 or more TNF antagonist therapies.</td>
</tr>
<tr>
<td>Dosage and administration instructions</td>
<td>The recommended dose is 3 mg per kg given as an IV induction regimen at 0, 2, and 6 weeks followed by a maintenance regimen of 3 mg per kg every 8 weeks thereafter for the treatment of moderately to severely active RA. Infliximab should be given in combination with methotrexate. For patients who have an incomplete response, consideration may be given to adjusting the dose up to 10 mg per kg or treating as often as every 4 weeks, bearing in mind that risk of serious infections is increased at higher doses.</td>
<td>Abatacept should be administered as a 30-minute IV infusion utilizing the weight range-based dosing specified (body weight of patient, dose, vials): • &lt; 60 kg, 500 mg, 2 • 60 to 100 kg, 750 mg, 3 • &gt; 100 kg, 1,000 mg, 4</td>
<td>Administer rituximab as two 1,000 mg IV infusions separated by 2 weeks. • Glucocorticoids administered as methylprednisolone 100 mg IV or its equivalent 30 minutes prior to each infusion are recommended to reduce the incidence and severity of infusion reactions. • Subsequent courses should be administered every 24 weeks or based on clinical evaluation, but not sooner than every 16 weeks. • Rituximab is given in combination with methotrexate.</td>
</tr>
<tr>
<td>Dosage forms and strengths</td>
<td>100 mg lyophilized infliximab in a 20 mL vial to be reconstituted in 10 mL of sterile water for injection</td>
<td>250 mg single-use vial</td>
<td>100 mg per 10 mL and 500 mg per 50 mL solution in a single-use vial</td>
</tr>
<tr>
<td>WAC prices per vial</td>
<td>$657.87 per 20 mL vial (100 mg)</td>
<td>$525.47 per 250 mg vial</td>
<td>$58.30 per 10 mg, $583 per 100 mg vial, and $2,915 per 500 mg vial</td>
</tr>
</tbody>
</table>

*Adapted from U.S. Food and Drug Administration package inserts.6,17,18

HCPCS and CPT-4 Codes Used to Define IV Infusion Administration Costs

<table>
<thead>
<tr>
<th>HCPCS or CPT-4 Code and Description</th>
<th>Total Allowed Charges ($)</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>96413</td>
<td>Chemotherapy administration, IV infusion technique; up to 1 hour</td>
<td>6,517,013</td>
</tr>
<tr>
<td>96415</td>
<td>Chemotherapy administration, IV infusion technique; each additional hour; 1 to 8 hours</td>
<td>1,780,781</td>
</tr>
<tr>
<td>90765</td>
<td>IV infusion, for therapy, prophylaxis, or diagnosis; initial; up to 1 hour</td>
<td>384,446</td>
</tr>
<tr>
<td>90780</td>
<td>IV infusion, for therapy/diagnosis; administered by physician</td>
<td>339,245</td>
</tr>
<tr>
<td>G0359</td>
<td>Chemotherapy administration, IV infusion technique; up to 1 hour</td>
<td>287,269</td>
</tr>
<tr>
<td>90781</td>
<td>Add sequential infusion, up to 1 hour</td>
<td>156,835</td>
</tr>
<tr>
<td>90766</td>
<td>IV infusion, for therapy, prophylaxis, or diagnosis; each additional hour; up to 8 hours</td>
<td>125,307</td>
</tr>
<tr>
<td>96410</td>
<td>Chemotherapy administration, IV infusion technique; up to 1 hour</td>
<td>103,523</td>
</tr>
<tr>
<td>G0360</td>
<td>Irrigation of implanted venous access device for drug delivery systems</td>
<td>100,825</td>
</tr>
<tr>
<td>90775</td>
<td>Therapeutic, prophylactic, or diagnostic injection</td>
<td>62,447</td>
</tr>
<tr>
<td>96412</td>
<td>Chemotherapy administration, IV infusion technique; 1 to 8 hours; each additional hour</td>
<td>48,954</td>
</tr>
<tr>
<td>36000</td>
<td>Introduction of needle or intracatheter; vein</td>
<td>26,447</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>9,933,171</td>
</tr>
</tbody>
</table>


January 1, 2006, to December 31, 2008. At the time of the study, all claims to the end of December 2008 had been fully adjudicated. RA diagnosis codes could be reported in any position on the claim (each claim contained up to 3 diagnostic codes). No additional exclusions were applied. Unique patients who had these claims were identified, and all claims for these patients were additionally extracted. Numbers of patients are reported together with the overall procedure and diagnostic codes to provide a description of the patient cohort.

Outcome Measures and Analysis

Costs were calculated as the mean cost per visit in which the IV
administration of a biologic agent occurred (IV administration visit). IV administration visits were selected based on administration of an IV therapy with 1 of the 3 target biologic agents during a clinic visit and identified by the claim identification and date. All services and materials used in the IV therapy administration visit cost analysis were identified by CPT-4 codes and HCPCS codes (Table 2). The primary interest was the IV administration cost as a proportion of the cost of the biologic medication; however, the cost of administration was also calculated as a proportion of the total visit cost.

Statistical tests included analysis of variance (ANOVA) and Student’s t-tests, comparing outcome measures by biologic drug administered during the visit and by physician specialty. Statistical analyses were performed using the STATA release 10 statistical package (StataCorp LP, College Station, TX) and an a priori alpha level of 0.05.

### Results

#### Study Cohort Characteristics

A total of 4,248 patients with 33,354 visits for IV therapy for at least 1 of the study drugs was identified: infliximab, 26,586 visits; abatacept, 4,807 visits; and rituximab, 1,961 visits (Figure 1). Demographic characteristics are presented in Table 3. Approximately one-half (49.2%) of the patients were aged 55 to 74 years. Geographically, there were more patients from the southern and western parts of the United States than from other regions, and fewer patients were from the northeastern part of the United States. Most (51.3%) patients had Medicare followed by private insurance (41.4%), which included employer-based, managed care, or indemnity health insurance.

#### Overall Payments for Patients with RA

The mean (SD) total payment for all drugs and cost categories was $2,874 ($1,515) per visit (Table 4). In the per-visit analysis, the mean cost for IV biologic medication accounted for 91.0% ($2,616) of the total, IV administration accounted for 7.9% ($226), and other services provided at the visit for 1.1% ($33). Other services consist of items identified on the claims as supplies and equipment, the most common being IV needles, sterile water, dressing pads, and infusion supplies; miscellaneous drugs, such as anti-emetics, steroids, sedatives, and supplements (calcium, magnesium, vitamin B₁₂,
TABLE 4  Cost Breakdown by Drug for Medical Visits with IV Drug Administration

<table>
<thead>
<tr>
<th>Specialty</th>
<th>Visits (n)</th>
<th>Abatacept</th>
<th>Infliximab</th>
<th>Rituximab</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal medicine</td>
<td>4,206</td>
<td>2,713</td>
<td>1,411</td>
<td>2,503</td>
<td>1,378</td>
</tr>
<tr>
<td>Hematology/oncology</td>
<td>1,633</td>
<td>2,849</td>
<td>1,874</td>
<td>2,616</td>
<td>1,831</td>
</tr>
<tr>
<td>Family practice</td>
<td>1,008</td>
<td>2,473</td>
<td>1,284</td>
<td>2,266</td>
<td>1,230</td>
</tr>
<tr>
<td>Medical oncology</td>
<td>259</td>
<td>2,346</td>
<td>1,423</td>
<td>2,048</td>
<td>1,443</td>
</tr>
<tr>
<td>All othersb</td>
<td>644</td>
<td>2,448</td>
<td>1,432</td>
<td>2,203</td>
<td>1,383</td>
</tr>
</tbody>
</table>

Mean ($) SD ($) 200 207 28.99 34.88 211

P<0.001 from ANOVA, Other specialties include gastroenterology, neurosurgery, nurse practitioner, allergy immunology, and pediatric rheumatology, as well as others. ANOVA = analysis of variance, IV = intravenous, SD = standard deviation.

TABLE 5  Cost Breakdown by Physician Specialty

<table>
<thead>
<tr>
<th>Specialty</th>
<th>Visits (n)</th>
<th>Total</th>
<th>Study Drug</th>
<th>IV Administration</th>
<th>Other Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rheumatology</td>
<td>25,604</td>
<td>2,934</td>
<td>1,510</td>
<td>2,664</td>
<td>1,447</td>
</tr>
<tr>
<td>Internal medicine</td>
<td>4,206</td>
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<td>1,383</td>
</tr>
</tbody>
</table>

P<0.001, ANOVA testing for differences by specialty.

additional hydration); and a miscellaneous administration-related services category primarily including fluid collection and laboratory tests. Many of the items classified as other services from their description could be logically related to the cost of IV administration; however, they were not classified as an IV administration cost within the claim.

Payments by IV Biologic Agent

The most commonly administered agent was infliximab, and the least commonly administered agent was rituximab. It should be noted that the labeled dosing interval for rituximab is longer than that for the other agents, which is evident in the lower relative number of visits for infusion shown in Table 4. Average total allowed payments significantly differed by drug (P<0.001 from ANOVA), with the greatest total payment per visit ($6,076) observed for rituximab compared with both abatacept and infliximab (P<0.001, t-test). Rituximab was also associated with the highest average cost of IV administration ($390) compared with both abatacept ($171) and infliximab ($224, P<0.001, t-test). Expressed as a percentage of drug cost, IV administration costs were 10.5%, 8.7%, and 6.9% for abatacept, infliximab, and rituximab, respectively.

Specialty of Physician Administering the Infusion

As expected, rheumatology was the predominant specialty that administered IV biologic medications to treat RA, followed by internal medicine (Table 5). Within each drug category, rheumatology was associated with the greatest cost of IV administration (P<0.001 from ANOVA), and medical oncology incurred greater costs for other services.

Payment by Payer Type, Patient Age, and Geography

Significant differences in costs for study drug, IV administration, and other visit-related services and drugs were observed across payer types (Table 6). The overall mean payment per visit was $3,373 for private insurance, $2,483 for Medicare,
and $2,773 for Medicaid, although the amount for Medicaid is based on a small number of patients. The allowed costs for IV administration were highest for private insurers ($278) and lower for Medicare ($181) and Medicaid ($105, P < 0.001 from ANOVA). Comparisons of mean drug costs, IV administration costs, and other related costs by patient age and by geographic groups showed no significant differences (data not shown).

### Discussion

Previous models of the cost-effectiveness of RA drugs estimated the costs of IV administration for inclusion in their calculations. These estimates often were extracted from fee schedules, rather than from actual costs of infusions\(^\text{[6,20]}\) or from unreported or data-on-file sources.\(^\text{[21]}\) In comparison with the mean estimate of $226 determined here, other models have used lesser estimates of $129\(^\text{[21]}\) and $181.\(^\text{[12]}\) Differences in these costs could reflect the present study’s determination of costs using the allowed payment from payers to providers, whereas other cost calculations relied on estimated rather than collected values and studied different time periods.

Although it could be argued that the costs of IV administration are small compared with drug costs,\(^\text{[6]}\) the relevant comparison should be any marginal differences in comparative cost-effectiveness among medications. When choosing among medications that have different routes of administration and similar efficacy, the cost of administration could become an important consideration. The relatively high cost associated with the infusion of a medication has previously been quantified in the treatment of other conditions for which both an IV agent and an oral agent were available.\(^\text{[19]}\) The costs of administering IV agents for RA are of a similar magnitude, which is likely because of the reimbursement amount associated with the J-code used in both circumstances. Consistent with previous research,\(^\text{[19]}\) we also found that payments for administrative costs from private insurers were greater than those from public insurers, Medicare, and Medicaid, which likely represents mandated payment levels from these agencies rather than the negotiated rates from private payers.

The cost of administration was found to be significantly higher for rituximab than for infliximab and abatacept. The differences in the costs of administration among the medications to treat RA is most likely due to the longer administration time and other factors, such as biases in patient selection for each medication, specific labeled infusion instructions for each medication, co-administered medications, volume of medication to be infused, or potential medication adverse effects.\(^\text{[10,18]}\) Rituximab in particular requires pre-medication with a glucocorticoid, which could affect the IV administration time.\(^\text{[22]}\) Mean IV infusion time was found to differ significantly by biologic agent in a study of patients with RA by Yazici et al. (2009): abatacept (42 minutes), infliximab (131 minutes), and rituximab (274 minutes).\(^\text{[22]}\) These factors could not be examined within the current reimbursement dataset and could be the subject of further research.

We found, as expected, that rheumatologists administered biologic agents to treat RA more commonly than did other specialists. Why rheumatologists had the highest allowed payments for the cost of administration is unclear; however, we speculate that they may be treating patients with more severe or advanced disease. Among the additional specialists treating RA with infused biologic agents, hematologists/oncologists and medical oncologists were unexpectedly common. Potential explanations could be their familiarity in administering infusions overall, the existence of facilities for administering infusions in oncology settings, or specific familiarity with rituximab as an oncology treatment. Importantly, the inclusion criteria for the study required an RA diagnosis to occur on at least 1 claim, and an RA diagnosis code was subsequently found to be recorded on each claim with each infusion of a biologic agent within the resulting sample.

Biologic agents were a breakthrough for the treatment of RA following the approval of infliximab in 1998 and with subsequent approval of multiple agents with similar or related mechanisms of action. The need for simplified administration regimens was among the reasons that subcutaneously administered agents, such as etanercept and adalimumab, were introduced. The quantification of the cost of the IV administration of biologic agents provides payers, pharmacists, and physicians with another piece of evidence with which to guide their choice of therapy, in addition to the medications’ safety, efficacy, and convenience.
Analysis of Drug and Administrative Costs Allowed by U.S. Private and Public Third-Party Payers for 3 Intravenous Biologic Agents for Rheumatoid Arthritis

Limitations
First, the data for this study were retrieved from a convenience sample generated at a particular commercial claims adjudication service, MPV. Although it is a large sample, it remains weighted toward the U.S. South and Southwest. Although it is uncertain whether there was a specific bias associated with the relative lack of East Coast clinics, the lack of significant variation between existing geographic groupings suggests good geographic generalizability to all patients who received biologic agents for RA. Second, costs of IV administration were determined only from clinic claims and were limited to services identified on the claim as an infusion administration cost. This method could have resulted in a conservative estimate of infusion costs because nonclinic and other costs are likely to be incurred. For example, indirect costs, such as travel to the clinic, lost time at work, or lost productivity were not accounted for, and potential nonclinic medical costs could also be incurred, such as late infusion reactions and complications. Third, the study was limited to patients receiving IV infusions for RA; results may not generalize to other patient populations, including those currently receiving subcutaneous treatment with biologics.

Conclusions
Analysis of a large U.S. claims database showed that the average cost of administering IV biologic agents to treat RA was $226 per infusion visit, or approximately 9% of the cost of the drug itself. The percentage of costs per infusion were highest for abatacept and lowest for rituximab. Along with the usual considerations of efficacy, safety, and drug cost, infusion costs should be considered when choosing an agent and route of administration for the treatment of RA.

DISCLOSURES
Wong is the principal and sole owner of the company that was contracted to undertake this project for Abbott Laboratories, manufacturer of adalimumab (Humira), an alternative biologic agent with an indication for rheumatoid arthritis that is administered subcutaneously. Wong has worked for Abbott Laboratories as a consultant and member of an advisory board. Stavrakas is an employee of Abbott Laboratories, and Roy was employed by Abbott at the time these analyses were conducted and is now an employee of Johnson & Johnson.

Concept and design were performed primarily by Wong with the assistance of Cifaldi and Stavrakas. Data collection was performed primarily by Skomeczyn with the assistance of Stavrakas. Data were interpreted by Cifaldi, Roy, Stavrakas, and Wong. The manuscript was written primarily by Wong with the assistance of Stavrakas and revised primarily by Wong.

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REFERENCES

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